



**Physical Activity and COVID-19:
A Review of the Benefits and Effective Behaviour Change Strategies**

Prepared by: Veronica Allan, PhD

July 14, 2020

Introduction

Social isolation and loneliness have been linked to increased risk of numerous health conditions, including heart disease, stroke, depression, and suicide (Courtin & Knapp, 2017; Holt-Lunstad et al., 2015; Valtorta et al., 2016). While physical distancing and self-isolation are necessary to help prevent the spread of COVID-19, finding ways to maintain and improve health are more important than ever. A simple and effective way to enhance health and wellbeing — while also preventing illness — is regular physical activity (Government of Canada, 2018). However, only 16% of Canadian adults meet Canada’s physical activity guidelines (Clarke et al., 2019). New demands at work and home, added stress, and the public health restrictions and closures associated with the pandemic have created additional challenges to being physically active.

Purpose and Objectives

The purpose of this document is to provide organizations with information and resources to assist in physical activity promotion during (and beyond) the COVID-19 pandemic. Specifically, this document synthesizes the findings of a literature review focused on the benefits of physical activity, as well as strategies to effectively promote the uptake of physical activity behaviours.

The objectives of the literature review were to:

1. Provide an overview of the benefits of physical activity, with a particular focus on:
 - a. Physical health and disease prevention;
 - b. Mental health and wellbeing; and
 - c. Immune system function.
2. Identify effective strategies for changing physical activity behaviour in general, as well as in the unique context of rural, remote and/or Indigenous communities.

Search Strategy

To review the literature focused on the benefits of physical activity, the titles of articles in four databases (PsycINFO, ERIC, MEDLINE, and PubMed) were searched using the following search terms: ‘physical activity’ OR ‘sport’ OR ‘exercise’ AND ‘benefit’ OR ‘disease prevention’ OR ‘disease risk’ OR ‘health outcome’ OR ‘mental health’ OR ‘mental illness’ OR ‘wellbeing’ OR ‘immune’ AND ‘review’ OR ‘meta-analysis’. Given the extensive body of evidence focused on the benefits of physical activity, the results were limited to peer-reviewed systematic reviews and meta-analyses published in English between 2010 and 2020. Articles were excluded if they were not focused on the outcomes or benefits of physical activity, examined the effects of physical activity in combination with other interventions (e.g., nutrition), or the methodological quality of the study was poor. Following the initial search, the review was further narrowed to focus on “apparently healthy” populations (i.e., with an absence of disease or disability). When not identified through the original searches, the results were supplemented with background research supporting the Canadian Society for Exercise Physiology’s Canadian Physical Activity Guidelines and Canadian 24-Hour Movement Guidelines¹. Additional articles were also identified through a manual search of the reference lists of key articles included in the review.

¹ See <https://csepguidelines.ca>.

To review the literature focused on effective strategies for changing physical activity behaviour, two additional searches were performed. The first search was focused on physical activity interventions in the general population. The titles of articles in three databases (PsycINFO, MEDLINE, and PubMed) were searched using the following search terms: 'physical activity' AND 'effective' AND 'behaviour' OR 'behaviour change' OR 'behaviour change technique' OR 'intervention' OR 'intervention technique' AND 'review' OR 'meta-analysis'. The second search was refined to focus on physical activity interventions in rural, remote and Indigenous populations. The titles and abstracts of articles in the same three databases were searched using the same combination of search terms — to which the following terms were added: 'rural' OR 'remote' OR 'Aboriginal' OR 'Indigenous'. The results of each search were limited to peer-reviewed systematic reviews and meta-analyses published in English between 2000 and 2020. Articles were excluded if they were not focused on the effectiveness of physical activity interventions, or if the methodological quality of the study was poor. To supplement the findings of these searches, an informal search of Google Scholar was conducted using related search terms.

Synthesis of Research Findings

Part 1: The Benefits of Physical Activity

Drawing on the most up-to-date, comprehensive and rigorous systematic reviews and meta-analyses, the benefits of physical activity related to *physical health and disease prevention*, *mental health and wellbeing*, and *immune system function* are outlined below. Of note, the evidence reviewed corresponds primarily to apparently healthy individuals (i.e., with an absence of disease or disability). Evidence to support the benefits of physical activity extend to people with a range of conditions (e.g., obesity, diabetes, hypertension, cancer, Alzheimer's, mental illness, physical disabilities), but a synthesis of the literature for each of these populations was beyond the scope of this review.

To achieve optimal benefits, the Canadian Physical Activity Guidelines and the Canadian 24-Hour Movement Guidelines provide evidence-based recommendations for the following groups: the early years (0-4 years); school-aged children and youth (5-17 years); adults (18-64 years); older adults (65 years and older); people with multiple sclerosis; and women who are pregnant. These guidelines can be accessed and downloaded for free at <https://csepguidelines.ca>. In general, however, more physical activity leads to greater health benefits.

Physical health and disease prevention

Physical activity is important for healthy growth and development among children and youth (Carson et al., 2017; Poitras et al., 2016), and prolongs strength and independence in later life (Paterson & Warburton, 2010). A physically active lifestyle prevents a number of diseases and reduces the risk of premature death (Warburton et al., 2010). In other words, physical activity is critical for health throughout the lifespan.

From birth until the age of 4 years, physical activity has been consistently associated with improved motor and cognitive development, as well as physical fitness and health — including cardiometabolic, bone and skeletal health (Carson et al., 2017). Similar benefits have also been found in school-aged children and youth (ages 5 to 17 years). For example, there is strong, consistent evidence that physical activity can improve adiposity, cardiometabolic disease risk, physical fitness, and bone health throughout childhood and adolescence (Janssen & LeBlanc, 2010; Poitras et al., 2016). In addition, there is some evidence to suggest that physical activity

can lead to motor skill development (e.g., balance, coordination) among this age group (Poitras et al., 2016).

Among adults (ages 18 to 64 years), an expansive body of literature demonstrates a dose-response relationship between physical activity and physical health, body composition, and disease prevention (Warburton et al., 2010). In other words, the research shows that greater amounts of physical activity are associated with greater physical health benefits. For example, when comparing the most active to the least active individuals across the literature, the most active individuals demonstrated a reduced risk of cardiovascular disease, stroke, hypertension, colon cancer, breast cancer, and type 2 diabetes (Warburton et al., 2010). More recently, physical activity has also been associated with the prevention of Crohn’s disease (Wang et al., 2016). Overall, regular physical activity can reduce the risk of premature all-cause mortality (i.e., death attributable to any cause) by up to 31% (Warburton et al., 2010).

Table 1. Reduction in disease risk associated with regular physical activity.

Disease	Percent Reduction in Disease Risk
Cardiovascular disease	33%
Stroke	31%
Hypertension	32%
Type 2 diabetes	42%
Breast cancer	20%
Colon cancer	30%
Chrohn’s disease	37%

Source: Wang et al., 2016; Warburton et al., 2010.

Additionally, there is preliminary evidence to indicate that regular participation in physical activity can maintain or improve adult bone health, including reduced risk of fractures and osteoporosis (Warburton et al., 2010). These benefits may extend into older age (i.e., ages 65 years and up), thus contributing to the maintenance of functional independence and mobility. In fact, regular physical activity can improve physical fitness (e.g., balance, flexibility, muscle strength) and reduce the risk of functional limitations and disability among older adults by as much as 50% (Paterson & Warburton, 2010).

Mental health and wellbeing

Research suggests that physical activity can improve mental health and psychological wellbeing — and that these benefits can be enjoyed at any age (Biddle et al., 2019; Kadariya et al., 2019; Rebar et al., 2015; Rodriguez-Allyon et al., 2019; Wiese et al., 2018; Windle et al., 2010). Sport, in particular, is a form of physical activity that may offer additional psychosocial benefits for children, adolescents and adults (Eime et al., 2013a, 2013b).

Research focused on adolescents demonstrates significant associations between physical activity and lower levels of psychological distress (e.g., depression, stress) as well as greater levels of psychological wellbeing (e.g., self-image, life satisfaction) (Rodriguez-Allyon et al., 2019). The evidence for children and youth is less robust, but there is some support for the benefits of physical activity involving enhanced quality of life and self-esteem, as well as reduced depressive symptoms (Biddle et al., 2019; Janssen & LeBlanc, 2010; Poitras et al., 2016). Physical activity may also contribute to enhanced cognitive function and academic achievement among these age groups, but the evidence is mixed (Poitras et al., 2016).

Among adults, leisure-time physical activity has been associated with positive affect and life satisfaction, which are indicators of subjective wellbeing (Wiese et al., 2018). There is also strong evidence to suggest that physical activity reduces depression and anxiety in non-clinical populations (Rebar et al., 2015). In fact, research indicates that people who are active on a regular basis have up to 45% lower odds of experiencing depression, and up to 48% lower odds of developing anxiety (United States Department of Health and Human Services, 2008). The benefits of physical activity also extend to clinical populations. Through regular exercise, people with mental illness can improve symptoms, sleep quality and quality of life (Alexandratos et al., 2012; Lederman et al., 2019).

Similar findings have been reported among older adults. For example, older adults who participate in regular exercise show reduced depression, improved sleep quality, and enhanced mental wellbeing (Kadariya et al., 2019; Windle et al., 2010). There is also consistent evidence that regular physical activity reduces the risk for dementia and Alzheimer's disease, and some support to suggest that physical fitness is associated with improved cognitive function in older age (Paterson & Warburton, 2010).

Participation in sport, in particular, has also been linked with a range of psychological and social benefits for children, youth and adults that may extend beyond the benefits of physical activity more generally (Eime et al., 2013a, 2013b). The most commonly reported benefits of sport participation for children and youth include improved self-esteem, social skills and mental health, including fewer depressive symptoms and less suicidality (Eime et al., 2013b). Other benefits include emotional regulation and control, life satisfaction, and wellbeing (Eime et al., 2013b). The benefits of sport participation for adults include enhanced wellbeing and reduced psychological distress (e.g., depression), as well as — among team sport participants — opportunities for social interaction, enhanced social support, higher self-esteem, and a sense of belonging (Eime et al., 2013a).

Immune system function

Preliminary evidence suggests that regular physical activity is beneficial for immunological health and might limit or delay immunological aging (Campbell & Turner, 2018; Nieman, 2011). Epidemiological studies show that leading a physically active lifestyle reduces the incidence of communicable (e.g., bacterial and viral infections) and non-communicable diseases (e.g., cancer) (Campbell & Turner, 2018). For example, research shows that people who engage in regular physical activity are 50% less likely to get an upper respiratory tract infection, such as the common cold, than people who are less active (Strasner et al., 2001). Among women, activities like brisk walking, in particular, have been shown to reduce the risk of pneumonia — a complication of viruses like the one that causes COVID-19 — by 18% (Neuman et al., 2010). Finally, when physically active people do get sick, the severity of their symptoms is reduced by up to 41% (Nieman et al., 2011). Of note, a single bout of exercise can produce immune and inflammatory responses that are linked to a range of health benefits (Brown et al., 2015). However, a single bout of heavy exercise (1.5 hours or longer) or chronic heavy exercise (1.5 hours on most days) may suppress the immune system (e.g., can lead to a greater incidence of upper respiratory tract infections) (Walsh & Oliver, 2016).

Part 2: Strategies for Changing Physical Activity Behaviour

There are three types of intervention strategies that are commonly used to increase physical activity around the world: (1) behavioural and social approaches; (2) environmental and policy approaches; and (3) campaigns and informational approaches (Heath et al., 2012). Behavioural

and social approaches are intended to teach people skills and strategies that will help them to adopt, regulate and maintain health behaviours such as physical activity. Environmental and policy approaches encompass modification or regulation of the physical, social, and/or organizational environment, as well as changes to legislation or organizational policy with the goal of providing accessible, safe, attractive, and convenient spaces for physical activity to take place. Finally, campaigns and informational approaches, such as mass media campaigns that use television, radio, newspapers and other forms of media to raise awareness of and reinforce the targeted behaviour (e.g., increasing physical activity), involve strategies to change knowledge, attitudes and behaviours at the individual or community level.

Articles identified through the search process for this review primarily focused on behavioural and social approaches for the promotion of physical activity. As such, a detailed review of effective physical activity intervention strategies grounded in *behavioural and social approaches* is provided. Subsequently, brief overviews of relevant *campaigns and informational approaches* and *environmental and policy approaches* are outlined. When possible, strategies to promote physical activity are discussed with respect to the general population, as well as in rural, remote and/or Indigenous communities.

Behavioural and social approaches

Interventions that target behaviour change are often complex and involve several different components. For example, intervention components typically include who delivers the intervention, to whom, how often, for how long, in what format, in what context, and with what content (Davidson et al., 2003). With respect to the content of these interventions, behaviour change techniques (BCTs) represent the “active ingredient that brings about behaviour change” (Michie et al., 2013, p. 82). In other words, BCTs are “observable, replicable and irreducible” components of an intervention designed to regulate behaviour, such as self-monitoring or behavioural reinforcement (Michie et al., 2013, p. 82).

Across the literature, nearly 100 different BCTs have been reported in interventions targeting health behaviour change (Michie et al., 2013). However, research demonstrates that only a small number of BCTs are effective for increasing physical activity. In particular, a cluster of BCTs focused on self-regulation have consistently been associated with increased self-efficacy, intentions and behaviour related to physical activity (Greaves et al., 2011; McDermott et al., 2016; Michie et al., 2009; Williams & French, 2011). These BCTs include:

1. **Goal setting:** A person sets or agrees on a goal defined in terms of the behaviour to be achieved (e.g., brisk walking for 30 minutes every day) or a positive outcome of the behaviour (e.g., losing 5 pounds) (Michie et al., 2013). In general, goal setting is most effective when goals are behaviour-focused and self-determined (Heath et al., 2012). Research also indicates that goals focused on daily physical activity or a combination of daily and weekly physical activity are more effective than goals focused on weekly physical activity alone (McEwan et al, 2016). Finally, goal setting works best when goals are set at baseline and subsequently modified on a daily or weekly basis (see 5. Goal Review, below for details) (McEwan et al, 2016).
2. **Action planning:** A person engages in specific detailed planning of when (e.g., before work on weekdays), where (e.g., at a local trail or track), and how (e.g., running) physical activity is going to be performed (Michie et al., 2013; Williams & French, 2011). Details related to the context, frequency, duration and intensity should also be considered (Michie et al., 2013). Similar to goal setting, action plans are most effective when they

are self-generated and tailored to the individual (Williams & French, 2011). Action planning can also facilitate goal attainment (McEwan et al., 2016).

3. **Self-monitoring:** A person monitors and records their behavior(s) and/or the outcome(s) of their behaviour as part of a behavior change strategy (Michie et al., 2013). Examples of self-monitoring of behaviour include writing down the number of minutes spent in a particular physical activity (e.g., walking) each day or using a pedometer or app to track the number of steps taken. In contrast, self-monitoring of outcomes might include recording one's weight on a weekly basis. Physical activity interventions that use self-monitoring and at least one other BCT focused on self-regulation tend to be most effective (e.g., Michie et al., 2009; Murray et al., 2017).
4. **Feedback on performance:** A person receives informative or evaluative feedback on their performance of the behaviour or progress towards a larger goal (Michie et al., 2013). Positive feedback, in particular, has been linked with increased physical activity self-efficacy (Ashford et al., 2010; Williams & French, 2011). Examples of this type of feedback include highlighting personal successes and offering praise for a person's attempts to achieve a physical activity goal. In addition to setting goals, people who receive feedback on their goals are most likely to increase their physical activity (McEwan et al., 2016).
5. **Goal review:** A person reviews their goal(s) and considers modifying either the goal(s) or the behaviour change strategy (e.g., action plan) in light of progress or achievement. This may lead to re-setting the same goal, a small change in that goal, or setting a new goal instead of (or in addition to) the first (Michie et al., 2013). In general, goal setting is most effective when goals are reviewed on a weekly or bi-weekly basis (McEwan et al., 2016). Furthermore, the timeline for goal review should align with the parameters of the goal (e.g., lose 5 pounds in 3 months) and the preferences of the person setting the goal. There is also some evidence to indicate that the use of rewards associated with goal progress or attainment can facilitate physical activity behaviour change (McEwan et al., 2016; Williams & French, 2011).

Other BCTs may also be effective for increasing physical activity. For example, the use of prompts and cues (e.g., a stimulus or reminder to engage in physical activity) has been associated with physical activity maintenance up to nine months after an intervention (Murray et al., 2017). Outside of the BCTs described above, BCTs with the potential to increase physical activity include providing information on the effects of the behaviour (e.g., the benefits of physical activity or the consequences of physical inactivity) (McDermott et al., 2016; Williams & French, 2011), setting graded tasks (i.e., progressive steps toward a larger goal that become increasingly difficult over time) (Williams & French, 2011), facilitating social comparison (i.e., drawing attention to others' performance to allow comparison with the person's own performance) (Ashford et al., 2010; Williams & French, 2011), and teaching time management skills (Williams & French, 2011). Notably, BCTs that are effective for increasing physical activity among adults aged 60 and over may look different from the BCTs described above. For example, goal setting, self-monitoring and social comparison have been linked to *decreased* physical activity in this age group (French et al., 2014). To increase physical activity, older adults respond better to BCTs such as barrier identification, rewards and modeling of the behaviour (French et al., 2014).

In addition to the use of established BCTs, other common features of effective physical activity interventions relate to how the interventions are delivered. Physical activity interventions are

more effective when they target multiple health behaviours (e.g., physical activity and nutrition), mobilize social support (i.e., engage others who are important such as family, friends and colleagues), and provide ample opportunities (frequency and duration) for “face time” or communication between program staff and participants (Greaves et al., 2011). Generally speaking, approaches that are person-centered and autonomy-supportive are likely to promote physical activity behaviour change (Samdal et al., 2017). In other words, physical activity programs and initiatives should prioritize the needs and preferences of participants, and also ensure that they play an active role in their own physical activity journey.

With respect to rural, remote and Indigenous communities, research focused on behavioural interventions targeting physical activity is limited — and of the research that does exist, the findings are inconsistent. To date, physical activity interventions in rural settings have been largely ineffective (Cai & Richards, 2016; Cleland et al., 2017). However, there are a few examples of physical activity programs that have produced positive results (Blackford et al., 2016; Campbell et al., 2004; Folta et al., 2009). Drawing on these examples, and consistent with the general population, interventions that are personalized or tailored, target multiple health behaviours, and include several contacts appear to be most effective (Cai & Richards, 2016; Moore et al., 2016). Among adults aged 65 and older, effective intervention components also included opportunities for personal contact (e.g., face-to-face counselling, group sessions) and a focus on low- to moderate-intensity physical activity (Moore et al., 2016). Finally, health and recreation professionals in rural areas should focus the promotion of physical activity programs on interpersonal communication strategies such as visits to local schools, housing communities, churches and other community agencies, in addition to promoting programs through contacts with past participants (Wages et al., 2010).

Promoting physical activity in Indigenous communities also possesses unique challenges and considerations. In addition to the continued effects of colonization and intergenerational trauma, barriers to physical activity among Indigenous people include a lack of safety (e.g., high levels of crime, wildlife), inaccessible transportation, and a lack of access to low-cost recreation facilities (Macniven et al., 2016; Pelletier et al., 2017). Consequently, addressing the barriers to physical activity is just as important as the intervention itself (Sushames et al., 2016). In general, engaging Indigenous communities and leadership in the design and planning of interventions is critical for success (Fazelipour & Cunningham, 2019; Sushames et al., 2016). Interventions that are designed and implemented based on Indigenous cultural values and beliefs have greater value among Indigenous groups and are more likely to result in behaviour change (Fazelipour & Cunningham, 2019; Pelletier et al., 2017; Sushames et al., 2016). As an example, physical activity programs could incorporate traditional activities (e.g., berry picking, hunting, fishing) or cultural customs (e.g., smudging, tobacco bundles, purification ceremonies) to encourage a holistic view of physical activity that aligns with Indigenous values. Indigenous groups should be supported and mentored to develop, implement and share culturally appropriate programs that promote physical activity (Teufel-Shone et al., 2009).

Environmental and policy approaches

Common environmental and policy approaches include the creation or enhancement of indoor and outdoor exercise facilities, as well as walking and biking trails (Kahn et al., 2002; Heath et al., 2012). Policies that encourage transit-oriented development and pedestrian-friendly neighborhoods in which stores, jobs and schools are located in close proximity to people’s homes are also recommended (National Institute for Health and Clinical Excellence, 2008). Other strategies include street-scale urban design and land use practices such as relighting (i.e., installing new lights or improving present lighting), redesigning, or improving the aesthetics

of streets (Heath et al., 2006, 2012). In fact, street-scale strategies have been shown to increase physical activity by an average of 48% in targeted neighborhoods (Heath et al., 2006).

Notably, research focused on environmental and policy approaches to promote physical activity has primarily taken place in dense, urban environments (Heath et al., 2012). Accordingly, the effectiveness of environmental and policy interventions in rural, remote and/or Indigenous communities has received limited attention to date. However, there is some research examining barriers to the implementation of environmental and policy interventions focused on physical activity in rural settings (Barnidge et al., 2013), as well as environmental features influencing physical activity levels in Indigenous communities (Kirby et al., 2007; Macniven et al., 2016; Pelletier et al., 2017).

For example, among Canadian and Australian Indigenous adults, barriers to physical activity include a lack of safety (e.g., high levels of crime, wildlife), inaccessible transportation, and a lack of access to low-cost recreation facilities (Macniven et al., 2016; Pelletier et al., 2017). As further evidence of environmental influences on physical activity participation, aesthetics and safety have been found to positively predict time spent walking in a Canadian rural, Indigenous community (Kirby et al., 2007). Consequently, environmental and policy interventions could go a long way towards physical activity promotion in rural, remote and Indigenous communities.

While interventions such as the creation and expansion of walking trails and bike lanes, sidewalk completion and enhancement, and “safe routes to school” have been implemented in rural settings, a number of barriers have limited their success. According to Barnidge and colleagues (2013), barriers identified as preventing or limiting the use of environmental and policy interventions targeting physical activity in rural communities include limited interest from funders or policymakers due to the small size of the population, difficulty adapting evidence from urban and suburban settings, a lack of capacity and/or buy-in among local councils or organizations, and cultural differences (e.g., physical activity may be viewed as an amenity rather than a necessity for a healthy lifestyle).

Strategies to overcome these barriers — and in turn address barriers to physical activity in rural, remote and Indigenous communities through targeted environmental and policy interventions — encompass the development of broad-based partnerships (i.e., collaborating with other groups or organizations to meet multiple needs in the community), building on existing resources (e.g., programming at a local community center), and focusing on the long-term vision (Barnidge et al., 2013). In addition, when working in Indigenous communities, the priorities and preferences of Indigenous peoples must be taken into account (Fazelipour & Cunningham, 2019). As previously discussed, Indigenous leaders should be actively engaged in the design and implementation of physical activity interventions, and interventions should incorporate Indigenous values, beliefs and practices (Fazelipour & Cunningham, 2019; Pelletier et al., 2017; Sushames et al., 2016; Teufel-Shone et al., 2009).

Campaigns and informational approaches

Large-scale, high-visibility campaigns that make use of television, radio and other forms of media to promote physical activity are commonly used in countries of middle to high income, such as Canada (Kahn et al., 2002). For instance, ParticipACTION is a national nonprofit organization that is dedicated to increasing physical activity in the Canadian population². Through a series of campaigns designed to promote physical activity, ParticipACTION has

² See <https://www.participaction.com/en-ca>

become one of the most recognizable physical activity brands in Canada. A recent example of a ParticipACTION campaign is “Build Your Best Day” — a gamified web platform and digital campaign that lets kids plan their ideal day while educating them about the Canadian 24-Hour Movement Guidelines.

Campaigns and informational approaches are often tailored to a specific community or segment of the population (e.g., the “Build Your Best Day” campaign targeted school-aged children and youth in Canada). These approaches are generally effective for raising awareness and enhancing understanding of campaign messages; however, their effectiveness related to increasing physical activity behaviour is unclear (Leavy et al., 2011). For example, in a review of published evaluations of physical activity mass media campaigns between 2003 and 2010, only seven of 15 campaigns (less than half) reported an increase in physical activity levels (Leavy et al., 2011). Of note, mass media campaigns are most likely to lead to physical activity behaviour change when they are linked to specific community programs (Heath et al., 2012).

Aside from campaigns, an informational approach that has been effective for increasing physical activity is the use of point-of-decision prompts designed to remind and motivate people to use the stairs rather than the elevator or escalator when ascending or descending to another level (Kahn et al., 2002). Point-of-decision prompts include the use of signage in targeted locations (e.g., at the base of stairs, elevators, or escalators), and areas in which access to stairs has been improved (Nocon et al., 2010).

No published evaluations of campaigns or informational interventions explicitly targeting rural, remote and/or Indigenous communities were identified in this review.

Summary and Conclusion

This document provides information and resources to assist organizations in the promotion of physical activity during (and beyond) the COVID-19 pandemic. Specifically, this document synthesizes the findings of a literature review focused on the benefits of physical activity, as well as strategies to effectively promote the uptake of physical activity behaviours. In summary, research demonstrates that regular physical activity is beneficial for physical, mental and immunological health throughout the lifespan. Physical activity is important for healthy growth and development among children and youth, and prolongs strength and independence in later life. A physically active lifestyle reduces the risk of bacterial and viral infections (e.g., upper respiratory tract infections, pneumonia) and several chronic diseases (e.g., cardiovascular disease, type 2 diabetes, breast and colon cancer), while reducing the risk of premature death. Physical activity can also improve psychological wellbeing, and there is evidence to suggest that regular exercise is an effective treatment for mental illness.

From a behaviour change perspective, strategies for increasing physical activity include behavioural and social approaches, environmental and policy approaches, and campaigns and informational approaches. First, a large body of evidence supports the effectiveness of behavioural and social approaches for increasing physical activity. Behaviour change techniques focused on self-regulation, including goal setting, action planning, self-monitoring, feedback on performance, and goal review, are particularly effective for increasing physical activity. Targeting multiple health behaviours, mobilizing social support, and providing ample opportunities for “face time” or communication between program staff and participants are other common features of effective behavioural and social approaches. Environmental and policy approaches, ranging from the creation or enhancement of indoor and outdoor exercise facilities to relighting, redesigning, or improving the aesthetics of streets, are also effective strategies for

the promotion of physical activity. However, research focused on these approaches has primarily focused on urban and suburban environments. Finally, campaigns and informational approaches work for raising awareness and enhancing understanding of campaign messages (e.g., the importance of physical activity), but their effectiveness related to changing physical activity behaviour remains unclear.

A secondary objective of this review was to identify effective strategies for promoting physical activity in rural, remote and/or Indigenous communities. Overall, research focused on physical activity interventions in these communities is limited — and of the research that does exist, the findings are inconsistent. The reason for these inconsistencies is partially attributable to the number of barriers that prevent or reduce opportunities for physical activity in these settings. For example, among Indigenous adults, barriers to physical activity include a lack of safety (e.g., high levels of crime, wildlife), inaccessible transportation, and a lack of access to low-cost recreation facilities. Consequently, environmental and policy interventions that address these challenges could go a long way towards physical activity promotion in rural, remote and Indigenous communities. Furthermore, based on the limited evidence available, behavioural and social interventions that are personalized or tailored, target multiple health behaviours, and integrate interpersonal communication strategies to initiate and maintain contact with participants could also be an effective tool for physical activity promotion. Perhaps most importantly, community stakeholders (e.g., Indigenous leaders) should be actively involved in the design and implementation of physical activity initiatives in rural, remote and Indigenous communities.

Recommended Resources

Key findings from this review have been summarized in a series of three practical one-pagers, available in English and French on the SIRC website:

- Building Health, Fortifying Resilience
- Evidence-Based Tips to Get You Active!
- Programming Tips for Rural, Remote and Indigenous Communities

Visit sirc.ca to download the resources and for more information.

References

- Alexandratos, K., Barnett, F., & Thomas, Y. (2012). The impact of exercise on the mental health and quality of life of people with severe mental illness: a critical review. *British Journal of Occupational Therapy*, 75(2), 48-60.
<https://doi.org/10.4276/030802212X13286281650956>
- Ashford, S., Edmunds, J., & French, D. P. (2010). What is the best way to change self-efficacy to promote lifestyle and recreational physical activity? A systematic review with meta-analysis. *British journal of health psychology*, 15(2), 265-288.
<https://doi.org/10.1348/135910709X461752>
- Barnidge, E. K., Radvanyi, C., Duggan, K., Motton, F., Wiggs, I., Baker, E. A., & Brownson, R. C. (2013). Understanding and addressing barriers to implementation of environmental and policy interventions to support physical activity and healthy eating in rural communities. *The Journal of Rural Health*, 29(1), 97-105.
<https://doi.org/10.1111/j.1748-0361.2012.00431.x>
- Biddle, S. J., Ciaccioni, S., Thomas, G., & Vergeer, I. (2019). Physical activity and mental health in children and adolescents: An updated review of reviews and an analysis of causality. *Psychology of Sport and Exercise*, 42, 146-155.
<https://doi.org/10.1016/j.psychsport.2018.08.011>
- Blackford, K., Jancey, J., Lee, A. H., James, A., Howat, P., & Waddell, T. (2016). Effects of a home-based intervention on diet and physical activity behaviours for rural adults with or at risk of metabolic syndrome: a randomised controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*, 13(1), 13.
<https://doi.org/10.1186/s12966-016-0337-2>
- Brown, W. M., Davison, G. W., McClean, C. M., & Murphy, M. H. (2015). A systematic review of the acute effects of exercise on immune and inflammatory indices in untrained adults. *Sports Medicine - Open*, 1(1), 35. <http://doi.org/10.1186/s40798-015-0032-x>
- Cai, Y., & Richards, E. A. (2016). Systematic review of physical activity outcomes of rural lifestyle interventions. *Western journal of nursing research*, 38(7), 909-927.
<https://doi.org/10.1177/0193945915625922>
- Campbell, J. P., & Turner, J. E. (2018). Debunking the myth of exercise-induced immune suppression: redefining the impact of exercise on immunological health across the lifespan. *Frontiers in Immunology*, 9, 648. <https://doi.org/10.3389/fimmu.2018.00648>
- Campbell, M. K., James, A., Hudson, M. A., Carr, C., Jackson, E., Oakes, V., Demissie, S., Farrell D., & Tessaro, I. (2004). Improving multiple behaviors for colorectal cancer prevention among African American church members. *Health Psychology*, 23, 492-502.
<https://doi.org/10.1037/0278-6133.23.5.492>
- Carson, V., Lee, E. Y., Hewitt, L., Jennings, C., Hunter, S., Kuzik, N., Stearns, J. A., Unrau, S. P., Poitras, V. J., Gray, C., Adamo, K. B., Janssen, I., Okely, A. D., Spence, J.C., Timmons, B. W., Sampson, M., & Tremblay, M. S. (2017). Systematic review of the

- relationships between physical activity and health indicators in the early years (0-4 years). *BMC Public Health*, 17(5), 854. <http://doi.org/10.1186/s12889-017-4860-0>
- Clarke, J., Colley, R., Janssen, I., & Tremblay, M. S. (2019). Accelerometer-measured moderate-to-vigorous physical activity of Canadian adults, 2007 to 2017. *Health Reports*, 30(8), 3-10.
- Cleland, V., Squibb, K., Stephens, L., Dalby, J., Timperio, A., Winzenberg, T., Ball, K., & Dollman, J. (2017). Effectiveness of interventions to promote physical activity and/or decrease sedentary behaviour among rural adults: a systematic review and meta-analysis. *Obesity Reviews*, 18(7), 727-741. <https://doi.org/10.1111/obr.12533>
- Courtin, E., & Knapp, M. (2017). Social isolation, loneliness and health in old age: a scoping review. *Health and Social Care in the Community*, 25(3), 799-812. <https://doi.org/10.1111/hsc.12311>
- Davidson, K. W., Goldstein, M., Kaplan, R. M., Kaufmann, P. G., Knatterud, G. L., Orleans, C. T., Spring, B., Trudeau, K. J., & Whitlock, E. P. (2003). Evidence-based behavioral medicine: what is it and how do we achieve it? *Annals of Behavioral Medicine*, 26(3), 161-171. https://doi.org/10.1207/S15324796ABM2603_01
- Eime, R. M., Young, J. A., Harvey, J. T., Charity, M. J., & Payne, W. R. (2013a). A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model of health through sport. *International Journal of Behavioral Nutrition and Physical Activity*, 10, 98. <http://doi.org/10.1186/1479-5868-10-98>
- Eime, R. M., Young, J. A., Harvey, J. T., Charity, M. J., & Payne, W. R. (2013b). A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model of health through sport. *International Journal of Behavioral Nutrition and Physical Activity*, 10, 98. <http://doi.org/10.1186/1479-5868-10-98>
- Fazelipour, M., & Cunningham, F. (2019). Barriers and facilitators to the implementation of brief interventions targeting smoking, nutrition, and physical activity for indigenous populations: a narrative review. *International journal for equity in health*, 18(1), 169. <https://doi.org/10.1186/s12939-019-1059-2>
- Folta, S. C., Lichtenstein, A. H., Seguin, R. A., Goldberg, J. P., Kuder, J. F., & Nelson, M. E. (2009). The Strong Women-Healthy Hearts program: Reducing cardiovascular disease risk factors in rural sedentary, overweight, and obese midlife and older women. *American Journal of Public Health*, 99, 1271-1277. <http://doi.org/10.2105/ajph.2008.145581>
- French, D. P., Olander, E. K., Chisholm, A., & McSharry, J. (2014). Which behaviour change techniques are most effective at increasing older adults' self-efficacy and physical activity behaviour? A systematic review. *Annals of Behavioral Medicine*, 48(2), 225-34. <https://doi.org/10.1007/s12160-014-9593-z>
- Government of Canada (2018). *Physical activity and your health*. Retrieved from <https://www.canada.ca/en/public-health/services/being-active.html>

- Greaves, C. J., Sheppard, K. E., Abraham, C., Hardeman, W., Roden, M., Evans, P. H., & Schwarz, P. (2011). Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. *BMC Public Health*, 11(1), 1-12. <http://www.biomedcentral.com/1471-2458/11/119>
- Heath, G. W., Brownson, R. C., Kruger, J., Miles, R., Powell, K. E., & Ramsey, L. T. (2006). The effectiveness of urban design and land use and transport policies and practices to increase physical activity: a systematic review. *Journal of Physical Activity and Health*, 3(s1), S55-S76. <https://doi.org/10.1123/jpah.3.s1.s55>
- Heath, G. W., Parra, D. C., Sarmiento, O. L., Andersen, L. B., Owen, N., Goenka, S., Montes, F., Brownson, R. C., & Lancet Physical Activity Series Working Group. (2012). Evidence-based intervention in physical activity: lessons from around the world. *The Lancet*, 380(9838), 272-281. [https://doi.org/10.1016/S0140-6736\(12\)60816-2](https://doi.org/10.1016/S0140-6736(12)60816-2)
- Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., & Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: a meta-analytic review. *Perspectives on Psychological Science*, 10(2), 227-237. <https://doi.org/10.1177/1745691614568352>
- Janssen, I., & LeBlanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *The International Journal of Behavioral Nutrition and Physical Activity*, 7, 40. <http://doi.org/10.1186/1479-5868-7-40>
- Kadariya, S., Gautam, R., & Aro, A. R. (2019). Physical activity, mental health, and wellbeing among older adults in South and Southeast Asia: A scoping review. *BioMed Research International*, 2019, 6752182. <https://doi.org/10.1155/2019/6752182>
- Kahn, E. B., Ramsey, L. T., Brownson, R. C., Heath, G. W., Howze, E. H., Powell, K. E., Stone, E., Rajab, M. W., & Corso, P. (2002). The effectiveness of interventions to increase physical activity: a systematic review. *American Journal of Preventive Medicine*, 22(4), 73-107. [https://doi.org/10.1016/S0749-3797\(02\)00434-8](https://doi.org/10.1016/S0749-3797(02)00434-8)
- Kirby, A. M., Lévesque, L., Wabano, V., & Robertson-Wilson, J. (2007). Perceived community environment and physical activity involvement in a northern-rural Aboriginal community. *International Journal of Behavioral Nutrition and Physical Activity*, 4(1), 63. <http://doi.org/10.1186/1479-5868-4-63>
- Leavy, J. E., Bull, F. C., Rosenberg, M., & Bauman, A. (2011). Physical activity mass media campaigns and their evaluation: a systematic review of the literature 2003–2010. *Health Education Research*, 26(6), 1060-1085. <https://doi.org/10.1093/her/cyr069>
- Lederman, O., Ward, P. B., Firth, J., Maloney, C., Carney, R., Vancampfort, D., Stubbs, B., Kalucy, M., & Rosenbaum, S. (2019). Does exercise improve sleep quality in individuals with mental illness? A systematic review and meta-analysis. *Journal of Psychiatric Research*, 109, 96-106. <https://doi.org/10.1016/j.jpsychires.2018.11.004>
- Macniven, R., Richards, J., Gubhaju, L., Joshy, G., Bauman, A., Banks, E., & Eades, S. (2016). Physical activity, healthy lifestyle behaviors, neighborhood environment characteristics and social support among Australian Aboriginal and non-Aboriginal adults. *Preventive Medicine Reports*, 3, 203-210. <http://dx.doi.org/10.1016/j.pmedr.2016.01.006>

- McDermott, M. S., Oliver, M., Iverson, D., & Sharma, R. (2016). Effective techniques for changing physical activity and healthy eating intentions and behaviour: A systematic review and meta-analysis. *British Journal of Health Psychology*, 21(4), 827-841. <https://doi.org/10.1111/bjhp.12199>
- McEwan, D., Harden, S. M., Zumbo, B. D., Sylvester, B. D., Kaulius, M., Ruissen, G. R., Dowd, J., & Beauchamp, M. R. (2016). The effectiveness of multi-component goal setting interventions for changing physical activity behaviour: a systematic review and meta-analysis. *Health Psychology Review*, 10(1), 67-88. <https://doi.org/10.1080/17437199.2015.1104258>
- Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: a meta-regression. *Health Psychology*, 28(6), 690. <https://doi.org/10.1037/a0016136>
- Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M. P., Cane, J., & Wood, C. E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*, 46(1), 81-95. <https://doi.org/10.1007/s12160-013-9486-6>
- Moore, M., Warburton, J., O'Halloran, P. D., & Shields, N. (2016). Effective community-based physical activity interventions for older adults living in rural and regional areas: a systematic review. *Journal of Aging and Physical Activity*, 24(1), 158-167. <https://doi.org/10.1123/japa.2014-0218>
- Murray, J. M., Brennan, S. F., French, D. P., Patterson, C. C., Kee, F., & Hunter, R. F. (2017). Effectiveness of physical activity interventions in achieving behaviour change maintenance in young and middle aged adults: A systematic review and meta-analysis. *Social Science and Medicine*, 192, 125-133. <https://doi.org/10.1016/j.socscimed.2017.09.021>
- National Institute for Health and Clinical Excellence (2008). Promoting and Creating Built or Natural Environments That Encourage and Support Physical Activity.
- Neuman, M. I., Willett, W. C., & Curhan, G. C. (2010). Physical activity and the risk of community-acquired pneumonia in US women. *The American Journal of Medicine*, 123(3), 281-e7. <https://doi.org/10.1016/j.amjmed.2009.07.028>
- Nieman, D. C. (2011). Moderate exercise improves immunity and decreases illness rates. *American Journal of Lifestyle Medicine*, 5(4), 338-345. <https://doi.org/10.1177/1559827610392876>
- Nieman, D. C., Henson, D. A., Austin, M. D., & Sha, W. (2011). Upper respiratory tract infection is reduced in physically fit and active adults. *British Journal of Sports Medicine*, 45(12), 987-992. <http://dx.doi.org/10.1136/bjism.2010.077875>
- Nocon, M., Müller-Riemenschneider, F., Nitzschke, K., & Willich, S. N. (2010). Increasing physical activity with point-of-choice prompts-a systematic review. *Scandinavian Journal of Public Health*, 38(6), 633-638. <https://doi.org/10.1177/1403494810375865>

- Paterson, D. H., & Warburton, D. E. (2010). Physical activity and functional limitations in older adults: a systematic review related to Canada's Physical Activity Guidelines. *International Journal of Behavioral Nutrition and Physical Activity*, 7(1), 38. <http://www.ijbnpa.org/content/7/1/38>
- Pelletier, C. A., Smith-Forrester, J., & Klassen-Ross, T. (2017). A systematic review of physical activity interventions to improve physical fitness and health outcomes among Indigenous adults living in Canada. *Preventive Medicine Reports*, 8, 242-249. <https://doi.org/10.1016/j.pmedr.2017.11.002>
- Poitras, V. J., Gray, C. E., Borghese, M. M., Carson, V., Chaput, J. P., Janssen, I., Katzmarzyk, P. T., Pate, R. R., Connor Gorbor, S., Kho, M. E., Sampson, M., & Tremblay, M. S. (2016). Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism*, 41(6), S197-S239. <https://doi.org/10.1139/apnm-2015-0663>
- Rebar, A. L., Stanton, R., Geard, D., Short, C., Duncan, M. J., & Vandelanotte, C. (2015). A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. *Health Psychology Review*, 9(3), 366-378. <https://doi.org/10.1080/17437199.2015.1022901>
- Rodriguez-Ayllon, M., Cadenas-Sanchez, C., Estévez-López, F., Muñoz, N. E., Mora-Gonzalez, J., Migueles, J. H., Molina-Garcia, P., Henriksson, H., Mena-Molina, A., Martinez-Vazcaino, V., Catena, A., Lof, M., Erickson, K., Lubans, D. R., Ortega, F., & Esteban-Cornejo, I. (2019). Role of physical activity and sedentary behavior in the mental health of preschoolers, children and adolescents: a systematic review and meta-analysis. *Sports Medicine*, 49, 1383-1410. <https://doi.org/10.1007/s40279-019-01099-5>
- Samdal, G. B., Eide, G. E., Barth, T., Williams, G., & Meland, E. (2017). Effective behaviour change techniques for physical activity and healthy eating in overweight and obese adults; systematic review and meta-regression analyses. *International Journal of Behavioral Nutrition and Physical Activity*, 14(1), 42. <http://doi.org/10.1186/s12966-017-0494-y>
- Strasner, A., Barlow, C. E., Kampert, J. B., & Dunn, A. L. (2001). Impact of physical activity on URTI symptoms in Project PRIME participants. *Medicine and Science in Sports and Exercise*, 33(5), S301.
- Sushames, A., van Uffelen, J. G., & Gebel, K. (2016). Do physical activity interventions in Indigenous people in Australia and New Zealand improve activity levels and health outcomes? A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 13(1), 129. <http://doi.org/10.1186/s12966-016-0455-x>
- Teufel-Shone, N. I., Fitzgerald, C., Teufel-Shone, L., & Gamber, M. (2009). Systematic review of physical activity interventions implemented with American Indian and Alaska Native populations in the United States and Canada. *American Journal of Health Promotion*, 23(6), S8-S32. <https://doi.org/10.4278/ajhp.07053151>
- United States Department of Health and Human Services (2008). Physical activity guidelines advisory committee report. Washington, DC.

- Valtorta, N. K., Kanaan, M., Gilbody, S., Ronzi, S., & Hanratty, B. (2016). Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. *Heart*, 102(13), 1009-1016. <http://dx.doi.org/10.1136/heartjnl-2015-308790>
- Wages, J. G., Jackson, S. F., Bradshaw, M. H., Chang, M., & Estabrooks, P. A. (2010). Different strategies contribute to community physical activity program participation in rural versus metropolitan settings. *American Journal of Health Promotion*, 25(1), 36-39. <https://doi.org/10.4278/ajhp.080729-ARB-143>
- Walsh, N. P., & Oliver, S. J. (2016). Exercise, immune function and respiratory infection: An update on the influence of training and environmental stress. *Immunology and Cell Biology*, 94(2), 132-139. <https://doi.org/10.1038/icb.2015.99>
- Wang, Q., Xu, K. Q., Qin, X. R., & Wang, X. Y. (2016). Association between physical activity and inflammatory bowel disease risk: A meta-analysis. *Digestive and Liver Disease*, 48(12), 1425-1431. <http://dx.doi.org/10.1016/j.dld.2016.08.129>
- Warburton, D. E., Charlesworth, S., Ivey, A., Nettlefold, L., & Bredin, S. S. (2010). A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. *International Journal of Behavioral Nutrition and Physical Activity*, 7(1), 39. <http://doi.org/10.1186/1479-5868-7-39>
- Williams, S. L., & French, D. P. (2011). What are the most effective intervention techniques for changing physical activity self-efficacy and physical activity behaviour—and are they the same? *Health Education Research*, 26(2), 308-322. <https://doi.org/10.1093/her/cyr005>