



Review Article

A systematic review of physical activity interventions to improve physical fitness and health outcomes among Indigenous adults living in Canada

Chelsea A. Pelletier^{a,*}, Jenna Smith-Forrester^b, Tammy Klassen-Ross^a

^a School of Health Sciences, University of Northern British Columbia, 3333 University Way, Prince George, BC V2N 4Z9, Canada

^b Northern Medical Program, University of British Columbia, 3333 University Way, Prince George, BC V2N 4Z9, Canada

ARTICLE INFO

Keywords:

Indigenous population
Canada
Physical activity
Intervention
Exercise

ABSTRACT

The Indigenous population of Canada faces an increased burden of chronic disease, leading to decreased life expectancy. Physical activity is an important health behaviour that improves chronic disease risk factors and physical fitness. The objective of this systematic review was to evaluate physical activity interventions in the Indigenous population in Canada to determine effects on physical activity rates, physical fitness, and health outcomes. MEDLINE, PsycINFO, EMBASE, and CINAHL were searched for peer-reviewed journal articles. Inclusion criteria were studies that examined a physical activity intervention delivered in Indigenous communities in Canada for adults over 18 years of age. Data was extracted and two authors independently rated quality of the evidence. Five studies were included in the narrative synthesis. Interventions were community-based, and three were multi-component interventions focused on preventing or managing type II diabetes. The interventions varied in their success in altering physical activity rates, with increases ($n = 2$), a decrease ($n = 1$), or non-significant changes reported ($n = 2$). No study reported any measure of physical fitness. BMI was reported in four studies, with only one reporting a significant decrease. Decreases in systolic blood pressure and total cholesterol were reported in two studies. There is limited evidence and a lack of robust interventions that examine the impacts of physical activity on health and fitness status in the Canadian Indigenous population. Validated, culturally relevant tools for measuring physical activity may aid in program evaluation and focused educational materials could better support population health initiatives.

Trial registration: The review protocol was registered prospectively with PROSPERO (registration number: CRD42017055363).

1. Introduction

Indigenous or Aboriginal Peoples are the original inhabitants of Canada and include three distinct groups with their own history, culture, and beliefs: The First Nations, Inuit, and Metis. First Nations people are peoples who historically lived in North America below the Arctic, while Inuit are circumpolar people and historically lived in Canada's far north. The Metis are people of mixed First Nations and European ancestry. Numerous socioeconomic and historical factors, such as colonization and the residential school system, have contributed to substantial health disparities between the Indigenous and general Canadian population.

Indigenous peoples face an increased burden of chronic disease when compared to members of the general population and rank among the lowest in every social determinant of health (Foulds et al., 2012; Reading, 2015). It is estimated that 75.6% of First Nations men and 87.3% of First Nations women in Canada will develop type II diabetes in

their lifetime (Turin et al., 2016). The higher risk of chronic disease exists among Indigenous populations globally (Australian Bureau of Statistics, 2014; Vos et al., 2008), and in Canada where First Nations, Metis, and Inuit populations are growing at a rate of nearly 6 times the general population and nearly 40% of adults report multiple chronic conditions (Kuwornu et al., 2014; Malenfant and Morency, 2011), compared to 12.9% of the general Canadian population (Roberts et al., 2015).

Creating, delivering, and supporting messaging and programs to encourage adequate physical activity represents a potent health promotion strategy; participation is associated with improved physical fitness, decreased risk of chronic disease, and ultimately increased life expectancy (Ambrose and Golightly, 2015; Warburton et al., 2006). The development and implementation of physical activity interventions in Indigenous communities poses myriad challenges, as many communities are located in rural and remote areas with varied or unknown access to recreational facilities. Common environmental barriers to

* Corresponding author.

E-mail address: chelsea.pelletier@unbc.ca (C.A. Pelletier).

physical activity in rural areas include limited access to facilities, lack of sidewalks, poor lighting/lack of streetlights, uneven road surfaces, wildlife, and inclement weather (Frost et al., 2010); barriers which are more commonly reported by Indigenous adults (Macniven et al., 2016). These unique environmental barriers are in addition to universal, individual level or personal barriers including lack of time, fatigue, family responsibilities, and socioeconomic factors (Bruner and Chad, 2013). In the Indigenous population, these barriers are amplified by historical events such as colonization contributing to health inequities that are preventable and unjust. Institutional, political, and cultural barriers must be considered when developing and implementing interventions for members of the Indigenous population (Giles and Darroch, 2014; McHugh et al., 2013).

Due in part to a loss of traditional lands and practices, historically active Indigenous lifestyles have become increasingly sedentary. Many Indigenous communities have adopted modern conveniences and ‘western’ lifestyle practices (Bruner and Chad, 2013; Foulds et al., 2013; National Collaborating Centre for Aboriginal Health, 2013). A previous report identified that 40.9% of First Nation individuals live sedentary lifestyles (Findlay, 2011), while other estimates indicate that only 21% of Indigenous adults meet physical activity guidelines with nearly 50% reporting no physical activity whatsoever (Young and Katzmarzyk, 2007). While several reviews have addressed sedentary behaviour (Foulds et al., 2016) and physical activity interventions in Indigenous populations in Australia and North America (Foulds et al., 2013; Sushames et al., 2016; Teufel-Shone et al., 2009), the various socioeconomic, historical, environmental, and cultural factors do not make it suitable to combine all Indigenous populations. The heterogeneity in Indigenous cultures contributes to a heterogeneous health risk, impacting the effectiveness of an intervention, outcomes of interest, and conceptualization of healing for Indigenous people (Bruce et al., 2014). Similarly, based on the need for cultural continuity, it is essential that physical activity interventions be designed locally with a strong community participatory perspective to reflect diverse Indigenous views on health and wellness (Tang et al., 2016).

The purpose of this review was to evaluate and review physical activity interventions delivered among Indigenous populations in Canada to assess their impact on physical fitness, health outcomes, and chronic disease. A secondary objective was to evaluate the role of community engagement in shaping the intervention to help determine effective models of knowledge user and knowledge holder engagement.

This systematic review was guided by the following research questions: 1. Do physical activity interventions delivered among Indigenous populations living in Canada improve a) physical activity; b) physical fitness; and c) health status; 2. Do previous physical activity interventions in the Indigenous populations in Canada incorporate aspects of holistic wellness and are they based on Indigenous values and beliefs about physical activity?

2. Methods

2.1. Literature search

This systematic review was designed in accordance with the PRISMA statement for systematic review protocols and reporting guidelines (Moher et al., 2009, 2015). The review protocol was registered prospectively with PROSPERO (registration ID: CRD42017055363). The search strategy was designed in consultation with a university health sciences librarian.

MEDLINE, PsycINFO, EMBASE, CINAHL databases were searched for academic literature until February 15, 2017. Gray literature was searched using Google Scholar and government and organizational websites related to Indigenous health. Search terms for population included First Nations OR Indigenous OR Aboriginal OR Native peoples OR Indian OR Eskimo OR Inuit OR Metis. Population terms were combined with intervention and physical activity related terms (activit*

Table 1
MEDLINE search strategy.

MEDLINE search strategy (results = 93)
Activit*
Adult
Aerobic exercise
American indian
Anaerobic exercise
Aquatic exercise
Canada
Canadian Aboriginal
Early intervention
Eskimo
Exercise
Exercise test
Exercise tolerance
First nation
Fitness
Indigenous people
Intervention study
Inuit
Metis
Physical
Sport
Stretching exercise
Team sport
Treadmill exercise

OR exercise OR physical activity OR fitness OR aerobic training OR strength training, OR cardiovascular training OR sports) AND Canada (OR Canadian OR Canadians) AND adult. The MEDLINE search strategy is presented in Table 1. The search strategies for other databases are available from the corresponding author. Backward and forward citation tracking from identified papers was completed to search for additional references.

2.2. Study inclusion & exclusion criteria

Eligible studies included those with Indigenous populations in Canada (First Nations, Metis, Inuit) where a physical activity intervention was evaluated. Studies were required to be individual- or community-level interventions (experimental or quasi-experimental design) with a focus on increasing physical activity and/or health status. This was defined as an exercise or physical activity intervention of any duration and that included at least one of the following outcomes a) physical activity participation, b) physical fitness, c) health status or d) occurrence/diagnosis of a lifestyle-related chronic disease. Studies that combined Indigenous populations with other ethnic or population groups were not included. Study participants were adults over 18 years of age. Studies that included youth under 18 were only included if the data for adults could be easily separated. Studies with multi-component interventions were included if increasing physical activity levels or physical fitness was an identified outcome of the intervention through either exercise programming or health education initiatives. Both controlled and uncontrolled studies were eligible for inclusion.

2.3. Data extraction & quality assessment

Articles were scanned for inclusion based on title, abstract, and full-text independently by two authors (JSF and CP). Differences were resolved through discussion and consensus. Final inclusion was confirmed by a third author (TKR). Data from included studies were extracted by a research assistant and crosschecked by CP and TKR. Information of interest included study population, setting, baseline characteristics of the population, details of the intervention, physical activity and health outcomes, and community engagement.

The quality of the included studies was assessed independently by CP and TKR using the Quality Assessment Tool for Quantitative Studies

(Armijo-Olivo et al., 2012; Effective Public Health Practice Project, 2009). This tool incorporates several aspects of study quality including study design, selection bias, and data collection methods. Studies are given an individual rating for each category and an overall rating as strong, moderate, or weak. This tool was chosen as it has been used in previous systematic reviews in Indigenous populations (Godin et al., 2015; Sushames et al., 2016) and is appropriate for a range of study designs in the field of public health. Differences were resolved through discussion and consensus.

Based on similar reviews in Indigenous populations, a high degree of heterogeneity in study design and quality was anticipated, making a meta-analysis of study findings not possible. Thus, a narrative synthesis of the evidence was completed to identify key patterns in study results using outcomes related to the intervention design, community characteristics, and community engagement process. The narrative synthesis was completed following the guidelines described by the Cochrane Consumers and Communications Review Group (Ryan, 2016) as a way to describe and integrate quantitative study findings by exploring key differences and similarities in the methodology. The effect of the intervention on health and fitness outcomes for each study is summarized based on statistical significance.

3. Results

The PRISMA flow diagram of included studies is presented in Fig. 1. Initial searches identified 267 articles, 162 of which were screened after removal of duplicates. One hundred thirty-five articles were excluded based on title or abstract review and the full-text of 27 articles were assessed for final inclusion. Five were identified as meeting all eligibility criteria and were included in the narrative synthesis. Studies were excluded based on review of full text because they did not present

an intervention, did not report outcomes (Sharma et al., 2010), were not accessible, or were a duplicate in that both a manuscript and dissertation describing the study were discovered in the search (Ho, 2007). One other study was excluded because it presented data on families where adults and children were included in the same analysis (Anand et al., 2007). Gray-Donald et al. (2000) completed a study that evaluated a pre-natal lifestyle intervention in Cree communities. Targeted adult interventions (with a sub-set of the population) were not an explicit exclusion criterion, however the unique focus of this intervention and its narrower target population was considered during synthesis and interpretation of the results. Extracted data from each study is presented in Table 2.

3.1. Study quality

Two of the included studies were given a global rating as moderate (Daniel et al., 1999; Ho et al., 2008) and three were rated as weak (Foulds et al., 2011; Gray-Donald et al., 2000; Heffernan et al., 1999) according to the Quality Assessment Tool for Quantitative Studies. The study ratings in each category are presented in Table 3. As is common in most physical activity interventions, all of the studies were rated as weak or not applicable for the blinding category.

3.2. Population & community characteristics

Three of the included studies were based in the province of British Columbia, one in Quebec, and one in Ontario, Canada. Four studies included First Nations communities (Daniel et al., 1999; Gray-Donald et al., 2000; Heffernan et al., 1999; Ho et al., 2008), with one Cree (Daniel et al., 1999) and another of Haida ancestry (Heffernan et al., 1999). One study did not specify the type of Indigenous population

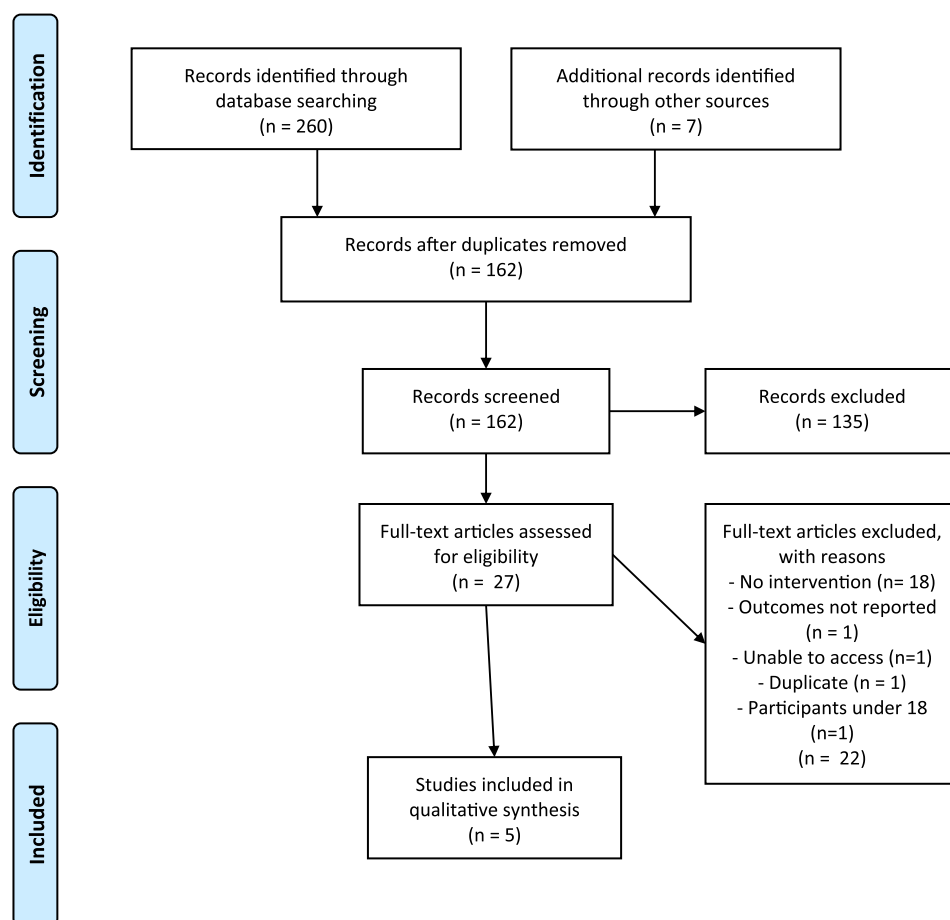


Fig. 1. PRISMA flow diagram.

Table 2
Summary of physical activity interventions in Indigenous populations living in Canada.

Author	Study design	Participants & location	Intervention	Data collection points	Physical activity & fitness outcomes	Health-related outcomes	Community consultation
Daniel et al.	Quasi-experimental, non-equivalent control group design	3 Canadian First Nation Communities in the Okanagan Region, British Columbia, Canada N = 105, 18–87 years of age	Title: Okanagan Diabetes Project Duration: 7 month pre-intervention, 16-month intervention periods Groups: one intervention community (n = 62) and two comparison communities (n = 27, n = 16) Activities: aerobics & gentle exercise classes, walking group, 100 Mile Club, health events, Diabetes support group, targeted education	Baseline, mid-intervention, post-intervention	Metabolic equivalent hours of physical activity: NS Self-reported sweat-producing activity: ^a ↓	BMI: ^a ↓ SBP: ^a ↓ Glycosylated hemoglobin (HbA1c): ^a ↑ Fasting glucose: NS HDL: NS Total cholesterol: NS BMI: NS Waist-to-hip ratio: NS	Interviews and qualitative analysis of community knowledge & perceptions
Foulds et al.	Non-randomized trial	Canadian Aboriginal Communities in British Columbia, Canada N = 262, 18–79 years of age	Title: Hearts in Training program Duration: 4 years, 13 weeks/year Groups: Self-selected, walking (Walk10K, n = 149), walk/running (LTR10K, n = 86), or running (Run10K, n = 27) Frequency: Weekly group training sessions, with 2 more days for individual training	Baseline & post-intervention	Self-reported physical activity Walk10K & LTR10: ↑ Run10K: ↑	BMI Walk10K: ↓ LTP10K: ↑ Run10K: ↑ Waist Circumference Walk10K: ^a ↓ LTP10K: ^a ↓ Run10K: ↓ SBP Walk10K: ^a ↓ LTR10K: ↑ Run10K: ↓ DBP: Walk10K & LTP10K: ↓ Run10K: ↑ Total cholesterol Walk10K: ^a ↓ LTR10K & RUN10K: ↓ HDL: All groups: ↑ TC:HDL ratio All groups: ↓ Rate of weight gain: NS Plasma glucose: ↔ Birth weights: NS	Local Aboriginal community leaders involved in design & implementation
Gray-Donald et al.	Pre-post Cohort	Cree community in James Bay, Quebec, Canada, N = 219, females receiving prenatal services prior to 26 weeks' gestation, age: 24.3 ± 6.29 (intervention), 23.8 ± 5.86 (control)	Duration: 9-month control period (n = 107), 10-month intervention (n = 112) Activities: physical activity sessions & counseling	Baseline (24–30 weeks gestation) & post-intervention (6 week postpartum)	Self-reported physical activity: ^a ↑		Staff received culture-specific training, health workers hired from communities

(continued on next page)

Table 2 (continued)

Author	Study design	Participants & location	Intervention	Data collection points	Physical activity & fitness outcomes	Health-related outcomes	Community consultation
Heffernan et al.	Pre-post Cohort	Haida Communities in Skidegate & Old Massett, British Columbia, Canada, <i>N</i> = 22, women (in physical activity portion), age 20–75	Title: The Haida Gwaii Diabetes Project Duration: 3 year project. Phase one: chart review, diabetes clinics, focus groups. Phase two: traditional herbal medicine trial, traditional diet trial, Getting Stronger Programme (exercise classes 3 times/week for 15 months) Activities: led my member of community, exercise classes using tapes, stationary bicycle, rowing machine, some free weights incorporated	Baseline, mid-intervention, post-intervention	Classes well-attended	Weight: ↓ BMI: ↓ Fasting blood glucose: ↓ Total cholesterol: ^a ↓ Triglycerides: ↑ HDL: ^a ↑ Glycosylated hemoglobin (HbA1c): ↓	Chart review, diabetes clinic, focus groups (phase one)
Ho et al.	Quasi-experimental, pre-post cohort	Northwestern Remote or Semi-remote First Nations, Ontario, Canada, <i>N</i> = 95, age 40.3 ± 11.5 (intervention), 44.7 ± 12.7 (control)	Duration: 9-month intervention, 5 phases of 6–8 weeks Activities: multi-institutional diabetes prevention program with school, store, community components, education focus Groups: 4 sites, 2 intervention (Site A and B, <i>n</i> = 57) & 2 controls (Site C and D, <i>n</i> = 38)	Baseline & post-intervention	Total activity count (accelerometry): ↓ Sedentary activity: ↑	BMI: ↑ Percentage body fat: NS	Collaboration with stakeholders & community members

^a Denotes statistically significant increase (↑) or decrease (↓); NS, non significant change or change not indicated in manuscript; SBP, systolic blood pressure; DBP, diastolic blood pressure; HDL, high-density lipoprotein; BMI, body mass index.

Table 3
Quality rating scores for included studies.

Author	Selection bias	Study design	Confounders	Blinding	Data collection method	Withdrawals and dropouts	Overall rating
Daniel et al.	Moderate	Moderate	Moderate	Weak	Moderate	Moderate	Moderate
Foulds et al.	Weak	Moderate	Moderate	Weak	Strong	Weak	Weak
Gray-Donald et al.	Moderate	Moderate	Strong	Weak	Strong	Weak	Weak
Heffernan et al.	Moderate	Moderate	N/A	N/A	Weak	Weak	Weak
Ho et al.	Moderate	Moderate	Strong	Weak	Strong	Moderate	Moderate

N/A, not applicable.

(Foulds et al., 2011). Four of the five included studies describe interventions implemented in rural Indigenous communities or on reserve land and one study included a combination of rural and urban participants (Foulds et al., 2011). Only one study reported the population size of the target communities (Daniel et al., 1999).

3.3. Intervention characteristics

The included interventions are diverse, although all were community-based and ranged from 13 weeks to 24 months in duration. All but one the interventions were multi-component, including both dietary and physical activity interventions. Four of the programs were designed with the goal of reducing or managing diabetes, while only one study was designed solely to improve physical activity.

Of the four multi-component interventions, two were behaviour change interventions developed based on social learning theory; in these programs, community members were encouraged to participate in physical activity but did not take part in activity supervised by study staff (Daniel et al., 1999; Gray-Donald et al., 2000).

Of the studies that included supervised physical activity, programming was in the form of regularly scheduled but seemingly unsupervised, non-progressive exercise classes (Daniel et al., 1999; Heffernan et al., 1999). Two studies also included walking groups (Daniel et al., 1999; Foulds et al., 2011). Only one study used a supervised, progressive training programming where participants were able to self-select either a walking, walk/running, or running training group that was led by a trained Indigenous community member (Foulds et al., 2011).

3.4. Physical activity & fitness outcomes

Three of five studies relied on subjective self-reported measures of physical activity (Daniel et al., 1999; Foulds et al., 2011; Gray-Donald et al., 2000). One study reported attendance at fitness classes but did not report any measure of physical activity (Heffernan et al., 1999). There was no consistency in the type of physical activity recall questionnaire used and only one study used an objective measure of physical activity, accelerometry (Ho et al., 2008). Similarly, there was little consistency in the definition of physical activity or physical activity intensity, as one study reported only participation in ‘sweat-producing activity’ (Daniel et al., 1999).

Overall, two of the five interventions reported an increase in physical activity. These increases were seen following both a supervised training program (Foulds et al., 2011) and non-supervised activity following behaviour change theory or education-based programming (Daniel et al., 1999; Gray-Donald et al., 2000). One study did not measure physical activity directly but did report high attendance at community exercise classes (Heffernan et al., 1999).

Ho et al. (2008) reported on a diet and physical activity program over 9-months and noted a decrease in total activity count as measured by accelerometry combined with an increase in sedentary time. This was attributed in part to weaknesses in the physical activity component of the intervention; the intervention failed to address built environmental barriers to physical activity (Ho et al., 2008). Similarly, Daniel

et al. (1999) reported no change in metabolic equivalent hours of physical activity and a reduction in number of community members participating in sweat-producing physical activity at least once per week.

3.5. Health outcomes

The most common health outcome measured was body mass index (BMI). A statistically significant decrease in BMI was reported in one study following a 16-month diabetes intervention program (Daniel et al., 1999). Significant decreases in waist circumference were also observed following a walking or walking/running intervention (Foulds et al., 2011).

A decrease in systolic blood pressure was reported in two studies from both a walking and mixed exercise intervention programs. While two studies did not report any change in high-density lipoprotein levels, one study did report a significant increase attributed to a change in physical activity (Heffernan et al., 1999). Total cholesterol decreased in two studies (Foulds et al., 2011; Heffernan et al., 1999). There were mixed results on diabetes-related outcomes; glycosylated hemoglobin (HbA1c) significantly increased in one study (Daniel et al., 1999) and was non-significantly changed in another (Heffernan et al., 1999). No studies reported significant changes in fasting blood glucose levels.

3.6. Community engagement

All included studies reported engagement with relevant community leaders or stakeholders as part of intervention development. Engagement activities included semi-structured interviews (Daniel et al., 1999), focus groups (Heffernan et al., 1999), cultural-competency training (Gray-Donald et al., 2000), and hiring community members as study staff (Gray-Donald et al., 2000). Foulds et al. (2011) indicated a participatory research process involving Indigenous community leaders in the design and implementation of the study, and involvement of local Indigenous health care professionals and volunteers in study testing and procedures. It is unclear if any of the interventions or programming was maintained or if ownership of study findings was transferred to the communities.

4. Discussion

This systematic review identified five intervention studies that focused on physical activity and health related outcomes in Indigenous adults living in Canada. The results of included studies suggest physical activity interventions have the potential to improve weight management, hypertension, and blood lipid profile among Indigenous adults, although the lack of relevant research and wide range of assessment methods yield a weak level of evidence. Overall, the study quality was weak to moderate and the lack of high quality intervention-based research in this population highlights a clear research gap to be addressed in the pursuit of effective, efficient health programming and policy.

Although the studies included in this review did report some overall improvements in various health outcomes, it is interesting to note that only two studies reported an increase in physical activity, with two

reporting a significant decrease. Similar results have been reported in a systematic review conducted on physical activity interventions in Indigenous people in Australia and New Zealand (Sushames et al., 2016), and in the United States (Teufel-Shone et al., 2009). This may indicate that the interventions were either not effective at increasing physical activity or may point to methodical issues in measurement of physical activity. All but one study relied on self-report questionnaires developed for use in the general population (with one study using an objective measure of activity) and none of the studies indicated if the measures were modified to reflect Indigenous activities, as has been suggested in other cross-sectional assessments (Bruner and Chad, 2013). While these are validated and commonly used tools, they may not properly reflect Indigenous activities, languages, or culture. Culturally appropriate self-report tools for physical activity have been validated for use in Indigenous youth (Lévesque et al., 2004), but to our knowledge do not exist for Indigenous adults.

It is also possible that since the majority of interventions reviewed were multi-component and included dietary interventions, they did not properly address the multifactorial set of barriers to physical activity in Indigenous populations. It is important that physical activity interventions be designed to reflect unique community-level barriers as being physically active is associated with being culturally engaged within one's own community (Tang et al., 2016). Indigenous adults are more likely to report that high levels of crime, inaccessible transportation, a lack of access to low-cost recreation facilities, and lack of organization impact their physical activity participation (Bruner and Chad, 2013; Macniven et al., 2016). Different types of exercise are also impacted by different set of barriers: Walking, for example is highly related to safety from wildlife and community aesthetics, while strenuous exercise is more strongly impacted by owning home exercise equipment (Bruner and Chad, 2013; Kirby et al., 2007).

In addition to addressing community-specific barriers, for an intervention to be successful it is essential that it reflect the conceptualization and meaning of physical activity among Indigenous peoples. Although we have used the umbrella term Indigenous, it is important to observe that each of the three Indigenous groups in Canada – First Nations, Metis, and Inuit - have a distinct culture, health risk, and most likely, conceptualization of physical activity. Previous work has suggested that including Indigenous values, beliefs, and healing practices in physical activity programming increases adherence and connection to the programs (Lavalée, 2007). The inclusion of traditional activities such as berry picking and fishing is not only preferred by Indigenous adults (Bruner and Chad, 2013) but may aid with cultural healing, familial connection, and education. Among remote Indigenous communities in Northern Australia, physical activity was revealed to be associated with social and economically necessary physical engagement with the environment and traditional education, contributing not only to physical health but also to education and employment (Thompson et al., 2013). All five of the included studies contained some aspects of community engagement, although it is unclear to what extent this process shaped the intervention or if Indigenous activities were included. Two of the reviewed studies described a community engagement process involving interviews and focus groups (Daniel et al., 1999; Heffernan et al., 1999), which contributed to the inclusion of group exercise classes and walking groups in their interventions. Based on the current evidence, we are unable to make any conclusion regarding the role of community engagement in the uptake and longevity of physical activity programming, or what forms of consultation yield a better researcher-community relationship.

Current Canadian public health guidelines recommend 150 min of physical activity per week (Tremblay et al., 2011). It is not known if this guideline is appropriate or applicable to the Indigenous population as there is a lack of methodologically rigorous exercise physiology research in this population. Preliminary work has demonstrated differences in cardiovascular responses to submaximal exercise between Indigenous and European adults (Foulds et al., 2017), although physical

fitness scores have been reported as similar in physically active individuals regardless of heritage (Foulds et al., 2015). It is not known how these factors may contribute to exercise prescription guidelines. Similarly, there has been little exploration of the cultural relevance of the related guidelines, tools, and public health campaigns used to promote these recommendations (Giles and Darroch, 2014). This underpins the need for distinct programming and guideline evaluation in this at-risk group that balances improving health with cultural sensitivity of Indigenous worldviews.

Methodologically, none of the studies reviewed were randomized controlled trials. Two studies included control or comparison communities, although the selection of the communities to be used as controls was designated non-randomly or matched by the researchers in both cases (Daniel et al., 1999; Ho et al., 2008). An additional study had three separate training groups, with participants self-selecting into the group of their choice (Foulds et al., 2011). While randomized controlled trials are typically considered the highest standard of evidence, there are substantial challenges and limitations in this field of research that limit their feasibility. Barriers to recruiting control groups must be considered, and the resources required both conduct well-designed evaluations of these programs and to sustain them in resource-poor communities. Instead, we would propose that future research focus on well-designed community-driven initiatives that utilize a pragmatic evaluation of interventions in situations where randomization and non-active controlled groups is not possible.

While we did attempt to include gray literature in our review, it is possible that some reports were missed in our search. As some of the projects presented in this review were conducted as quality improvement initiatives they may not have been funded or published through traditional research pathways. We have also not considered or accounted for research that may fall outside of western scientific tradition, this may include projects or programming developed and delivered in Indigenous communities that was evaluated based on community established criteria or grounded in Indigenous knowledge.

5. Conclusions

The present systematic review included five studies that evaluated the impact of physical activity interventions on health outcomes in select Indigenous populations living in Canada. Composite results indicate preliminary, but weak, evidence that community-based physical activity interventions can improve chronic disease risk factors in this growing, high-risk population. To move past the damaging history and impacts of colonization, there is a need to expand beyond a reliance on western-based measures and interventions to improve health and wellness in the Indigenous populations of Canada. Culturally safe practices and authentic engagement should be of paramount importance in the design of future research to ensure proper alignment with ethical principles outlined in the Tri Council Policy Statement (TCPS-2).

Competing interest

The authors declare that they have no competing interests.

Funding

This work was supported by the Canadian Institutes of Health Research (grant number: 150493).

Author contributions

The literature search was completed by JSF. CP and JSF independently screened the articles and determined inclusion. CP and TKR independently appraised each article and wrote the manuscript. All authors read and approved the final manuscript.

Acknowledgments

The authors wish to acknowledge Trina Fyfe for her assistance in developing the search strategy.

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