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Positive lifestyle behaviour changes among Canadian men: Findings from the HAT TRICK program

Abstract

Purpose: To estimate program effectiveness regarding physical activity (PA), diet, and social connectedness as part of a feasibility study.

Design: Pre-post quasi-experimental.

Setting: HAT TRICK was delivered in collaboration with a Canadian semi-professional ice hockey team and offered at the arena where they trained and played games.

Participants: Participants (N=62) at baseline were overweight (BMI >25kg/m²) and inactive (<150 minutes of MVPA/week) men age 35+ years.

Intervention: Gender-sensitised 12-week intervention for men targeting PA, healthy eating and social connectedness.

Method: Baseline, post-intervention (12 weeks) and 9-month follow-up self-report and accelerometer data were collected. Multi-level modelling assessed growth trajectories of outcome measures across time.

Results: Accelerometer measured weekly/min. of moderate PA showed significant linear trends (95%CI: 42.9 – 175.3) from baseline (147.0±104.6), 12-week (237.7±135.5) and 9-month follow-up (204.89±137.7) qualified with a quadratic trend. Self-reported weekly/min of moderate and vigorous PA showed significant linear trends (95%CI: 94.1, 264.1; 95%CI: 35.1, 109.6) from baseline (52.6±83.8, 22.42±44.9), 12 week (160.1±157.4, 66.6±74.4) and 9-month follow-up (118.6±104.6, 52.2±59.2) qualified with quadratic trends. DINE measured

fat score rating showed linear trends over time (95%CI -14.24, -6.8), qualified with a quadratic trend. DINE fibre score and social connectedness showed no trends.

Conclusion: Findings yield valuable information about the implementation of gender-sensitised lifestyle interventions for men and demonstrate the importance of male-specific strategies for reaching and engaging overweight, physically inactive men.

Key Words: men's health, health behavior, physical activity, diet, social connectedness

Trial Registration: This trial is registered with clinicaltrials.gov (XXXXXXX) and the International Clinical Trials Registry Platform (XXXXXXXXXX).

Purpose

Regular physical activity, consuming a healthy diet, and engaging in practices to promote psychological well-being can reduce the likelihood of developing chronic diseases including cardiovascular disease, type 2 diabetes, cancer and depression ¹. Despite the physical and mental benefits associated with these healthy lifestyle behaviors, up to 83% of Canadian men do not meet the recommended physical activity guidelines ², and over 62% of Canadian men engage in unhealthy dietary behaviors, including high fat intake and inadequate fruit and vegetable consumption ³. Moreover, there is mounting evidence that engaging in poor lifestyle behaviors, weight gain, and mental illness are closely linked as a result of shared pathophysiological pathways and processes ⁴.

A fundamental reason why many men avoid taking preventive actions for their health, is that health promotion initiatives rarely address the influence of masculinities ⁵. Specifically, some men say they are reticent to access or attend preventive health services and programs because they perceive this as threatening to masculine ideals of strength, self-reliance and independence ^{5,6}. Moreover, men's estrangement from health promotion initiatives (i.e., programs to enhance physical activity, healthy eating and activities promoting psychological well-being) can reflect the lack of appeal that these initiatives hold for them and/or their irrelevance to their masculine identities ⁶. As a consequence, poor engagement and program uptake are common ⁷. Thus, when designing and implementing health promoting initiatives for men, it is crucial to take into account prevailing constructions of masculinities ⁸.

Integrated gender-sensitized approaches that combine physical activity and healthy eating and promote aspects of psychological well-being may be effective for engaging men in health promoting lifestyle behaviors. For example, activities that enhance a sense of belonging, foster teamwork, camaraderie and social connectedness using male-specific

engagement strategies (e.g., group based format with male facilitators and role models, meeting in a ‘male-friendly’ setting such as a sports arena, using humor and ‘banter’ during group sessions) have consistently been reported as crucial elements to program uptake, engagement and sustainability⁹⁻¹¹. Further, researchers have highlighted the value of social contact and group-based activities in locations where men often congregate and feel comfortable for improving the social-emotional and physical health of men⁹.

The HAT TRICK program¹² is a gender-sensitized, group-based intervention focused on supporting physical activity, healthy eating and social connectedness among overweight and inactive men, and delivered in collaboration with a major junior (i.e., level preceding professional) Canadian ice hockey team. It was specifically created to address the masculine constructs associated with engaging and retaining men in health promoting initiatives and this is reflected in the design, content, setting, and delivery of the program. For example, the content utilized hockey-related themes to frame health-related topics and emphasized strategies that appeal to prevailing masculinities, such as mastery and group/team dynamics^{9,13}; the program was delivered at the hockey arena where our partner team trained and played home games (i.e., ‘male-friendly’ environment)^{8,9,11}; and all messaging was delivered using frank and familiar communication styles, utilizing humor and ‘banter’ where possible, as these have been reported as important components to engaging men in health promotion programs^{13,14}.

The overarching aim of the HAT TRICK evaluation was to determine intervention feasibility and acceptability, and secondly, to estimate effectiveness in terms of physical activity, diet, and psychological well-being, including social connectedness. Further details concerning the feasibility and acceptability of the gender-sensitized components of HAT TRICK are reported elsewhere¹⁰. This article reports on the secondary aim and provides an

exploratory analysis of the effectiveness of HAT TRICK on physical activity, diet, and social connectedness.

Methods

Study Design

HAT TRICK's intervention design and methodological protocol have been detailed elsewhere ¹². In brief, this exploratory study utilized a pre-post, quasi-experimental design. Baseline, post-intervention (12 weeks) and 9 month follow-up measures were completed between December 2016 and January 2018. All participants provided informed consent prior to baseline assessments. Ethics approval was obtained from the XXXXX (#H1600736) and this trial is registered with clinicaltrials.gov (XXXXXXXX) and the International Clinical Trials Registry Platform (XXXXXXXX).

Sample

A variety of recruitment methods were employed, including: local news media (e.g., print and digital newspapers, radio broadcasts); social media (e.g., Facebook, Twitter); poster advertisements at community centers, ice hockey arenas, pubs and bars, hardware and automotive commercial entities, and face-to-face flyer handouts at the ice hockey teams home games. A project specific website was developed as an additional recruitment strategy, and to provide information about the project (i.e., eligibility criteria, information about what the program included). Lastly, participants who had completed initial HAT TRICK sessions assisted with the recruitment of subsequent groups by word of mouth. Interested participants were encouraged to contact the research team by telephone in order to determine eligibility.

To be eligible, men had to be over the age of 35 years; residing in the region; self-report the accumulation of less than 150 minutes of physical activity per week and a body mass index (BMI) of over 25kg/m² with a pant waist size of 38" or greater; and if required,

medical clearance from a physician after screening positive using the Physical Activity Readiness Questionnaire (PAR-Q+) ¹⁵. Because group session delivery was limited to a maximum of 20 men, eligible individuals were accepted on a ‘first come first served’ basis with additional individuals being placed on a waitlist for the next available session.

HAT TRICK Intervention

HAT TRICK ¹² is a 12-week group-based intervention focused on three specific components including physical activity, diet, and social connectedness. Each 90-minute weekly session comprised of targeted health education (e.g., how to accumulate physical activity throughout the day, understanding macronutrients, managing symptoms of depression, anxiety, and stress), while simultaneously promoting enjoyment and increased social connectedness through an interactive and informal style of learning. For instance, to enhance social connectedness, facilitators fostered a sense of teamwork and camaraderie among the men through group activities and competition. Part of each 90-minute session was allocated to progressive physical activity (i.e., duration and intensity of physical activity increased each week) using a variety of ‘men-friendly’ activities such as road/floor hockey, strength and resistance training, and walking. The intervention is theory-guided, drawing on multiple constructs from the Social Cognitive Theory ¹⁶ and Self-Determination Theory ¹⁷ and on health models and theories which incorporate gender and socially constructed masculinities ¹⁸ as an important social determinant.

All participants were provided with a wearable device (i.e., Fitbit Charge2™) and encouraged to use this to self-monitor progress towards graduated increases in daily physical activity. Men also received an individual resource manual called the ‘Playbook’ which provided tips and resources for healthy living, information about behavior change techniques (e.g., goal setting, social support, self-monitoring) and a log to track physical activity and dietary behaviors. In addition, relevant HAT TRICK team personnel and community health

professionals were invited as guest presenters to some sessions. For instance, the hockey team's fitness trainer delivered a 'boot camp' type exercise session focused on building muscular strength and a local registered dietician presented and discussed how to choose healthier food options and tips for controlling portion sizes.

Measures

All measures, except for demographic information, were assessed at baseline, post-intervention (12 weeks) and 9 month follow-up.

Participant characteristics

Demographic information, including date of birth, ethnic background, level of education, marital status, co-morbidities (heart disease, hypertension, high cholesterol, diabetes, cancer, stroke, arthritis, mental health problems respiratory disease), main physical activity, occupation and household income were self-reported. Ethnic background categories were taken from the Canadian Census questionnaire and were provided in list form for participants to select (White, South Asian (e.g., East Indian, Pakistani, Sri Lankan), Chinese, Black, Filipino, Arab, Latin American, Southeast Asian (e.g., Vietnamese, Cambodian, Laotian, Thai), West Asian (e.g., Iranian, Afghan), Korean, Japanese, Other: specify)¹⁹. Anthropometric and physiological variables, including height (cm), weight (kg), waist circumference (cm), blood pressure (mmHg), and heart rate (beats/min) were assessed by a research team member, trained to a standard protocol.

Objectively measured physical activity

An ActiGraph GT3X accelerometer (ActiGraph, Pensacola, Florida, USA) was used to objectively measure physical activity (mild, moderate and vigorous) and step counts. It was worn on the participants' hip during waking hours over seven days (at each time assessment period), except during bathing or other water-related activities. Participant data were downloaded in 60-second epochs, and established cut-off points were used to calculate

daily minutes of moderate (2691–6166 counts/min) and vigorous (>6167 counts/min) physical activity²⁰. Only those with total daily wear times of at least 600 minutes on four or more days were included in the analyses.

Self-reported physical activity

Physical activity was also assessed by self-report using the valid and reliable modified version of the Godin Leisure Time Exercise Questionnaire-GLTEQ²¹. The GLTEQ classifies physical activity/exercise into three intensity subgroups: vigorous, moderate, and light activity. Participants were asked to report the frequency, intensity and duration (minutes) of their weekly physical activity.

Dietary behavior

Dietary behaviors were assessed using the validated Dietary Instrument for Nutrition Education (DINE)²². This 19-item food frequency questionnaire assesses dietary intake of total fat and dietary fiber over a 7 day period. Composite scores were calculated in accordance with the DINE scoring protocol²², with higher scores indicating greater consumption of total fat and dietary fiber.

Social Connectedness

Social support was assessed using the valid and reliable abbreviated Duke Social Support Index (DSSI-11)²³. This 11-item index contains two subscales, social interaction and satisfaction with social support, evaluated on a four-point Likert scale. The total score for the DSSI-11 ranges from 10 to 30 with higher scores indicating stronger perception of social support²³.

Analysis

Demographic data were first analyzed descriptively. Secondly, dependent variable linear and quadratic trends were analyzed between baseline, post-program and 9-month follow-up using multi-level modelling (MLM) and intention to treat analyses to estimate

effects²⁴. MLM was used for its ability to account for random effects. Initial modelling began with linear and quadratic components and a random effect for the intercept estimated on the linear term, to assess the shape of growth trajectories and to assess whether the means of the accelerometer, GLTEQ, DINE, social connectedness and BMI measures differed across time. Covariance estimates were assessed to determine if a random intercept was appropriate for the model. Models were re-run if covariance estimates suggested no between participant variability. Differing covariance structures were assessed in an attempt to define the best model indicated by the smallest Akaike's Information Criterion (AIC). Analyses were run using SPSS version 22.

Results

Demographics

Sixty-two male participants with a mean age of 50.98 (SD = 10.09, range = 35 – 77) years completed self-report measures at baseline, 58 completed post program measures and 54 completed 9 month follow-up measures. Participant flow is outlined in Figure 1. The majority of participants had a post-secondary degree, worked full time, and were married. Full demographic measures can be seen in Table 1.

Multilevel modeling showed BMI having no significant linear ($p = .066$) or quadratic trends ($p = .465$).

Accelerometer measured physical activity

Sixty participants wore accelerometers at baseline, 56 post-program and 52 at 9 month follow up. At baseline one participant had insufficient wear time, as did four at post-program and eight at follow up measures. Average daily wear times for those with sufficient wear was 808.46 (203.55) min at baseline, 842.79 (225.73) min at post program and 756.37 (143.05) min at follow-up.

Initial multilevel models showed moderate physical activity having linear growth trends over time ($p < .001$), qualified with a quadratic trend ($p < .001$). Total weekly step counts also showed linear growth trends over time ($p = .014$), qualified by a quadratic trend ($p = .032$). Mild physical activity and vigorous physical activity did not show linear or quadratic trends. Means and standard deviations across time points are shown in Table 2. Estimates of fixed effects and 95% confidence intervals are shown in Table 3.

1 **Self-report measures**

2 Self-reported vigorous physical activity showed a linear growth trend over time ($p <$
3 $.001$), qualified with a quadratic trend ($p = .004$). Mild physical activity showed no marked
4 trends over time. Self-reported moderate physical activity showed linear growth trends over
5 time ($p < .001$), qualified with a quadratic trend ($p = .001$).

6 DINE measured fat score rating showed decreasing linear trends over time ($p < .001$),
7 qualified with a quadratic trend ($p = .001$). The DINE fiber score showed no marked trends.

8 Duke social support, social interaction and satisfaction with social support showed no
9 trends over time.

10 All self-reported means and standard deviations are shown in Table 2. Estimates of
11 fixed effects and 95% confidence intervals are shown in Table 3. All models had random
12 intercepts for participants unless otherwise stated in Table 3.

13

14 **Discussion**

15 HAT TRICK was designed as a new, gender-sensitized intervention aimed at
16 attracting, engaging and retaining a sub-group of men in healthier lifestyle behavior change.
17 Results from this exploratory study showed increases in both objectively measured (i.e.,
18 accelerometry) and self-reported moderate PA. Participants' self-reported vigorous PA
19 increased over time, although similar increases in vigorous PA were not seen in the
20 accelerometer data. However, accelerometer data did show an increase in step-count.

21 Concerning diet, results indicated a decrease the DINE fat score, from scores representing
22 moderate fat intake at baseline to scores indicating low fat intake at both follow-up time
23 points. The DINE fiber score, which is based on fruit and vegetable consumption, did not
24 change. There were also no indication of changes in our measure of social connectedness.
25 BMI showed no notable significant differences. Taken together, these results provide

1 promising evidence that HAT TRICK is likely to be an effective strategy for engaging more
2 men in positive and sustainable lifestyle behavior changes.

3 The sustained improvements in moderate physical activity, assessed objectively and
4 subjectively, aligns with previous gender-sensitized interventions ²⁵ and may further support
5 program acceptability claims and the notion that men may more readily engage in health
6 behavior change programs which focus on activities that promote feelings of strength and
7 mastery, such as preferred forms of physical activity ^{11,26}. Previous work has also suggested
8 that when working towards achieving a healthy weight, programs which forefront physical
9 activity are particularly attractive to men because this plays to masculine identities. For
10 example, men's enjoyment of physical activity and motivation to try new forms of physical
11 activity has been linked to the nostalgia for playing team sports as a younger man, and the
12 masculine appeal of expert physical training to improve athletic performance, as well as the
13 camaraderie and allyship that can develop among men working (and playing) together to
14 achieve shared goals ^{10,11,25}. In contrast, too strong a focus on engagement in healthy eating
15 can challenge normative masculinities and gendered food roles ²⁶.

16 Our results also indicated an increase in self-reported vigorous physical activity, but
17 this was not supported by the accelerometer data. Although over-reporting of physical
18 activity is recognized as a common issue of self-report instruments ²⁷, in this study these
19 differences may also be related to men's interpretation of the increase in physical activity
20 participation (over the 12 week intervention) and the exposure to new, more intense activities
21 (e.g., 'bootcamp' style session) as working harder than they actually were. However, this
22 finding should not be disregarded because it does suggest that the men have become more
23 aware of their physical activity as a result of taking part in the program and hence may have
24 started to build greater self-efficacy and confidence surrounding their engagement and
25 participation in physical activity.

1 The accelerometer data did indicate a strong increase in step counts over time. Based
2 on the use of a documented ‘gold standard’ objective measure of physical activity (i.e.,
3 accelerometer) and findings from our HAT TRICK formative evaluation ¹⁰, we confidently
4 speculate that the design of our intervention may have played a major role in these promising
5 results. A key focus of our intervention was the use of simple, real and frank
6 messaging/communication about physical activity and healthy eating, as this has been
7 reported as a crucial strategy for engaging and sustaining men in preventive health behaviors
8 ^{13,14}. For instance, the program regularly highlighted the impact that including small,
9 incremental changes in physical activity could have on overall health benefit (e.g.,
10 accumulating small 3 x 10 minute bouts of activity throughout the day; taking the stairs at
11 least once every day instead of an escalator). To foster engagement and recognize masculine
12 ideals of competitiveness ^{11,13,14}, we set up weekly personal step challenges and gave the men
13 Fitbits so that they could self-monitor their daily steps (and other activity), and this internal
14 competition may have served well to motivate the men to do more ^{11,14}. Together, these
15 elements proved to be beneficial in increasing steps and overall PA levels.

16 A substantial reduction in the DINE fat score was observed in the current study but no
17 corresponding change in the fiber score. The reduction in the fat score of approximately 12
18 units suggests a reduction in fat intake to <30g/day or ~ 270 calories ²⁸. The reduction in fat
19 intake can be attributed to the messaging related to the macronutrient content of foods in the
20 HAT TRICK program (e.g., encouragement to choose lower fat versions of commonly
21 consumed foods, and if consuming a fatty type food, to just eat less). The results for dietary
22 fiber were less encouraging in that total fiber intake may have actually gone down. However,
23 the scores from baseline to 36-weeks follow-up fell within a ‘medium’ fiber score which
24 equates to 21-30g/day ²⁸. Current recommendations for men aged 19-50 in Canada is to
25 reach a fiber intake 38g/day ²⁸, and so this result suggests a different messaging approach

1 may be required to reach that target. The small reduction in fiber intake may be related to a
2 reduction in total intake (i.e., eating less) but because the DINE assessment does not assess
3 total intake (i.e., calories) we can only speculate on our interpretation for this result.
4 Nevertheless, the changes observed for the fat score are encouraging given that supporting
5 men to make healthy changes in their diet has been shown to be a challenge ²⁹.

6 A lack of any notable change in social support over time was surprising. Recent
7 research has challenged assumptions that men are disinterested in establishing close
8 relationships with others ³⁰, and suggested that men commonly establish social relationships
9 with other men through sports and physical activities – a practice that is aligned with
10 hegemonic masculinities and avoids social taboos in building social connections with other
11 men ³⁰. While HAT TRICK included opportunities for men to meet as a group in weekly
12 interactive sessions involving physical activity, it did not appear to be sufficient to influence
13 men’s perceptions of social support. The HAT TRICK program may benefit from providing
14 opportunities for men to explore and challenge gender-related expectations about men’s
15 social relationships, and demonstrate practices to support positive social connections and
16 relationships among men ¹⁰.

17 **Strengths, limitations, and future directions**

18 There are strengths and limitations to this research that must be considered when
19 interpreting the findings. HAT TRICK was specifically designed to address a need to engage
20 more men in sustainable healthy behavior change. In this regard, the program addresses a
21 need for evidence-based health promotion interventions that consider the influence of
22 prevailing cultures of masculinities and how these may promote or curtail particular
23 behaviors. This research is also strengthened by the use of objectively (i.e., accelerometry)
24 measured physical activity. While some previous studies in men’s health have incorporated
25 the use of objectively measured steps (i.e., pedometers) for evaluation purposes,

1 accelerometers provide additional valuable information such as the intensity of activity, a
2 variable that cannot be assessed by pedometer³¹. It should be noted that accelerometers can
3 have difficulties assessing exercises in a fixed position.

4 The exploratory nature of this study as reflected in the modest sample size and lack of
5 a control group limit any conclusions regarding the overall effectiveness of the program.
6 Future testing of HAT TRICK, through a fully powered randomized control trial, is needed to
7 claim effectiveness. Further, despite efforts to recruit a diverse sample of men, participants
8 were predominantly white, well educated, and with higher incomes. Thoughtful consideration
9 should be given to reaching less well-resourced men whose access to such programs is
10 inhibited by health inequities. Further, the HATTRICK model does show promise for
11 transferability across other sport settings^{25,32} however particular adaptations are required to
12 ensure acceptability. For example, the ‘look and feel’ of the program and the tools and
13 resources utilized for program delivery, will need to reflect the particular sport. It should also
14 be noted that not all men will relate to prevailing cultures of masculinities, such as sport, and
15 the HAT TRICK program is only one possible avenue of addressing the health and wellbeing
16 of certain types of men.

17

18 **“SO WHAT?” (100 – 150 words)**

19 **What is already known on this topic?**

20 Up to 83% of Canadian men do not meet the recommended physical activity guidelines and
21 over 62% of Canadian men engage in unhealthy dietary behaviors, including high fat intake
22 and inadequate fruit and vegetable consumption. Many men are reticent to access or attend
23 preventive health services/programs because they perceive this as threatening to masculine
24 ideals of strength, self-reliance and independence.

25

1 **What does this article add?**

2 HAT TRICK was designed as a new, gender-sensitized intervention aimed at attracting,
3 engaging and retaining a sub-group of men in healthier lifestyle behavior change and shows
4 promising impacts on men’s physical activity levels and healthy eating habits.

5

6 **What are the implications for health promotion practice or research?**

7 This paper highlights a practical way to engage more men in positive healthy eating, active
8 living and social behaviours.

9

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16 the report; or the decision to submit the report for publication.

17

18 **Compliance with Ethical Standards**

19 **Authors’ statement of conflict of interest**

20 Authors XXXXXXXXXXXX declare that they have no conflict of interest.

21 **Research involving human participants**

22 All procedures performed in this study were in accordance with the ethical standards
23 of the institutional and/or national research ethics committee and with the 1964 Helsinki
24 declaration and its later amendments or comparable ethical standards.

25 **Informed consent**

1 Informed consent was obtained from all individual participants included in the study.

2

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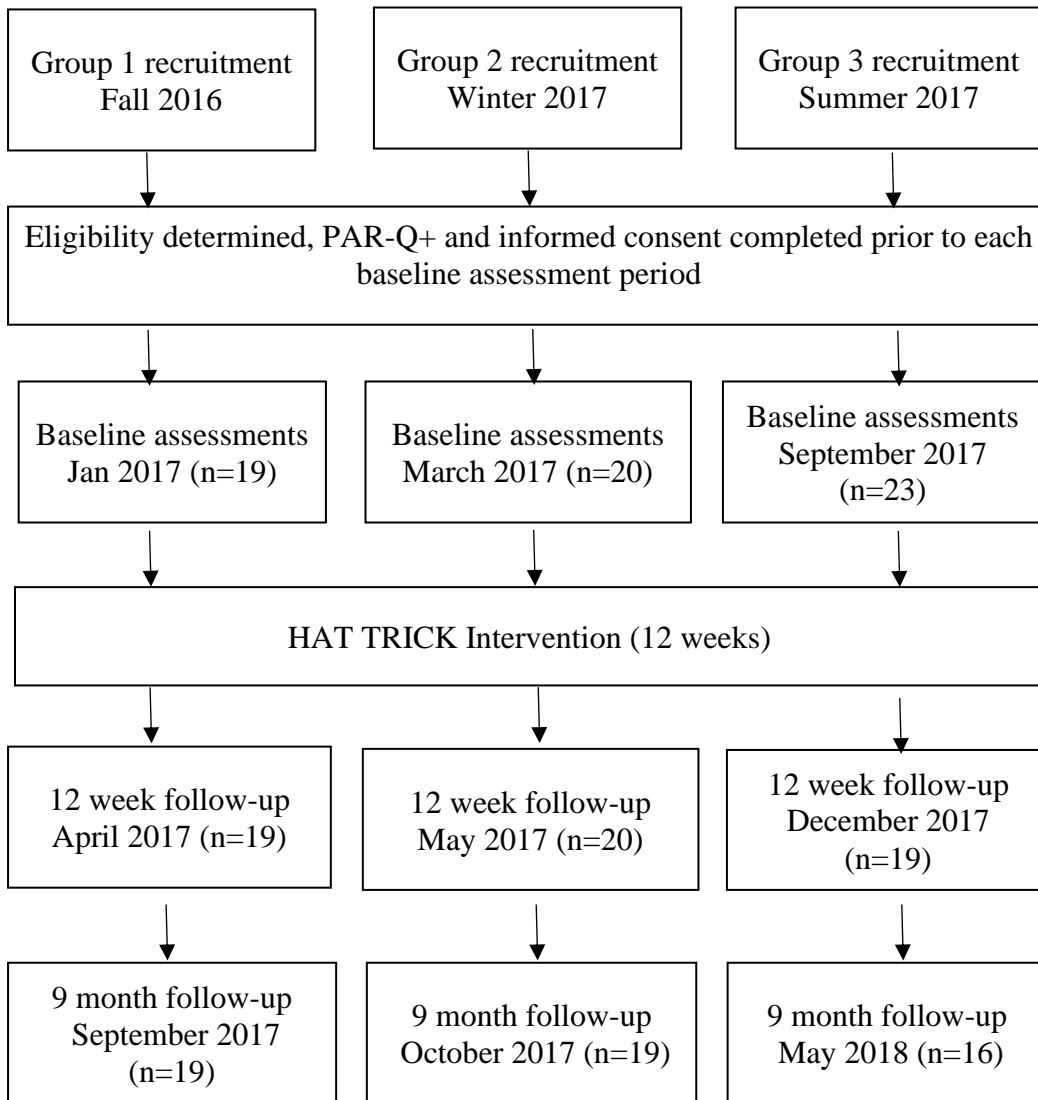
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1 **Figure 1** Participant Flow Diagram

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1 **Table 1** Demographic Measures

Measure	Frequency (n=62)	Percentage
Highest Level of Education		
Some high school or less	1	1.6%
High school diploma	13	20.9%
College or technical diploma / University degree	48	77.4%
Household Income Before Taxes		
\$25,000 – \$49,999	6	9.7%
\$50,000 – \$99,999	26	41.9%
\$100,000 or more	30	48.4%
Main Activity		
Full time work	50	80.6%
Part time work	1	1.6%
Caring for family/managing household/retired	11	17.7%
Marital Status		
Married/domestic partnership	54	87.1%
Divorced/separated	5	8.1%
Single/never married/widowed	3	4.8%
Ethnic Background		
White	57	91.9%
Metis ¹	1	1.6%
Latin	1	1.6%
South Asian	1	1.6%
West Asian	1	1.6%
Other	1	1.6%

BMI Category		
Overweight (25 - <30 kg/m ²)	5	8.1%
Obese Class 1 (30 - <35 kg/m ²)	21	33.9%
Obese Class 2 (35 - <40 kg/m ²)	25	40.3%
Obese Class 3 (40+ kg/m ²)	11	17.7%
Co-morbidities		
None	19	30.6%
One	21	33.9%
Two or more	22	35.5%

1 ¹ An aboriginal peoples of Canada³³

Table 2 Means and Standard Deviations Across Time Points with MLM linear and quadratic 95% Confidence Interval.

	Baseline Mean (SD)	12-weeks Mean (SD)	36-weeks Follow-up Mean (SD)	Linear 95% CI	Quadratic 95% CI
Weekly Physical Activity (PA)					
GLTEQ (minutes/week)					
Mild PA	157.58 (202.61)	206.25 (172.51)	236.87 (276.26)	-53.70, 162.17	-55.53, 43.47
Moderate PA	52.67 (83.77)	160.09 (157.41)	118.58 (104.57)	94.10, 264.10	-116.30, -32.08
Vigorous PA	22.42 (44.91)	66.57 (74.42)	52.21 (59.23)	35.07, 109.66	-46.88, -9.27
Accelerometer (minutes/week)					
Mild PA	1743.76 (408.44)	1759.06 (598.55)	1696.38 (501.45)	-194.96, 260.7	-131.79, 94.14
Moderate PA	147.00 (104.63)	237.70 (135.47)	204.89 (137.73)	42.98, 175.27	-76.79, -0.84
Vigorous PA	2.00 (5.17)	3.15 (6.38)	1.89 (4.21)	-0.72, 6.15	-3.08, 0.41
Step Count	39,175.44 (14,747.59)	45,507.56 (19,160.22)	42,145.20 (20,544.97)	1464.86, 20916.13	-9754.46, 207.81
DINE					
Fat Score	36.60 (14.57)	24.77 (11.02)	24.15 (12.69)	-14.24, -6.80	1.36, 4.84

Fibre Score	24.32 (10.46)	23.68 (12.04)	20.95 (14.03)	-4.74, 5.53	-3.47, 1.39
Duke Social Support Index					
Social Support	26.21 (3.08)	26.5 (4.09)	26.96 (3.52)	-1.39, 1.48	-0.61, 0.81
Social Interaction	8.27 (1.40)	8.48 (1.51)	8.59 (1.25)	-0.38, 0.90	-0.37, 0.25
Satisfaction with Social Support	17.93 (2.39)	18.02 (3.21)	18.37 (2.85)	-1.37, 0.95	-0.41, 0.73
BMI					
BMI	36.19 (6.02)	35.78 (6.30)	35.19 (6.67)	-1.50, 0.05	-0.23, 0.50

PA=Physical activity; GLTEQ=Godin Leisure Time Exercise Questionnaire; SD=Standard deviations; CI=Confidence Interval
 Bold text indicated statistical significance

Table 3. Multilevel Modelling Estimates of Fixed Effects and Akiaike’s Information Criterion

Dependent Variable	<i>t</i> (df)	Estimates of Fixed Effects		Akaike’s Information Criterion
		Estimate (Std. Error)	95% CI	
Physical Activity (PA)-GLTEQ				
Mild PA				2284.56
Intercept	<i>t</i> (61) = 6.12	157.58 (25.73)	106.13, 209.03	
Linear	<i>t</i> (78.98) = 1.00	54.23 (54.22)	-53.70, 162.17	
Quadratic	<i>t</i> (80.11) = -0.24	-6.05 (24.86)	-55.53, 43.47	
Moderate PA				2081.14
Intercept	<i>t</i> (105.94) = 3.54	54.91 (15.50)	24.18, 85.65	
Linear	<i>t</i> (62.82) = 4.21	179.10 (45.53)	94.10, 264.10	
Quadratic	<i>t</i> (59.46) = -3.52	-74.19 (21.05)	-116.30, -32.08	
Vigorous PA				1841.58
Intercept	<i>t</i> (61.00) = 3.93	22.42 (5.7)	11.01, 33.82	

Linear	$t(54.87) = 3.89$	73.37 (18.61)	35.07, 109.66	
Quadratic	$t(55.92) = 8.94$	-28.07 (9.39)	-46.88, -9.27	
Physical Activity (PA)-Accelerometer				
Mild PA^F				2117.75
Intercept	$t(66.26) = 26.56$	1742.71 (65.61)	1611.71, 18.73.70	
Linear	$t(50.41) = 0.29$	32.87 (113.46)	-194.96, 260.71	
Quadratic	$t(56.14) = 46.47$	-18.82 (56.14)	-131.79, 94.14	
Moderate PA^F				1785.45
Intercept	$t(56.07) = 12.03$	167.57 (13.93)	139.66, 195.48	
Linear	$t(52.95) = 3.31$	109.13 (32.98)	42.98, 175.27	
Quadratic	$t(51.34) = - 2.05$	-38.82 (18.92)	-76.79, -0.84	
Vigorous PA				851.40
Intercept	$t(55.51) = 2.76$	1.91 (0.69)	0.52, 3.30	
Linear	$t(47.95) = 1.59$	2.72 (1.71)	-0.72, 6.15	
Quadratic	$t(50.06) = -1.53$	-1.33 (0.87)	-3.08, 0.41	

Step Counts^F				3142.87
Intercept	$t(55.28) = 19.63$	38763.44 (1974.22)	34807.46, 42719.41	
Linear	$t(52.84) = 2.31$	11190.50 (4848.55)	1464.86, 20916.13	
Quadratic	$t(50.26) = -1.92$	-4773.32 (2480.27)	-9754.46, 207.81	
Duke Social Support Index				
Social Support				866.38
Intercept	$t(61.00) = 66.91$	26.21 (0.39)	25.43, 26.99	
Linear	$t(54.72) = 0.06$	0.47 (0.71)	-1.39, 1.48	
Quadratic	$t(56.06) = 0.29$	0.10 (0.35)	-0.61, 0.81	
Social Interaction				579.65
Intercept	$t(69.68) = 44.17$	8.27 (0.19)	7.90, 8.64	
Linear	$t(63.95) = 0.80$	0.25 (0.32)	-0.38, 0.90	
Quadratic	$t(55.41) = -0.38$	-0.06 (0.15)	-0.37, 0.25	
Satisfaction with Social Support				787.57
Intercept				
Linear	$t(61.00) = 59.32$	17.94 (0.30)	17.33, 18.54	

Quadratic	$t(55.68) = -0.36$	-0.21 (0.58)	-1.37, 0.95	
	$t(56.43) = 0.58$	0.17 (0.28)	-0.41, 0.73	
DINE				
Fat Score				1307.56
Intercept	$t(68.82) = 21.90$	25.84 (1.18)	23.48, 28.19	
Linear	$t(79.30) = -5.63$	-10.52 (1.87)	-14.24, -6.80	
Quadratic	$t(61.00) = 3.57$	3.10 (0.87)	1.36, 4.84	
Fibre Score				1407.85
Intercept	$t(73.23) = 18.18$	24.32 (1.34)	21.66, 26.99	
Linear	$t(75.86) = 0.15$	0.39 (2.58)	-4.74, 5.53	
Quadratic	$t(61) = -0.85$	-1.04 (1.22)	-3.47, 1.39	
BMI				
BMI				846.61
Intercept	$t(64.68) = 45.45$	36.19 (0.80)	34.60, 37.78	
Linear	$t(73.16) = -1.87$	-0.73 (0.39)	-1.50, 0.05	
Quadratic	$t(58.34) = 0.74$	0.13 (0.18)	-0.23, 0.50	

^F = Fixed intercept; PA=Physical activity; GLTEQ=Godin Leisure Time Exercise Questionnaire; DINE=Dietary Instrument of Nutrition Education

Bold text indicated statistical significance