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Original mixed methods research

Development of a prenatal program for adults with personal histories of childhood abuse or neglect: a Delphi consensus consultation study

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This article has been peer reviewed.

Abstract

Introduction: Pregnancy and the birth of a child present particular challenges for adults with personal histories of childhood abuse or neglect. However, few prenatal interventions address the specific needs of this population. This research aims to determine a list of actions that should be achieved during group interventions designed for expectant parents who experienced childhood trauma.

Methods: Fifteen stakeholders representing nine different Quebec health care and community organizations that work with families and/or trauma survivors participated in a Delphi process in two rounds. In round 1, three project leaders identified, from clinical and empirical literature, a set of 36 actions relevant for expectant parents who experienced childhood trauma. Using an anonymized online survey, stakeholders coded how important they considered each action and whether they were already conducting similar interventions in their clinical setting. Stakeholders subsequently participated in a one-day in-person meeting during which they discussed the pertinence of each action, proposed new ones and refined them. This was followed by a second anonymized online survey (round 2). A consensus was reached among the stakeholders regarding a final list of 22 actions.

Results: Two central clusters of actions emerged from the consultation process: actions aiming to support mentalization about self and parenthood, and actions aiming to support mentalization of trauma.

Conclusion: The Delphi process helped to identify what should be the core of a prenatal intervention targeting adults who experienced childhood trauma, from the viewpoint of professionals who will ultimately deliver such a program.

Keywords: *adult survivors of child adverse events; child maltreatment; parenting; intervention; mentalization; Delphi process*

Highlights

- Childhood abuse or neglect have long-term impacts that persist throughout adulthood and negatively affect the transition to parenthood.
- Few interventions are designed for the numerous adults with histories of childhood abuse and neglect who are expecting.
- Such interventions are of great importance for public health because they could promote the physical and mental health of adults with personal histories of childhood trauma, promote the psychosocial development of their child, and interrupt intergenerational cycles of abuse.
- Stakeholders targeted to offer such a program consider that its primary focus should be to support mentalization of self and parenthood and mentalization of trauma.

Introduction

Pregnancy and the year following childbirth is a critical transitional period—a time of risk and opportunities. The level of adaptation that pregnancy and the birth of a child requires makes this one of the most critical periods for a woman's mental health.[1] Such an important life transition is a challenge even for adults with no apparent biological, psychological, marital or socioeconomic vulnerabilities. The challenge associated with pregnancy or birth may be even more intense for adults who experienced adverse life events, such as childhood abuse or neglect.

There is extensive evidence confirming that childhood abuse and neglect have mental[2,3] and physical health[4,5] consequences that persist into adulthood. Disorders in adults associated with childhood trauma include major depressive disorder, anxiety disorder, conduct disorder, posttraumatic stress disorder, substance use disorder, obesity, arthritis, high blood pressure, migraine headaches, cancer and strokes. Pregnancy and the birth

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of a child may trigger or intensify these latent or apparent disorders.[6]

Pregnant women with personal histories of childhood trauma are at increased risk of significant challenges, pain and distress. They are also at increased risk of having limited access to personal and social protective factors. Expecting a child may resurrect unresolved attachment trauma;[7] such non-mentalized trauma (i.e. trauma that are denied, reported incoherently or for which the victim takes the blame) have been associated with negative feelings towards the baby and motherhood, and difficulties in intimate relationships.[8] Women who experienced childhood trauma report common complaints of pregnancy significantly more often [9] and are more likely to have a high-risk pregnancy.[10,11] In addition, they are more at risk of intimate partner violence than pregnant women who have not experienced childhood trauma.[12,13] They are also at greater risk of trauma-related symptoms, such as dissociation and symptoms of posttraumatic stress disorder,[14] as well as symptoms not specific to trauma, such as anxiety and depression.[15,16]

The strategies often used to regulate intense negative emotions in adults with a history of trauma (e.g. dissociation, avoidance, psychoactive medication, alcohol or drug use/abuse) may actually interfere with parenting or affect the fetus and eventually the child. Women who experienced maltreatment in childhood are more inclined to be isolated during pregnancy[17] and in the years following childbirth,[18] and to report low satisfaction with the social support they receive.[19]

Although the literature on expectant fathers who experienced childhood trauma is scant, we can assume they have similar challenges given that 10% of men in the general population experience significant psychological distress after the birth of a child.[20] Moreover, childhood maltreatment is associated with important long-term consequences in men as well as women.[21]

Risk trajectories associated with early experiences of abuse and neglect may be transmitted from one generation to the next. For instance, early in their development, the majority of children born to a mother with a personal history of abuse or neglect develop insecure attachment strategies (82% vs 38% of the general population) and as many as 44% (vs 15% of the general population) display disorganized/disoriented attachment.[22] Disorganized attachment is a significant precursor of social, intellectual, cognitive, affective and behavioural difficulties.[23,24] Children of mothers with personal histories of trauma are also at greater risk of presenting with developmental problems such as biological anomalies in the physiological regulation of stress[25-27], neurodevelopmental disorders[10] and emotional and behavioural problems.[18,28-30] In addition, empirical evidence supports the notion of intergenerational cycles of childhood maltreatment.[31-33]

Given the high prevalence (32%) of reported child maltreatment in Canada,[21] a significant number of expectant parents have a personal history of abuse or neglect. Considering (1) the multiple challenges expectant parents encounter during the transition to parenthood; (2) the empirical evidence for the intergenerational transmission of risk following childhood trauma; and (3) the fact that intervening soon after birth may already be late as some intergenerational impacts of parental trauma can be identified immediately after birth[25], there is a definite need for prenatal interventions specifically designed for this population. Such interventions should aim to promote the physical and mental health of expectant parents who experienced childhood trauma; promote the psychosocial development of their child; and interrupt intergenerational cycles of abuse and neglect.

Different programs are offered worldwide to support parents considered at "high-risk": the Nurse–Family Partnership,[34] Circle of Security,[35] Early Start[36] or Minding the Baby.[37] The program with the strongest evidence for preventing childhood maltreatment is the Nurse–Family Partnership.[38] All of these programs generally include home visitations and mainly target adults who have difficulties responding to infant needs or who present general risk factors (e.g. adolescent motherhood, poverty, drug use). However, they are not specifically designed to address the particular challenges associated with the experience of childhood trauma or do not evaluate their effects in parents with histories of abuse or neglect.[39]

Conceptualizing specific interventions for this population may be important, as the way adults with histories of abuse or neglect view their experiences plays a distinctive role in their adaptation to parenthood and in the attachment relationship they develop with their child.[8,22] A recent literature review confirmed that there are currently very few perinatal interventions for parents with histories of trauma and that no intervention was evaluated with fathers.[39] Many of the programs listed above are designed to intervene primarily during the postnatal period. Only two programs specifically designed for adults with histories of trauma are delivered primarily during pregnancy: Survivor Moms Companion, a self-help manual,[40] and the Perinatal Child–Parent Psychotherapy,[41] which involves one-on-one psychotherapy. Prenatal interventions are required for different reasons. First, parents are psychologically and physically more available during this period than after the birth of the child. It has been suggested that pregnancy invariably activates internalized attachment representations,[42] making pregnancy an ideal time for clinical approaches that aim to rework internalized object relationships.[43] From a practical stance, parents may be unavailable to participate in interventions after the child's birth, when obligations and responsibilities are numerous. Overall, perinatal interventions for parents who experienced interpersonal traumas in childhood were safe and acceptable to parents, but further research is required.

Sensitive parenting may require that someone has previously been sensitive to the parent's own history and psychological conflicts. Based on this reasoning, prenatal interventions offer the opportunity to sensitively accompany the person in the development of their identity as a parent, while the focus of postnatal interventions can be placed on the child and the parent–child relationship. As well, intervening in the postnatal period, however early, may be considered more therapeutic than preventive as intergenerational impacts of childhood maltreatment are observed immediately after the child's birth[25] and important problems in the mother–child attachment relationship may already be in place at the time of consultation.[22] Prenatal interventions would complement existing postnatal programs in preventing the emergence of difficulties in the parent–child relationship and may help interrupt the intergenerational transmission of risk associated with childhood maltreatment.

Considering the lack of prenatal interventions for adults with personal histories of childhood maltreatment, the aim of the present study was to consult health care providers and community organizations about the actions that should be taken during a prenatal group intervention designed to help expectant parents who experienced childhood trauma.

Methods

Delphi consensus development method

The Delphi consensus development method was used to identify important actions that should be accomplished during a prenatal group intervention for expectant parents who experienced childhood abuse or neglect. The Delphi method is widely used by health care professionals to determine sets of priorities in relation to health practice and research,[44,45] and it has been previously used to establish guidelines on how to support people with personal histories of trauma.[46]

The goal of the Delphi method is to reach a consensus among a panel of experts on a specific domain. Consensus is reached using a series of questionnaires that experts complete in two or more rounds. After each round, the results are summarized and the experts are invited to discuss their responses. A revised questionnaire is then presented and the participants are encouraged to re-evaluate their earlier answers in light of the discussions. This process eventually leads to a decrease in the variance in experts' ratings of priorities in a domain and the achievement of a consensus about a certain number of priorities.

Supporting the transition to and engagement in parenthood (STEP)

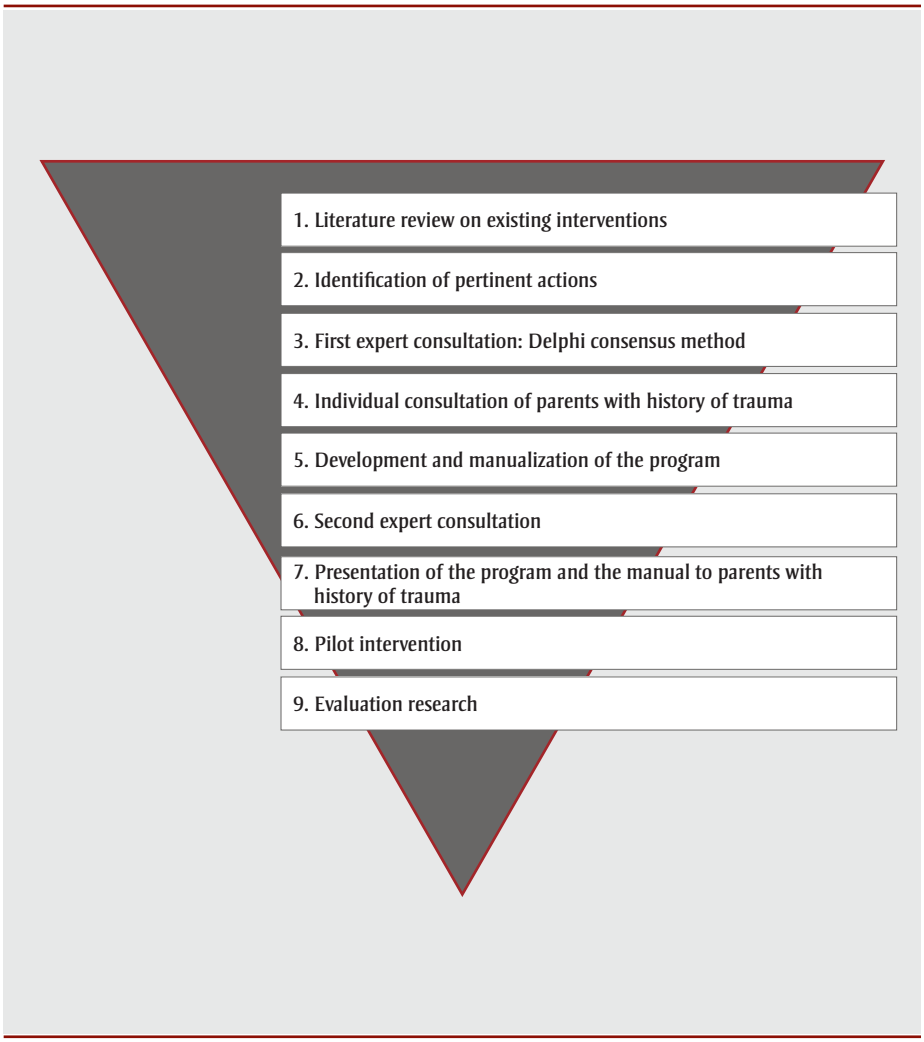
STEP is a clinical research program carried out at the Université du Québec à Trois-Rivières and funded by the Public Health Agency of Canada. The aim is to design, deliver and evaluate an innovative group accompaniment program for expectant parents who experienced interpersonal trauma in childhood. Ultimately, the aim of the program is to (1) promote the physical and mental health of adults with histories of childhood trauma who are transitioning to parenthood; (2) promote the psychosocial development of the program participants' children; and (3) interrupt intergenerational cycles of abuse.

The present study reports on the first steps of the program's development (see Figure 1). The program is designed for adults with histories of abuse or neglect who either do or do not present with or currently experience psychosocial difficulties. The program aims to complement existing interventions and services for expectant parents and promote participation of parents with histories of childhood trauma in such services.

Participants

The research was initiated by three project leaders who are clinical psychologists and researchers in the fields of mental health, child development and parenting. The research also involved 18 partners from 10 independent organizations that offer services to expectant parents, families and/or other adults who experienced childhood trauma. Three of these 18 stakeholders identified themselves as more or less qualified to complete the Delphi consensus development process, but one had to withdraw to take maternity leave. Fifteen professionals from nine organizations participated in the first round of consultations, 15 in the in-person discussions and 14 in the final round of consultations. All participants were francophone and worked in Quebec. Stakeholders were selected by the project leaders for their expertise in childhood trauma; childhood sexual abuse; parental neglect; intimate partner violence; pregnancy, childbirth and delivery; parenting in the context of vulnerabilities; parent–child relationships; fatherhood; prevention of child abuse and neglect; child protection; Indigenous communities; individual psychotherapy with survivors of trauma; group intervention; health care

FIGURE 1
Framework of the development and evaluation of the STEP accompaniment program



Note: The current article reports on steps 1 to 3.

management; community services; health care; and program evaluation. Table 1 provides more information on the participants.

Procedure

After reviewing clinical and empirical literature on parenting interventions and interventions with parents and victims of trauma, the three project leaders first identified a preliminary list of actions to accomplish during a prenatal group intervention with adults with personal histories of childhood trauma. The selected actions had to be particularly pertinent to adults with histories of interpersonal trauma, and sufficiently appropriate and safe to be conducted during pregnancy. Following the team discussions, the project leaders identified six core themes that they determined to be important for expectant parents who are trauma survivors: attachment; mentalization (the ability to think of behaviours in terms of underlying mental states such as emotions, motivations or beliefs); transition to parenthood; emotion regulation; trauma; and social support. A starting list of 36 potential actions covering these core themes was proposed. The preliminary list of actions is presented in Table 2.

The participants in the consultation process were first requested to rate in terms of importance the proposed actions using an anonymized online survey. A five-point Likert scale was used (1 = not important; 2 = somewhat important; 3 = important; 4 = very important; 5 = essential). Participants were also asked to propose additional actions and to identify the extent to which each action was being accomplished in their clinical setting using a five-point Likert scale (1 = different from existing services; 2 = slightly different from existing services; 3 = I don't know if such an action is offered in my clinical setting; 4 = similar to existing services; 5 = identical to existing services).

This first round of the consultation process was followed by a one-day in-person meeting during which the results of the first round were presented and each action was discussed. Participants were invited to comment on their responses, to discuss the feasibility of these interventions and to identify the extent to which they replicate services already available to expectant parents in the participants' own clinical practices. The discussions were recorded and used to refine the actions and to prepare a final list. One week after the meeting, participants received the revised list through a second online survey and were requested to code for a second time the importance they attributed to each action.

Ethical approval for the study was given by the Comité d'éthique de la recherche avec des êtres humains de l'Université du Québec à Trois-Rivières (CER15-226-10.04) and the Comité d'éthique de la recherche du Centre intégré universitaire de santé et de services sociaux de la Mauricie-et-du-Centre-du-Québec (CER2016-016-00).

TABLE 1
Participants in the STEP program development Delphi consensus

Work setting	Training	Primary occupation
Academic	Clinical psychology	Researcher
Academic	Clinical psychology	Researcher
Academic	Clinical psychology	Researcher
Academic	Clinical psychology	Service to the population
Academic	Pediatric nursing	Researcher
Academic	Perinatal nursing	Researcher
Governmental agency	Social work	Service to the population
Governmental agency	Nursing	Coordination of services
Governmental agency	Social work and management	Coordination of services
Governmental agency	Psychoeducation	Coordination of services
Non-governmental organization	Social work	Coordination of services
Non-governmental organization	Psychoeducation	Coordination of services
Non-governmental organization	Social work	Coordination of services
Non-governmental organization	Law	Coordination of services
Non-governmental organization	Psychoeducation	Service to the population
Non-governmental organization	Psychology	Service to the population
Non-governmental organization	Animation and training	Service to the population
Non-governmental organization	Animation and administration	Service to the population
Non-governmental organization	Midwifery	Service to the population

Abbreviation: STEP, Supporting the transition to and engagement in parenthood.

Results

Round 1 (online survey)

A total of 15 stakeholders completed the first round of consultations. The results are presented in Table 2. Overall, each dimension was considered important. Top-ranked themes for discussion included attachment relationships, followed by social support, mentalization, trauma, transition to parenthood and emotional regulation. All actions obtained an average score of over 3, indicating their importance in the context of working with expectant parents who experienced trauma in childhood. While the themes of attachment relationships and social support were rated by the experts as the most important, they were also more likely to be offered in existing services compared with those actions that aim to help people process the trauma and improve mentalization, which appear more innovative.

In-person meeting

Fifteen participants attended the one-day discussion meeting. The relevance, feasibility and implementation of each action were discussed to refine them. Overall, the group agreed on some general considerations. One of those considerations was that all actions that implied a passive role in participants (teaching, informing, etc.) had to be redefined in order to involve participants actively in the intervention and to make sure that the professionals delivering the program do not present themselves as experts with solutions that have to be implemented by the parents. In other words, rather than providing information or teaching skills, the intervention should aim to support participants' sense

TABLE 2
Preliminary list of actions for prenatal group intervention prior to Delphi consensus development

Actions for prenatal group intervention	Importance[a]		Availability[b]	
	Mean	Standard deviation	Mean	Standard deviation
Theme: Attachment relationships	4.40	0.85	3.10	1.02
To discuss the children's emotional needs	4.53	0.74	3.29	1.07
To provide information on the importance of the parent-child attachment relationship (e.g. for the development of the child's sense of security)	4.33	0.98	2.93	1.00
To address strategies to foster the development of a secure attachment relationship between the parent and the child (e.g. to be sensitive to the child's needs)	4.33	0.82	3.07	1.00
Theme: Mentalization	4.12	0.80	2.51	1.16
To help identify the person's strengths as a parent	4.60	0.63	2.86	1.35
To foster the identification of positive parental models in the parent's personal history and of the behaviours that should be reproduced as a parent	4.47	0.64	2.36	1.08
To support reflecting on the person's parental values	4.33	0.62	2.79	1.25
To help identify the person's vulnerabilities as a parent	4.33	0.72	2.64	1.22
To support reflecting on the challenges that the person may encounter in their parental role (e.g. to think about the implications of having a child)	4.33	0.82	2.86	1.29
To anticipate and discuss the specific situations where the child's needs may potentially compete with the parent's needs (e.g. the child needs to be reassured at night when the parent is tired)	4.27	0.88	2.79	1.19
To discuss the importance of the parent reflecting on what goes through the mind of their child (e.g. trying to identify the emotions, desires or intentions behind the behaviour of the child)	4.27	0.96	2.43	1.34
To support the person in the development of a realistic vision of what it is to be a parent (e.g. to understand that it is not possible to be perfect)	4.13	0.74	2.86	1.10
To explain that it is possible to exercise control over our own actions and that this faculty can improve	4.00	0.65	2.36	1.01
To discuss the importance of the parent reflecting on his/her reactions during interactions with the child (e.g. trying to identify their own thoughts and emotions)	3.80	1.08	2.43	1.28
To discuss the ideas that our thoughts do not determine who we are and that it is possible to have thoughts that we won't ever act upon (e.g. briefly thinking about hitting their child does not make the parent abusive)	3.73	0.80	1.93	0.83
To teach the concept of mentalization	3.71	0.73	2.07	1.00
To foster the identification of negative parental models in the parent's personal history and of the behaviours that should not be reproduced as a parent	3.53	1.13	2.29	1.14
Theme: Transition to parenthood	4.07	0.85	2.83	1.10
To give the person an opportunity to voice their reactions to pregnancy and emotions during pregnancy	4.47	0.64	3.21	1.19
To guide the person towards being able to identify the different emotions/reactions that can be triggered by the transition to parenthood (e.g. negative, positive or mixed emotions)	4.20	0.77	2.86	1.10
To bring up troubling emotions or reactions that some expectant parents may experience (e.g., if they have the impression that they will not be emotionally attached to the child)	3.53	1.13	2.43	1.02
Theme: Emotion regulation	3.87	0.85	3.07	0.95
To identify strategies to put in place when the parent will feel overwhelmed in their role	4.53	0.74	3.29	0.99
To support better recognition of the warning signs of emotional/psychological distress	3.80	0.94	3.43	0.85
To teach emotion regulation strategies in the context of parenthood (e.g. relaxation techniques)	3.27	0.88	2.50	1.02

Continued on the following page

TABLE 2 (continued)
Preliminary list of actions for prenatal group intervention prior to Delphi consensus development

Actions for prenatal group intervention	Importance[a]		Availability[b]	
	Mean	Standard deviation	Mean	Standard deviation
Theme: Trauma	4.07	0.87	2.49	1.28
To discuss the importance of protection in order to be safe and keep the child safe (e.g. to help the person to more effectively identify the contexts that will potentially place them at risk or place the child at risk)	4.40	0.74	2.79	1.19
To discuss how the unmet needs and frustrations of the adult victim of childhood maltreatment can emerge in their adult/parenting life (e.g. the need to feel adequate, the need to feel in control)	4.40	0.74	2.43	1.02
To discuss the potential impacts of the trauma on the adult's perception and identity as a parent (e.g. to continue to see himself/herself as a victim, to see the child's behaviours as malevolent)	4.27	0.80	2.50	1.09
To assist the person in identifying the normal childhood needs that were not met during the person's own childhood	4.27	0.88	2.36	1.34
To inform about the potential impacts of trauma in the context of parenting (e.g. fear of repeating the trauma experienced, not being alert to risky situations)	4.20	0.86	2.43	1.40
To discuss the coping strategies often used by victims of maltreatment to protect themselves from the feelings and memories associated with the trauma (e.g. avoidance behaviours)	3.93	0.96	2.43	1.50
To provide information on the impacts of trauma (e.g. biological impacts, intense emotions, negative self-perception and of others, sense of insecurity)	3.80	0.94	2.57	1.45
To discuss the potential harmful effects on the parent and the child of behaviours or strategies commonly used to alleviate trauma-associated distress (e.g. alcohol or drug use/abuse, dissociation, avoidance) and to offer clues for alternative solutions	3.73	0.96	2.50	1.22
To identify the various situations that may cause trauma	3.60	0.99	2.43	1.34
Theme: Social support	4.23	0.73	3.43	0.91
To create an opportunity to seek support from community organizations	4.40	0.63	3.64	1.01
To suggest strategies to reinforce the parent's social network	4.27	0.59	3.64	0.74
To create an opportunity to seek professional support	4.27	0.70	3.64	0.93
To discuss the importance of both parents for the child, even when one is less involved	4.13	0.83	3.36	0.93
To offer strategies to strengthen the parental couple or to discuss how to face the challenges of lone parenting	4.07	0.88	2.86	0.95

[a] Based on a 5-point Likert scale where 1 = not important; 2 = somewhat important; 3 = important; 4 = very important; 5 = essential.

[b] Based on a 5-point Likert scale where 1 = different from existing services; 2 = slightly different from existing services; 3 = I don't know if such an action is offered in my clinical setting; 4 = similar to existing services; 5 = identical to existing services.

of competence and personal agency. Another consideration was that the actions should not try to identify deficiencies, but rather should be formulated as opportunities for self-development for all expectant parents. In other words, the program should be presented as an "accompaniment program" rather than as an "intervention." The group also agreed that the program should listen to and address participants' needs before discussing the children's needs—the focus should first be on the "developing parents" and later on the "developing children." Stimulating sensitive parenting cannot be accomplished without being sensitive to parents' personal history, reality and internal conflicts. In addition, the actions had to be gender-specific rather than gender-neutral, and thus be delivered differently to men and women.

Overall, the group recommended that the program be designed in a way that helps participants gain awareness of their personal strengths and weaknesses; to think, in a compassionate fashion, about how their past experiences influence how they perceive themselves as person and a parent today; and to be sensitive to issues relevant to the experiences of expectant mothers and fathers. As a result, mentalization was reconsidered from being a specific dimension to address with future participants to being the core framework of the intervention. The six themes were thus regrouped in two broader categories: (1) actions with the aim of stimulating participants' mentalization about themselves and their experience of parenthood; and (2) actions with the aim of stimulating participants' mentalization about their adverse life experiences.

Round 2 (online survey)

Actions were refined by the project leaders and a final list of 22 (15 actions on mentalizing self and parenthood and 7 on mentalizing trauma) was sent to the stakeholders in an online survey. Fourteen participants completed this final round anonymously. The results, ranked in order of importance, are presented in Table 3.

TABLE 3
Final list of actions for prenatal group intervention after Delphi consensus development

Overall ranking	Actions for prenatal group intervention	Mean[a]	Standard deviation
Theme 1 – Mentalization of self and parenthood			
1	To discuss the specific situations where the person's needs will potentially compete with the child's needs (e.g. the child is in need of reassurance at night when the parent is tired)	4.50	0.65
3	To support the person in elaborating a realistic version of what it is to be a parent (e.g. to understand it is not possible to be perfect)	4.46	0.66
4	To support reflecting on the signs of emotional distress and to discuss the available forms of support (e.g. emotional, material assistance, coaching, physical assistance, socialization) that are the most appropriate for the person's specific needs	4.43	0.85
5	To guide the person in identifying the different emotions/reactions arising as a response to parenting in general and for this person specifically, and to offer a place to voice opinions on these emotions (negative, positive or mixed emotions)	4.36	0.63
6	To support reflecting on the person's strengths and weaknesses as a parent	4.36	0.50
8	To reflect on the emotional needs of children and what these needs may trigger in the parent in terms of emotions, thoughts and behaviours	4.29	0.61
9	To support reflecting on the typical challenges that parents encounter and to help identify those that this person is inclined to meet in their parental role	4.29	0.83
11	To foster the identification of positive as well as negative parental models in the person's personal history and to reflect on the influence of these models on the person's perception of parenthood and on the future relationship with the child	4.21	0.97
12	To support reflecting on the intentions and motivations underlying the behaviours of the child and to discuss contexts that may influence the person's interpretation of the child behaviours	4.21	0.70
13	To support reflecting on the person's values as a parent	4.14	0.77
14	To support reflecting on the affective, cognitive and behavioural strategies that the person is considering using when feeling destabilized after the arrival of the child	4.14	0.86
17	To support reflecting on the parent's social network	4.00	0.68
18	To support reflecting on the importance of both parents for the child, even when one of them is less involved	3.93	0.83
19	To support reflecting on parents' relationships in the context of parenthood and on the experience of being a lone parent	3.79	0.80
22	To discuss psychological functioning by illustrating its principles with concrete examples (e.g. it is possible to exercise control over our own actions and that this faculty can be improved; our thoughts do not determine who we are, and it is possible to have thoughts that we won't ever act upon)	3.57	1.09
Theme 2 – Mentalization of trauma			
2	To discuss the potential impacts of trauma in the context of parenting (e.g. fear of repeating the trauma)	4.50	0.65
7	To stimulate the potential to reach out for help and for community services support	4.36	0.74
10	To discuss the coping strategies often used by victims of maltreatment to protect themselves from the feelings and memories associated with the trauma (e.g. avoidance behaviours), and to identify how the typical challenges of parenthood may exacerbate or interfere with the use of such strategies	4.29	0.91
15	To support reflecting on the contexts that may potentially be a risk for the parent's and for the child's security	4.14	0.77
16	To support identifying the normal childhood needs that were not met during the person's own childhood. To discuss how these unmet needs can affect typical parenthood challenges (e.g. difficulty in tolerating the child's dependency or, eventually, their developing autonomy)	4.07	0.83
20	To identify the various situations that may cause trauma	3.79	1.12
21	To support a discussion on the impacts of trauma on diverse spheres of functioning (e.g. biological impacts, intense emotions, negative self-perception, sense of insecurity)	3.79	1.12

[a] Based on a 5-point Likert scale where 1 = not important; 2 = somewhat important; 3 = important; 4 = very important; 5 = essential.

Overall, all actions were considered important.

Discussion

The aim of the present study was to consult with health care providers and community organizations about the actions that should be accomplished by prenatal group programs designed to help adults with personal histories of childhood trauma.

The research led to three main observations. First, we identified very few prenatal interventions specifically designed for expectant women and men who have personal histories of abuse or neglect, despite the long-term and intergenerational consequences associated with these adverse childhood experiences.[39] Second, our results confirm that health care providers and community organizations consider such an intervention important and a valuable addition to the services they already offer to victims of abuse or expectant parents. Third, the mentalization framework should be considered when developing such a program, with actions aimed at supporting participants' mentalization of their experience of parenthood and mentalization of their adverse childhood experiences.

A focus on mentalization is in accordance with recent clinical and empirical literature. Mentalization-based interventions integrate psychodynamic, cognitive and neurodevelopmental theories.[47,48] Mentalization-based approaches typically aim to reinforce participants' ability to think of their behaviours and those of others (for instance, their baby) in terms of mental states. While empirical evidence confirms the efficacy of such interventions among adults with severe psychological difficulties[49] and among parents of young children,[50] the interventions have never been specifically adapted for expectant parents with personal histories of childhood trauma. Enhancing mentalization could play a major protective role in parents who experienced childhood trauma: mentalization abilities in pregnant women with personal histories of childhood abuse correlate with their engagement in parenthood and with the quality of their couple relationship during pregnancy[8] and predict the quality of the attachment relationship they develop with their baby.[22] However, enhancing mentalization in parents for whom the normal development of this ability was disturbed by adverse life circumstances is complex and calls for specific adaptations.[51]

This study adds to the literature on the provision of an empirically and clinically grounded framework for the development of a prenatal accompaniment program aimed at expectant parents who experienced childhood abuse or neglect. The actions identified by the stakeholders during this Delphi process differ from what currently exists in terms of prenatal psychosocial interventions in Quebec. The principal aim of many of the programs offered to the general population is to provide information on pregnancy, child development and child care. These programs, which are mainly informed by social learning theories, focus on enhancing knowledge, skills and confidence in parents through role models, practical exercises and feedback.[52] Several prenatal programs have been designed for at-risk parents, and many have been shown to lead to significant improvement in parental functioning and to positive outcomes for children.[39,52-54]

However, to the best of our knowledge, few interventions specifically address the unique needs of parents with personal histories of trauma or use a theory of trauma as conceptual framework. Even parenting interventions aimed at preventing childhood maltreatment and trauma are rarely informed by trauma theories.[55] In other words, these programs do not consider the challenges that face people who grow up in environments where their needs or vulnerabilities were neither considered nor respected in becoming parents and participating in psychosocial interventions.

Public and community services for parents and children represent an institutional space within which several approaches or perspectives coexist. Some of these are contradictory in the actions they offer to families. The implementation of a new service model for expectant parents with histories of trauma must consider this institutional complexity.

Limitations

This study had some limitations. First, the priorities presented here reflect the perspective of stakeholders in health care and from community organizations and may not reflect the position of adults who will ultimately benefit from such psychosocial programs. Our team is investigating the points of view and specific needs in terms of prenatal interventions of adults with personal histories of childhood trauma. Second, the panel of professionals recruited for this research reflects the diverse range of services offered to victims of abuse or neglect or expectant parents in the region where the study was conducted. A panel recruited elsewhere may have identified other priorities. Third, despite that having 15 professionals involved in this process is a considerable success, the number of participants is relatively small.

Conclusions

To the best of our knowledge, this paper articulates the first set of priorities for a clinical program aimed at supporting expectant parents with personal histories of childhood trauma. This set of priorities will represent the framework for STEP, a prenatal group program currently under development that, once evaluated and implemented, will be offered to women and men who experienced childhood abuse and neglect. This program may contribute to promoting the physical and mental health of adults with personal histories of childhood trauma who are transitioning to parenthood; promoting the psychosocial development of their children; and interrupting intergenerational cycles of abuse.

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Conflict of interest

The authors have no conflict of interest

Authors's contributions and statement

NB contributed to the design and conceptualization of the study; to the acquisition, analysis and interpretation of the data; and to drafting the paper. RL contributed to the design and conceptualization of the

study; to the acquisition, analysis and interpretation of the data; and to revising the paper. CL contributed to the design and conceptualization of the study; to the acquisition of the data; and to revising the paper.

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Original quantitative research

Factors associated with sleep duration across life stages: results from the Canadian Health Measures Survey

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Abstract

Introduction: Sleep is essential for both physical and mental well-being. This study investigated sociodemographic, lifestyle/behavioural, environmental, psychosocial and health factors associated with sleep duration among Canadians at different life stages.

Methods: We analyzed nationally representative data from 12 174 Canadians aged 3–79 years in the Canadian Health Measures Survey (2009–2013). Respondents were grouped into five life stages by age in years: preschoolers (3–4), children (5–13), youth (14–17), adults (18–64) and older adults (65–79). Sleep duration was classified into three categories (recommended, short and long) according to established guidelines. Logistic regression models were used to identify life stage–specific correlates of short and long sleep.

Results: The proportion of Canadians getting the recommended amount of sleep decreased with age, from 81% of preschoolers to 53% of older adults. Statistically significant factors associated with short sleep included being non-White and having low household income among preschoolers; being non-White and living in a lone-parent household among children; and second-hand smoke exposure among youth. Boys with a learning disability or an attention-deficit/hyperactivity disorder and sedentary male youth had significantly higher odds of short sleep. Among adults and older adults, both chronic stress and arthritis were associated with short sleep. Conversely, mood disorder and poor/fair self-perceived general health in adults and weak sense of community belonging in adults and older men were associated with long sleep.

Conclusion: Our population-based study identified a wide range of factors associated with short and long sleep at different life stages. This may have implications for interventions aimed at promoting healthy sleep duration.

Keywords: *sleep, life stages, preschoolers, children, youth, adults, older adults*

Highlights

- A large proportion of Canadians across all life stages do not get the recommended amount of sleep.
- This population-based study identified a wide range of factors associated with sleep duration at different life stages.
- Sociodemographic factors, such as non-White ethnicity, low household income and living in a lone-parent household, are associated with short sleep in younger children.
- Second-hand smoke exposure is associated with short sleep in youth.
- Psychosocial and health-related factors, such as arthritis, chronic stress, self-perceived health, mood disorder, and sense of community belonging, are associated with short and/or long sleep in adults and older adults.

Introduction

Sleep is essential for the promotion and maintenance of health across all stages of life.[1] However, sleep deprivation has become highly prevalent in modern societies.[1,2] For example, recent national surveys in Canada showed that approximately 20–30% of children and adolescents [3,4] and one-third of adults and older adults [5] sleep less than the recommended amount for their age.

Insufficient sleep has been linked to a number of adverse physical and mental health outcomes, including obesity, diabetes, cardiovascular disease, injuries, anxiety, depression, neurological disorders and all-cause mortality.[2] In addition, sleep loss and related disorders contribute to substantial societal and economic burdens resulting from productivity losses and health care costs.[6,7] There is some evidence suggesting a U-shaped relationship between sleep duration and health outcomes, where both short and long sleep,

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especially among adults, are associated with increased risk of chronic diseases.[8-10] A 2016 systematic review found that shorter sleep in children and youth was associated with excess adiposity, lower quality of life/well-being, and poorer emotional regulation and academic achievement.[11]

Despite the growing evidence on the health consequences of short (and long) sleep, public health research and education has paid relatively little attention to sleep compared to other health-related behaviours (e.g., diet, physical activity).[1] To better identify targets for interventions aimed at improving sleep, an understanding of factors associated with sleep duration is warranted.

In addition to genetic and physiological factors, sleep duration is likely affected by a combination of behavioural, psychological, social, cultural and environmental factors.[12] Studies in various countries have explored potential correlates of sleep duration among children,[13-18] adolescents[18-21] and adults.[22-26] For example, sociodemographic factors, such as ethnicity, parental education and household income,[17-19] as well as lifestyle factors, especially screen time (e.g., television, computer),[15-17,20,21] have been identified as important correlates of sleep duration among children and adolescents. In adults, additional sociodemographic correlates, including employment and marital status, as well as various factors related to lifestyle (e.g., physical activity, smoking) and physical and mental health (e.g., self-rated general health, depression, chronic conditions) were found to affect sleep duration.[22-26]

To the best of our knowledge, there has not been a detailed assessment of factors associated with sleep duration in the general Canadian population. Given cross-cultural differences in sleep duration and its correlates,[26-28] identifying determinants of sleep duration in the Canadian context may have important implications for informing the development of future intervention strategies aimed at improving sleep. Furthermore, despite age-related differences in sleep needs and patterns,[2] previous studies have not comprehensively examined life stage–specific associations between potential correlates and sleep duration within a single population. Hence, the objective of this study was to investigate sociodemographic, lifestyle/behavioural, environmental, psychosocial and health factors associated with short and long duration of sleep among Canadians at different life stages.

Methods

Data source and study population

This study utilized data from the Canadian Health Measures Survey (CHMS), cycles 2 (2009–2011) and 3 (2012–2013). Details of the CHMS have been described elsewhere.[29,30] Briefly, the CHMS is an ongoing cross-sectional survey that uses a multistage stratified sampling design to collect nationally representative data from the Canadian household population 3–79 years of age. Residents of the three territories, people living on reserves or other Aboriginal settlements, full-time members of the Canadian Forces and residents of institutions and certain remote regions were excluded from the sampling frame. The sample for each cycle represented approximately 96% of the Canadian population in the target age range. The combined (household- and person-level) response rates were 55.5% and 51.7% for cycles 2 and 3, respectively.

The CHMS consists of an in-home household interview that collects information on various sociodemographic, lifestyle and health characteristics, followed by a visit to a mobile examination centre to take direct physical measures (e.g., height, weight). Written informed consent was obtained from respondents aged 14 years and older or from parents/guardians of those younger than 14 years who gave permission to participate. All processes of the CHMS were reviewed and approved by Health Canada and the Public Health Agency of Canada Research Ethics Board.

Analyses for this study were based on all respondents within the target age range (3–79 years) of the CHMS (cycle 2: n = 6395; cycle 3: n = 5785). Data from two survey cycles were pooled to increase sample size and precision of estimates. To keep consistency of the age groupings, cycle 1 (which covered 6–79 year-olds only) was not included in our analysis. Respondents with missing data on sleep duration (n = 6) were excluded, yielding a sample size of 12 174 respondents. To examine sleep duration and its correlates separately by life stage, respondents were grouped into five age categories, including preschoolers (3–4 years), children (5–13 years), youth (14–17 years), adults (18–64 years) and older adults (65–79 years), consistent with existing sleep duration recommendations.[31-33]

Sleep duration

During the household interview, respondents (or parents/guardians for those aged less than 12 years) were asked to report the number of hours (to the nearest half hour) in a 24-hour period they usually spend sleeping, excluding time spent resting. Respondents were classified into three sleep duration categories (recommended, short or long) according to the *Canadian 24-Hour Movement Guidelines for the Early Years* (preschoolers),[31] the *Canadian 24-Hour Movement Guidelines for Children and Youth* (children and youth),[32] and the United States National Sleep Foundation's sleep time duration recommendations (adults and older adults).[33] The recommended hours of daily sleep were 10–13 hours/day for preschoolers, 9–11 hours/day for children, 8–10 hours/day for youth, 7–9 hours/day for adults and 7–8 hours/day for older adults.[31-33] Respondents with sleep durations shorter or longer than the recommended range were classified as "short sleepers" or "long sleepers," respectively.

Correlates

Potential correlates of sleep duration were identified from the existing literature[13-26] as applicable to each age group.

Sociodemographic factors included age (years); sex (male or female); ethnicity (White or non-White); highest level of education (less than secondary school degree, secondary school degree or post-secondary school degree) attained in the household for preschoolers, children and youth or by the respondent for adults and older adults; household type (no children < 18 years of age, couple with children < 18 years or lone-parent with children < 18 years); and household income adequacy. Based on total annual household income and number of people living in the household, household income adequacy was categorized as low (< $30 000 for 1–2 people, < $40 000 for 3–4 people, < $60 000 for ≥5 people); middle ($30 000–$59 999 for 1–2 people, $40 000–$79 999 for 3–4 people, $60 000–$79 999 for ≥ 5 people); or high (≥ $60 000 for 1–2 people, ≥ $80 000 for ≥ 3 people).[34] We also examined marital status (married/common-law, divorced/separated, widowed or

TABLE 1
Characteristics of the study population, by age group, 2009–2013, Canadian Health Measures Survey

Characteristics	Age group (years)				
	Preschoolers (3–4)	Children (5–13)	Youth (14–17)	Adults (18–64)	Older adults (65–79)
Total unweighted, *n*	802	3 030	1 092	5 905	1 345
Age (years), mean (SE)	3.5 (0.03)	9.0 (0.08)	15.5 (0.07)	41.3 (0.23)	70.6 (0.20)
Sex, female (%)	47.8	48.9	47.7	50.4	52.5
Ethnicity, non-White (%)	35.8	34.0	30.9	25.3	12.4[E]
Highest level of education[a] (%)					
Post-secondary degree	81.4	83.8	80.6	62.8	49.6
Secondary school degree	12.4	12.1	14.3	26.9	19.5
Less than secondary school	6.2[E]	4.1	5.1[E]	10.3	30.9
Household income adequacy (%)					
High	45.7	47.0	53.9	51.7	33.2
Middle	24.0	26.9	26.7	28.0	39.7
Low	30.3	26.1	19.4	20.3	27.1
Household type (%)					
No children <18 years	NA	NA	NA	65.4	98.7
Couple with children <18 years	84.1	81.3	75.6	29.9	—[F]
Lone-parent with children <18 years	15.9	18.7	24.4	4.7	—[F]
Marital status (%)					
Married/common-law	NA	NA	NA	62.3	70.1
Divorced/separated				8.0	10.3
Widowed				1.4	16.1
Single (never married)				28.2	3.5[E]
Employment status (%)					
Full-time	NA	NA	NA	65.6	9.8
Part-time				17.9	9.4
Unemployed				16.5	80.8
Physical activity guideline adherence[b] (%)					
Yes	76.9	44.3	23.0	19.2	10.0
No	23.1	55.7	77.0	80.8	90.0
Screen time–based sedentary behaviour guideline adherence[c] (%)					
Yes	19.9	30.1	27.6	37.0	26.1
No	80.1	69.9	72.4	63.0	73.9
Second-hand smoke exposure at home (%)					
No	96.3	92.5	88.1	NA	NA
Yes (every day or almost every day)	3.7[E]	7.5	11.9		
Smoking status (%)					
Never	NA	NA	88.3	52.0	41.1
Former			—[F]	24.7	46.7
Current			10.4	23.3	12.3
Alcohol consumption (%)					
Non-drinker	NA	NA	47.2	16.7	23.0
< once per week			45.3	33.9	28.5
1–6 times per week			7.4	41.4	31.6
Daily			—[F]	8.0	16.8

Continued on the following page

TABLE 1 (continued)
Characteristics of the study population, by age group, 2009–2013, Canadian Health Measures Survey

Characteristics	Age group (years)				
	Preschoolers (3–4)	Children (5–13)	Youth (14–17)	Adults (18–64)	Older adults (65–79)
Self-perceived mental health (%)					
Excellent/very good			75.5	70.7	69.8
Good	NA	NA	19.5	22.0	25.6
Poor/fair			5.0[E]	7.3	4.6[E]
Sense of community belonging (%)					
Strong	NA	NA	77.9	61.8	77.9
Weak			22.1	38.2	22.1
Chronic stress (%)					
No	NA	NA	NA	74.6	89.6
Yes				25.4	10.4
Self-perceived general health (%)					
Excellent/very good	84.4	81.6	59.8	53.1	45.7
Good	15.2	16.4	33.7	35.7	38.2
Poor/fair	—[F]	2.0[E]	6.5[E]	11.1	16.1
BMI, 3–4 years (%)					
Thin/normal	66.6				
At risk of overweight	23.9	NA	NA	NA	NA
Overweight/obese	9.5[E]				
BMI, ≥5 years (%)					
Underweight	NA	1.8[E]	—[F]	1.9	1.3[E]
Normal		66.7	65.9	38.8	23.8
Overweight		20.3	17.8	33.6	44.4
Obese		11.1	14.2	25.7	30.5
Chronic conditions (%)					
Learning disability/ADHD	1.4[E]	9.4	13.2	NA	NA
Mood disorder	NA	NA	3.9[E]	11.9	8.1
Asthma	8.7[E]	11.4	15.9	10.2	7.2
COPD	NA	NA	NA	2.4	5.9
Arthritis	NA	NA	NA	11.8	43.7
Osteoporosis	NA	NA	NA	3.4	15.2
Diabetes	NA	NA	NA	4.5	16.9
Hypertension	NA	NA	NA	17.9	61.6
Heart disease	NA	NA	NA	2.7	17.2
Stroke	NA	NA	NA	0.7[E]	3.5[E]
Cancer	NA	NA	NA	1.3[E]	3.1[E]
Thyroid condition	NA	NA	NA	6.1	12.5
Kidney disease	NA	NA	NA	1.6	3.4[E]
Liver/gallbladder disease	NA	NA	NA	2.5	2.3[E]

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; BMI, body mass index; COPD, chronic obstructive pulmonary disease; NA, not applicable; SE, standard error.

Note: Means and percentages were weighted using sampling weights.

[a] Highest level of education attained in the household (for preschoolers, children and youth) or by the respondent (for adults and older adults).

[b] Preschoolers: ≥180 min/day of physical activity (any intensity); children and youth: ≥60 min/day of moderate-to-vigorous physical activity; adults and older adults: ≥150 min/week of moderate-to-vigorous physical activity, in bouts of ≥10 min. Based on respondents with ≥4 valid days of accelerometer data.

[c] Recreational screen time of ≤1 h/day for preschoolers and ≤2 h/day for all other age groups.

[E] Interpret with caution (coefficient of variation is between 16.6% and 33.3%).

[F] Data do not meet Statistics Canada's guidelines for release due to extreme variability (coefficient of variation > 33.3%).

single/never married) and employment status (full-time [≥30 hours/week], part-time [< 30 hours/week] or unemployed) among adults and older adults.

Lifestyle/behavioural and environmental factors included physical activity, screen time–based sedentary behaviour, active and/or passive smoking and alcohol consumption.

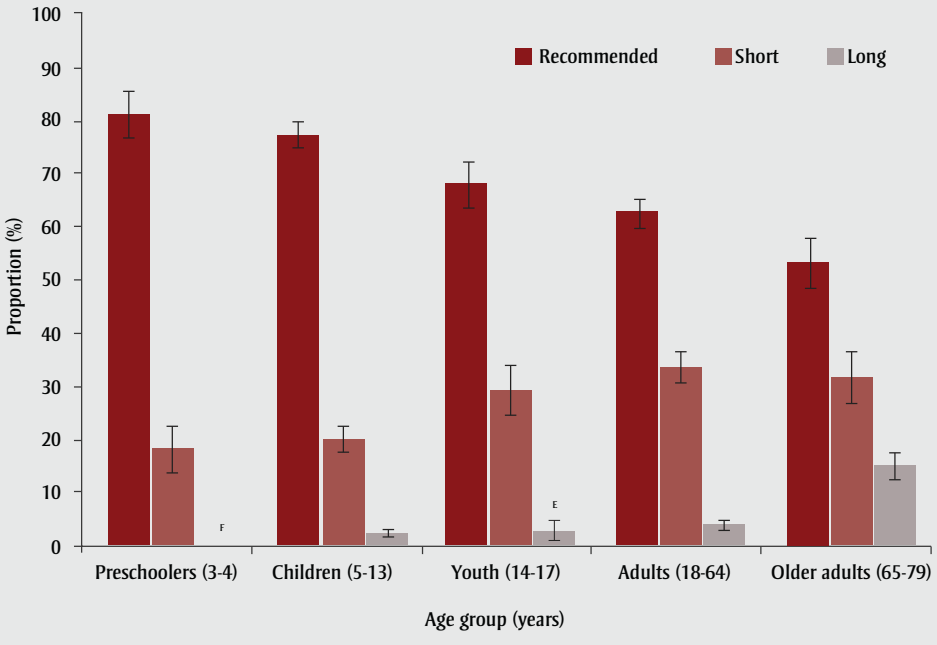
For consistency with sleep duration, we assessed physical activity and sedentary behaviour based on adherence to current Canadian guidelines.[31,32,35] Physical activity was objectively measured using an activity monitor (Actical accelerometer) worn by respondents for 7 days following the mobile examination centre visit. Only respondents with 4 or more valid days of accelerometer data (i.e., wear time of ≥ 10 hours [≥ 5 hours for 3–5 year-olds] each day)[30] (~75%) were assessed for guideline adherence; those with less than 4 valid days were included as a separate "missing" category for the logistic regression analysis. Preschoolers who accumulated 180 or more minutes of physical activity (any intensity) per day,[31] children and youth who accumulated 60 or more minutes of moderate-to-vigorous physical activity per day,[32] and adults and older adults who accumulated 150 or more minutes of moderate-to-vigorous physical activity (in bouts ≥10 minutes) per week[35] were considered to have met the guidelines. Sedentary behaviour was assessed based on parent/guardian- or self-reported recreational screen time (i.e., watching television, playing video games and/or using a computer during leisure-time), with adherence defined as 1 hour/day or less for preschoolers[31] and 2 hours/day or less for all other age groups.[32,35]

Passive smoking among preschoolers, children and youth was defined as regular (i.e., every day or almost every day) exposure to second-hand smoke at home. Smoking status (never, former or current) and alcohol consumption (non-drinker, less than once per week, 1–6 times per week or daily) were examined in youth, adults and older adults.

We assessed psychosocial factors, including self-perceived mental health (excellent/very good, good or poor/fair) and sense of belonging to the local community (strong or weak) among youth, adults and older adults. We also examined self-perceived chronic stress (yes [extremely or quite a bit stressful in life] or no [a bit, not very or not at all stressful in life]) in adults and older adults.

Health factors included self- or parent/guardian-perceived general health (excellent/very good, good or poor/fair); body mass index, derived from directly measured weight and height and categorized according to standard World Health Organization cut-offs appropriate for each age group;[36-38] and presence of each of the following self-reported, health professional–diagnosed chronic conditions: mood disorder, asthma, chronic obstructive pulmonary disease, arthritis, osteoporosis, diabetes, hypertension, heart disease, stroke, cancer, thyroid condition, kidney disease and liver/gall bladder disease. Due to the low prevalence of most chronic conditions among preschoolers, children and youth, we only examined asthma in these age groups and mood disorder in youth. We also examined learning disability or attention-deficit/hyperactivity disorder (ADHD) among preschoolers, children and youth.

FIGURE 1
Proportion of the population in different sleep duration categories, by age group, 2009–2013, Canadian Health Measures Survey



Notes: Error bars represent 95% confidence intervals.
The recommended number of hours of sleep per day are 10–13 for preschoolers, 9–11 for children, 8–10 for youth, 7–9 for adults and 7–8 for older adults.[31-33] Sleep durations shorter or longer than the recommended range are classified as "short" or "long," respectively.

[E] Interpret with caution (coefficient of variation is between 16.6% and 33.3%).

[F] Data do not meet Statistics Canada's guidelines for release due to extreme variability (coefficient of variation >33.3%).

Statistical analysis

To account for the complex sampling design of the CHMS, sampling weights were used in all of our analyses, and variance estimates were obtained using the bootstrap method.[31,32] All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

First, we conducted descriptive analyses to examine the distribution of all variables of interest in the study population and to estimate the proportion of the population in each of the three sleep duration categories, by age group. Next, we used univariable logistic regression to estimate unadjusted associations between potential correlates and short (vs. recommended) sleep duration in each age group, as well as long (vs. recommended) sleep duration in adults and older adults. Because of the small numbers of long sleepers among preschoolers (n < 10; < 1%), children (n = 91; 2%) and youth (n = 29; 3%), we did not model long sleep as an outcome in these age groups. Variables that were statistically significant at p < .20 in the univariable analyses were selected as candidates for inclusion in multivariable models and were retained if they remained significant at p < .20, or if removing them resulted in greater than 10% change in the odds ratio (OR) for any of the other variables.[39,40] Age and sex were retained in all multivariable models regardless of statistical significance. We also evaluated potential interactions with sex by including product terms (sex × correlate), which were retained in the final model if statistically significant at p < .05, in which case effect estimates were reported separately for males and females. Respondents with missing data on any of the variables (< 5%) were excluded from the logistic regression analysis to ensure equal samples used for model building.

Results

Characteristics of participants in each age group are shown in Table 1. The study sample (n = 12 174) represented approximately 31.6 million Canadians aged 3–79 years. The proportion of Canadians who slept for the recommended amount of time decreased across life stages (p-trend < .001), from 81% of preschoolers and 77% of children to 68%, 63% and 53% of youth, adults and older adults, respectively (Figure 1). The prevalence of short sleep duration increased from

TABLE 2
Crude (unadjusted) logistic regression models for correlates of short (vs. recommended) sleep duration in preschoolers, children and youth

	Preschoolers (3–4 years old)		Children (5–13 years old)		Youth (14–17 years old)	
Correlates	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Age, per 1-year increase	0.86	0.47–1.59	1.30	1.18–1.44	1.23	1.03–1.48
Sex						
Male	1.00	Ref	1.00	Ref	1.00	Ref
Female	1.43	0.85–2.41	1.18	0.84–1.66	1.33	0.87–2.04
Ethnicity						
White	1.00	Ref	1.00	Ref	1.00	Ref
Non-White	2.46	1.33–4.53	1.68	1.13–2.49	0.90	0.45–1.79
Highest household education level						
Post-secondary degree	1.00	Ref	1.00	Ref	1.00	Ref
Secondary school degree	1.45	0.68–3.10	1.16	0.62–2.14	1.40	0.84–2.34
Less than secondary school	4.54	0.66–31.4	1.39	0.67–2.88	0.45	0.10–2.12
Household income adequacy						
High	1.00	Ref	1.00	Ref	1.00	Ref
Middle	1.06	0.55–2.05	1.38	0.89–2.15	0.79	0.43–1.44
Low	2.87	1.64–5.03	1.63	1.04–2.56	0.87	0.43–1.76
Household type						
Couple	1.00	Ref	1.00	Ref	1.00	Ref
Lone parent	0.99	0.44–2.22	1.70	1.05–2.75	1.04	0.57–1.88
Physical activity guideline adherence						
Yes	1.00	Ref	1.00	Ref	1.00	Ref
No	0.82	0.43–1.56	1.39	0.93–2.07	0.99	0.47–2.12
Screen time–based sedentary behaviour guideline adherence						
Yes	1.00	Ref	1.00	Ref	1.00	Ref
No	1.28	0.63–2.59	1.60	1.09–2.34	1.55	0.70–3.46
Second-hand smoke exposure at home						
No	1.00	Ref	1.00	Ref	1.00	Ref
Yes (every day/almost every day)	2.01	0.58–6.91	1.70	0.84–3.42	2.00	1.00–4.00
Current smoker						
No		NA		NA	1.00	Ref
Yes					1.44	0.63–3.31
Alcohol consumption						
Non-drinker					1.00	Ref
Less than once per week		NA		NA	1.36	0.83–2.24
At least once per week					1.63	0.53–5.06
Self-perceived mental health						
Excellent/very good					1.00	Ref
Good		NA		NA	1.09	0.58–2.04
Poor/fair					1.72	0.66–4.47
Sense of community belonging						
Strong		NA		NA	1.00	Ref
Weak					1.42	0.81–2.51

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TABLE 2 (continued)
Crude (unadjusted) logistic regression models for correlates of short (vs. recommended) sleep duration in preschoolers, children and youth

	Preschoolers (3–4 years old)		Children (5–13 years old)		Youth (14–17 years old)	
Correlates	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Self-perceived general health						
Excellent/very good	1.00	Ref	1.00	Ref	1.00	Ref
Good	1.22[a]	0.54–2.73	1.80	1.00–3.13	1.06	0.59–1.89
Poor/fair			0.91	0.32–2.61	1.44	0.66–3.14
BMI, 3–4 years						
Thin/normal	1.00	Ref				
At risk of overweight	1.07	0.56–2.03	NA		NA	
Overweight/obese	1.05	0.28–4.01				
BMI, ≥5 years						
Underweight			0.77	0.19–3.21	0.60	0.02–17.8
Normal	NA		1.00	Ref	1.00	Ref
Overweight			1.51	0.95–2.41	0.93	0.51–1.69
Obese			1.75	1.04–2.95	1.37	0.59–3.19
Asthma						
No	1.00	Ref	1.00	Ref	1.00	Ref
Yes	0.64	0.19–2.19	1.14	0.67–1.94	1.36	0.68–2.74
Learning disability/ADHD						
No	1.00	Ref	1.00	Ref	1.00	Ref
Yes	1.10	0.001–994.2	1.75	0.95–3.25	1.29	0.64–2.63
Mood disorder						
No	NA		NA		1.00	Ref
Yes					2.67	1.05–6.83

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; BMI, body mass index; CI, confidence interval; NA, not applicable; OR, odds ratio; Ref, reference category.

[a] Due to small cell sizes, the two categories ("good" and "poor/fair") were combined in the analysis for preschoolers.

approximately 20% in preschoolers and children to 29% in youth and 34% in adults and 32% in older adults. Less than 5% of Canadians in each age group reported sleeping longer than the recommended range, with the exception of older adults (15%).

Unadjusted associations between potential correlates and short and long sleep are shown in Tables 2 and 3.

Table 4 presents life stage–specific multivariable models for correlates of short sleep. Among preschoolers, ethnicity (non-White vs. White; OR = 1.94, 95% confidence interval [CI]: 1.03–3.65) and household income adequacy (low vs. high; OR = 2.59, 95% CI: 1.12–5.65) were significantly associated with short sleep. Children who were non-White (OR = 2.08, 95% CI: 1.42–3.04) or living in a lone-parent household (OR = 1.76, 95% CI: 1.07–2.91), as well as youth regularly exposed to second-hand smoke at home (OR = 2.54, 95% CI: 1.25–5.16), had significantly higher odds of short sleep. In addition, interactions with sex ($p < .05$) were noted for learning disability/ADHD in children and screen time–based sedentary behaviour in youth, with significant associations observed among boys only. Chronic stress in both adults (OR = 1.63, 95% CI: 1.14–2.33) and older adults (OR = 1.95, 95% CI: 1.01–3.87); arthritis in both adults (OR = 1.53, 95% CI: 1.08–2.16) and older adults (OR = 1.42, 95% CI: 1.01–1.98); being non-White (OR = 1.41, 95% CI: 1.11–1.79) and having poor/fair self-perceived mental health (OR = 1.82, 95% CI: 1.24–2.69) in adults; and less than secondary school education (OR = 1.83, 95% CI: 1.22–2.75) in older adults were all significantly associated with short sleep (Table 4). Conversely, female (vs. male) adults (OR = 0.76, 95% CI: 0.59–0.98) and older adults who were unemployed (OR = 0.46, 95% CI: 0.22–0.96) or employed part-time (OR = 0.40, 95% CI: 0.18–0.87) and those with a mood disorder (OR = 0.46, 95% CI: 0.25–0.85) were less likely to have short sleep.

Table 5 presents multivariable models for correlates of long sleep among adults and older adults. In both age groups, less than secondary school education (vs. post-secondary degree) was significantly associated with long sleep. Adults living as a couple with children younger than 18 years (vs. no children) were less likely (OR = 0.41, 95% CI: 0.17–0.96) to have longer sleep than the recommended duration, while unemployed (vs. employed) older adults were more likely (OR = 3.52, 95% CI: 1.02–12.2) to sleep longer than the recommended duration. A weak sense of community belonging (OR = 2.09, 95% CI: 1.21–3.61), poor/fair self-perceived general health (OR = 2.50, 95% CI: 1.21–5.18) and mood disorder (OR = 3.06, 95% CI: 1.40–6.69) in adults, as well as a weak sense of community belonging in older men (OR = 3.58, 95% CI: 1.97–6.52) were also associated with long sleep.

Discussion

Even at a young age, a large proportion of Canadians do not get the recommended amount of sleep, with a prevalence of short sleep duration ranging from approximately one-fifth of preschoolers and children to one-third of youth, adults and older adults. In contrast, long sleep duration is relatively uncommon except in older adults.

Our analysis of a large-scale population-based survey identified a wide range of factors associated with short and long sleep at different stages of life. Notably, sociodemographic factors (e.g., ethnicity, household income, lone-parent household) appeared to play a stronger role in determining sleep duration in preschoolers and children, whereas environmental and lifestyle factors (e.g., second-hand smoke exposure, screen time–based sedentary behaviour) may be more important in youth. In addition to sociodemographic factors (e.g., education, employment status), several psychosocial and health-related factors, including arthritis, chronic stress, mood disorder, self-perceived general or mental health and sense of community belonging, were found to be associated with short and/or long sleep among adults and older adults.

TABLE 3
Crude (unadjusted) logistic regression models for correlates of short and long sleep duration in adults (18–64 years) and older adults (65–79 years)

	Short (vs. recommended) sleep				Long (vs. recommended) sleep			
	Adults		Older adults		Adults		Older adults	
Correlates	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age, per 1-year increase	1.01	1.00–1.02	0.98	0.94–1.01	0.99	0.96–1.01	1.02	0.97–1.07
Sex								
Male	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Female	0.80	0.63–1.01	1.13	0.77–1.66	1.15	0.72–1.86	1.00	0.64–1.56
Ethnicity								
White	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Non-White	1.29	1.05–1.59	1.42	0.84–2.41	0.90	0.48–1.66	0.63	0.26–1.52
Highest respondent education level								
Post-secondary degree	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Secondary school degree	1.17	0.89–1.54	0.91	0.53–1.57	2.83	1.48–5.40	1.58	0.85–2.91
Less than secondary school	1.23	0.89–1.70	1.81	1.17–2.79	3.99	1.70–9.35	2.78	1.55–5.00
Household income adequacy								
High	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Middle	1.09	0.86–1.39	0.97	0.56–1.68	1.43	0.74–2.78	1.65	0.88–3.08
Low	1.18	0.90–1.55	1.17	0.66–2.06	1.95	0.99–3.83	2.88	1.41–5.85
Household type								
No children <18 years	1.00	Ref			1.00	Ref		
Couple with children <18 years	1.19	0.88–1.60	NA		0.28	0.14–0.57	NA	
Lone-parent with children <18 years	1.47	0.80–2.69			0.72	0.38–1.37		
Marital status								
Married/common-law	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Divorced/separated	1.59	1.00–2.55	1.73	0.94–3.18	1.86	0.53–6.52	2.01	0.94–4.54
Widowed	2.04	0.96–4.31	1.16	0.77–1.73	1.70	0.01–211.8	0.73	0.39–1.36
Single (never married)	0.89	0.67–1.17	0.75	0.30–1.89	2.03	1.07–3.82	1.87	0.81–4.33
Employment status								
Full-time	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Part-time	0.76	0.56–1.03	0.36	0.17–0.77	2.77	1.44–5.35	2.37	0.65–8.68
Unemployed	1.00	0.78–1.28	0.48	0.25–0.92	3.06	1.47–6.37	3.93	1.33–11.6
Physical activity guideline adherence								
Yes	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
No	1.23	0.81–1.86	0.73	0.39–1.39	1.51	0.35–6.51	0.83	0.28–2.45
Screen time–based sedentary behaviour guideline adherence								
Yes	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
No	0.85	0.69–1.05	0.97	0.61–1.54	2.39	1.27–4.52	0.86	0.51–1.43
Smoking status								
Never	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Former	1.08	0.84–1.38	0.90	0.58–1.41	1.53	0.66–3.52	1.33	0.89–1.98
Current	1.37	1.11–1.67	0.32	0.68–2.57	2.12	1.11–4.08	1.87	0.90–3.87
Alcohol consumption								
Non-drinker	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
< once per week	0.83	0.54–1.27	0.94	0.54–1.64	0.98	0.52–1.83	0.65	0.32–1.29
1–6 times per week	0.78	0.56–1.09	0.88	0.45–1.72	0.57	0.25–1.29	0.73	0.36–1.46
Daily	0.83	0.50–1.36	0.61	0.36–1.03	0.72	0.26–2.04	0.59	0.30–1.18

Continued on the following page

TABLE 3 (continued)
Crude (unadjusted) logistic regression models for correlates of short and long sleep duration in adults (18–64 years) and older adults (65–79 years)

	Short (vs. recommended) sleep				Long (vs. recommended) sleep			
	Adults		Older adults		Adults		Older adults	
Correlates	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Self-perceived mental health								
Excellent/very good	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Good	1.43	1.07–1.93	1.15	0.71–1.86	1.55	0.81–2.95	1.30	0.71–2.37
Poor/fair	2.71	1.95–3.75	1.16	0.43–3.12	4.85	1.58–14.9	1.18	0.39–3.52
Sense of community belonging								
Strong	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Weak	1.30	1.02–1.65	1.58	0.96–2.61	2.39	1.38–4.13	1.95	1.20–3.16
Chronic stress								
No	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Yes	1.93	1.39–2.67	2.09	1.05–4.13	1.28	0.73–2.27	1.25	0.55–2.84
Self-perceived general health								
Excellent/very good	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Good	1.47	1.10–1.97	1.44	1.07–1.92	1.89	1.01–3.54	0.96	0.61–1.50
Poor/fair	2.07	1.48–2.88	2.02	1.31–3.11	5.24	2.67–10.3	1.24	0.66–2.35
BMI								
Underweight	1.37	0.49–3.84	0.94	0.03–35.1	1.61	0.04–71.5		–[a]
Normal	1.00	Ref	1.00	Ref	1.00	Ref	1.00	Ref
Overweight	1.14	0.89–1.47	1.38	0.89–2.15	0.82	0.38–1.80	1.22	0.62–2.40
Obese	1.11	0.85–1.44	1.26	0.87–1.83	1.63	0.90–2.93	1.76	0.93–3.35
Chronic conditions (yes vs. no)								
Mood disorder	1.37	1.06–1.77	0.59	0.32–1.08	4.34	2.12–8.82	0.61	0.29–1.27
Asthma	1.05	0.67–1.65	1.98	0.96–4.10	2.18	0.88–5.39	1.93	0.73–5.08
COPD	1.29	0.75–2.25	1.02	0.54–1.93	2.51	1.01–6.23	0.69	0.31–1.55
Arthritis	1.69	1.20–2.40	1.47	1.05–2.07	1.25	0.47–3.34	1.03	0.64–1.65
Osteoporosis	1.35	0.83–2.20	1.12	0.67–1.86		–[a]	0.85	0.43–1.70
Diabetes	1.47	0.80–2.69	1.04	0.58–1.88	1.30	0.30–5.53	1.56	0.82–2.96
Hypertension	1.23	0.90–1.66	1.01	0.62–1.63	1.21	0.48–3.09	1.37	0.81–2.33
Heart disease	1.38	0.82–2.35	1.05	0.66–1.66		–[a]	1.11	0.69–1.77
Stroke	1.48	0.30–7.37	1.43	0.33–6.20		–[a]	1.99	0.53–7.49
Cancer	0.70	0.30–1.65	0.91	0.43–1.89	3.38	0.03–44.7	0.93	0.30–2.85
Thyroid condition	0.98	0.64–1.49	0.73	0.41–1.28	1.09	0.10–11.9	0.75	0.37–1.51
Kidney dysfunction/disease	1.01	0.49–2.08	2.19	0.72–6.62		–[a]	1.01	0.04–23.4
Liver/gallbladder disease	1.07	0.45–2.53	0.83	0.25–2.72	1.95	0.07–56.3		–[a]

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease; CI, confidence interval; NA, not applicable; OR, odds ratio; Ref, reference category.
[a] Estimate suppressed due to extreme variability.

The prevalence estimates of short sleep duration in our study are similar to those reported previously in Canada[4,5,41] and the USA,[18,42] although differences in age groupings and methods of assessing sleep duration may have contributed to some inconsistencies. For example, based on child-reported sleep duration averaged across all days of the week, a 2016 Canadian study found that short sleepers were more common among children aged 10–13 years (31%) than among those aged 14–17 years (26%),[3] whereas short sleepers were more common among youth aged 14–17 years (29%) than among children aged 5–13 years (20%) in our study.

Our results for the associations between sociodemographic factors and short sleep duration in the younger age groups are in line with previous research.[17,43] For example, a recent United States birth cohort study showed that low maternal education, low household income and ethnicity (Black, Hispanic and Asian vs. White children) were associated with chronic sleep curtailment from infancy to mid-childhood.[17] The influence of sociocontextual factors on sleep at a young age may be related to variations in bedtime routines

TABLE 4
Multivariable logistic regression models for correlates of short (vs. recommended) sleep duration in preschoolers, children, youth, adults and older adults

Correlates	OR	95% CI
Preschoolers, 3–4 years (*n* = 775)		
Sex (female vs. male)	1.42	0.83–2.44
Ethnicity (non-White vs. White)	1.94	1.03–3.65
Highest household education level		
Post-secondary degree	1.00	Ref
Secondary school degree	0.99	0.40–2.49
Less than secondary school	2.81	0.36–22.2
Household income adequacy		
High	1.00	Ref
Middle	1.07	0.52–2.19
Low	2.59	1.12–5.65
Household type (lone-parent vs. couple)	0.53	0.16–1.73
Children, 5–13 years (*n* = 2 848)		
Ethnicity (non-White vs. White)	2.08	1.42–3.04
Household type (lone-parent vs. couple)	1.76	1.07–2.91
Sedentary behaviour guideline adherence (no vs. yes)	1.41	0.92–2.16
Learning disability/ADHD[a] (yes vs. no)		
Males	3.13	1.40–6.99
Females	0.73	0.35–1.52
Youth, 14–17 years (*n* = 1 001)		
Highest household education level		
Post-secondary degree	1.00	Ref
Secondary school degree	1.44	0.73–2.83
Less than secondary school	0.39	0.07–2.02
Household income adequacy		
High	1.00	Ref
Middle	0.66	0.34–1.29
Low	0.80	0.37–1.74
Second-hand smoke exposure at home (yes vs. no)	2.54	1.25–5.16
Sedentary behaviour guideline adherence[b] (no vs. yes)		
Males	4.32	1.37–13.6
Females	1.00	0.46–2.17
Mood disorder (yes vs. no)	1.84	0.67–5.03
Adults, 18–64 years (*n* = 5 445)		
Sex (female vs. male)	0.76	0.59–0.98
Ethnicity (non-White vs. White)	1.41	1.11–1.79
Sedentary behaviour guideline adherence (no vs. yes)	0.80	0.64–1.01
Smoking status		
Never	1.00	Ref
Former	0.98	0.72–1.32
Current	1.21	0.97–1.50
Self-perceived mental health		
Excellent/very good	1.00	Ref
Good	1.22	0.90–1.67
Poor/fair	1.82	1.24–2.69

Continued on the following page

or behaviours (e.g., regular bedtime, parent–child interactive routines) across families of different structures (e.g., lone-parent vs. couple), cultures and socioeconomic status,[44,45] as well as factors such as family stress and the living/bedroom environment (e.g., noise, crowding).[17,18] Furthermore, our findings support existing evidence on the links between learning disability/ADHD and sleep deprivation or disturbances in children, possibly relating to shared neurobiological pathways and effects of ADHD medications.[46,47] In particular, the significant association noted in boys alone is consistent with studies reporting a higher prevalence of sleep problems in boys (vs. girls) with ADHD.[48,49] However, a more detailed examination of sleep in relation to specific subtypes of learning disability/ADHD in boys and girls is warranted to further understand the moderating role of gender.[49]

While active smoking has been previously linked to short sleep duration and sleep problems among adolescents,[50,51] our study is one of the very few demonstrating an association between second-hand smoke exposure and short sleep duration in this age group. These results are similar to a recent British Columbia study that assessed overall second-hand smoke exposure rather than exposure in the home environment.[52] Possible mechanisms through which second-hand smoke exposure may interfere with sleep include nicotine-stimulating effect, nicotine withdrawal at night and disruption of pulmonary function.[52,53] Future studies, including those with objective measures of second-hand smoke, are warranted to confirm these findings.

Despite evidence suggesting that screen time is inversely associated with sleep duration in children and adolescents,[54] we only found a significant association among male youth. Sex has also been noted as an effect modifier in several other studies where male adolescents were more likely to show an association between television watching and short sleep compared to female adolescents.[54,55] These age and gender differences may be related to the type and timing (e.g., bedtime) of screen time exposure.

In addition to sociodemographic characteristics, psychosocial and mental health–related factors appeared to play an important role in sleep duration among

TABLE 4 (continued)
Multivariable logistic regression models for correlates of short (vs. recommended) sleep duration in preschoolers, children, youth, adults and older adults

Correlates	OR	95% CI
Sense of community belonging (weak vs. strong)	1.20	0.93–1.54
Chronic stress (yes vs. no)	1.63	1.14–2.33
Self-perceived general health		
Excellent/very good	1.00	Ref
Good	1.25	0.91–1.71
Poor/fair	1.34	0.91–1.97
Arthritis (yes vs. no)	1.53	1.08–2.16
Cancer (yes vs. no)	0.57	0.26–1.23
Older adults, 65–79 years (n = 1 094)		
Sex (female vs. male)	1.20	0.76–1.89
Ethnicity (non-White vs. White)	1.48	0.86–2.55
Highest respondent education level		
Post-secondary degree	1.00	Ref
Secondary school degree	0.99	0.59–1.66
Less than secondary school	1.83	1.22–2.75
Marital status		
Married/common-law	1.00	Ref
Divorced/separated	1.54	0.87–2.73
Widowed	1.05	0.65–1.80
Single (never married)	0.64	0.19–2.12
Employment status		
Full-time	1.00	Ref
Part-time	0.40	0.18–0.87
Unemployed	0.46	0.22–0.96
Sense of community belonging (weak vs. strong)	1.51	0.86–2.65
Chronic stress (yes vs. no)	1.95	1.01–3.87
Mood disorder (yes vs. no)	0.46	0.25–0.85
Arthritis (yes vs. no)	1.42	1.01–1.98
Asthma (yes vs. no)	1.79	0.78–4.08
Kidney disease (yes vs. no)	1.98	0.67–5.87

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; CI, confidence interval; OR, odds ratio; Ref, reference category.

Note: All models adjusted for age (continuous). Models for children, youth and adults additionally adjusted for age squared to account for the nonlinear relationship between age and short sleep duration.

[a] p-value for sex × learning disability/ADHD interaction term = 0.004.

[b] p-value for sex × sedentary behaviour guideline adherence interaction term = 0.02.

adults and older adults in our study. These findings are consistent with previous research,[23-26] although it should be noted that the relationship between mental health and sleep is bidirectional and likely involves a complex interplay between biological and behavioural factors.[56] Notably, in contrast to studies reporting associations between lifestyle/behavioural factors and sleep duration in adults,[22-24] these factors were not significant in our study, although unadjusted models suggested a possible link between current smoking and both short and long sleep in adults (Table 3).

Our results also highlight the importance of examining specific determinants of both short and long sleep durations. For example, while a high level of self-perceived lifetime stress (possibly a marker of coping ability) was associated with short sleep, having been diagnosed with a mood disorder (e.g., depression) was associated with long sleep, suggesting different measures or domains of mental health may affect sleep differently. Moreover, the association between arthritis and short sleep observed in both adults and older adults is likely mediated through pain-related sleep problems.[57] Finally, our finding of an association between sense of community belonging and long sleep is novel and warrants additional research with regard to the role of community-level factors (e.g., social support) contributing to healthy sleep durations, including potential sex differences.

Strengths and limitations

Strengths of our study included the population-based design, large sample size, use of evidence-informed recommendations to define sleep duration categories,[31-33] detailed assessment of a wide range of factors associated with both short and long sleep, and investigation of the associations, including potential sex differences, by life stage.

Our study had several limitations. First, sleep duration was assessed based on self- or parent/guardian-reported information, which has generally been shown to overestimate actual sleep duration and potentially bias the observed relationships between sleep duration and related factors or health outcomes.[58,59] Including objective measurements of sleep, such as actigraphy-assessed sleep duration, may help reduce bias associated with measurement errors in future studies.[58] Similarly, with the exceptions of body mass index and physical activity, all other factors were assessed by self- or parent/guardian-reports, which were subject to social desirability and recall bias.

Second, given the cross-sectional nature of the CHMS, the temporality of associations could not be established. For example, while chronic stress may have contributed to short sleep duration among adults and older adults, it is also possible that inadequate sleep resulted in chronic stress.

Third, due to insufficient sample size, young adults (aged 18–24 years) were not examined as a separate life stage in our analyses; this age group may have distinct sleep patterns and correlates of sleep duration that warrant further research.

Fourth, the sleep questionnaire in the CHMS did not include details such as time

TABLE 5
Multivariable logistic regression models for correlates of long (vs. recommended) sleep duration in adults and older adults

Correlates	OR	95% CI
Adults, 18–64 years (*n* = 3 882)		
Sex (female vs. male)	1.10	0.64–1.91
Highest respondent education level		
Post-secondary degree	1.00	Ref
Secondary school degree	1.88	0.94–3.75
Less than secondary school	3.25	1.31–8.04
Household type		
No children <18 years	1.00	Ref
Couple with children <18 years	0.41	0.17–0.96
Lone-parent with children <18 years	0.48	0.15–1.51
Employment status		
Full-time	1.00	Ref
Part-time	1.96	0.97–3.94
Unemployed	1.64	0.68–3.97
Sedentary behaviour guideline adherence (no vs. yes)	1.56	0.78–3.11
Self-perceived general health		
Excellent/very good	1.00	Ref
Good	1.33	0.74–2.37
Poor/fair	2.50	1.21–5.18
Sense of community belonging (weak vs. strong)	2.09	1.21–3.61
Mood disorder (yes vs. no)	3.06	1.40–6.69
Older adults, 65–79 years (*n* = 913)		
Highest respondent education level		
Post-secondary degree	1.00	Ref
Secondary school degree	1.56	0.85–2.88
Less than secondary school	2.23	1.24–4.03
Household income adequacy		
High	1.00	Ref
Middle	1.32	0.68–2.58
Low	2.01	0.96–4.17
Employment status		
Full-time	1.00	Ref
Part-time	2.72	0.75–9.90
Unemployed	3.52	1.02–12.2
Sense of community belonging[a] (weak vs. strong)		
Males	3.58	1.97–6.52
Females	1.28	0.62–2.62
Mood disorder (yes vs. no)	0.61	0.28–1.31

Abbreviations: CI, confidence interval; OR, odds ratio; Ref, reference category.
Note: All models adjusted for age (continuous).
[a] *p*-value for sex × sense of community belonging interaction term = 0.02.

spent napping and sleep duration on weekdays compared to weekends, which may provide additional insights into the role of different factors in determining sleep duration. Finally, despite the broad range of potential correlates evaluated, the CHMS lacked information on other factors that may affect sleep duration, such as shift work, caffeine intake and the bedroom environment.

Conclusion

Short sleep duration is highly prevalent among Canadians across all stages of life. The present study provides the first detailed examination of correlates of sleep duration in a nationally representative sample of Canadians. Although more research is needed to disentangle the complex interrelations between various factors and sleep, surveillance efforts should continue to monitor sleep and related factors to inform public policies aimed at promoting healthy sleep duration across life stages.

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Conflicts of interest

The authors declare no conflicts of interest.

Authors' contributions and statement

VC and MD conceptualized the study. VC conducted the data analyses, interpreted the results and drafted the manuscript. JC, KR, GJ and MD contributed to the interpretation of results and critically reviewed and revised the manuscript. All authors approved the final version submitted.

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Evidence synthesis

Promotion of physical activity in rural, remote and northern settings: a Canadian call to action

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Abstract

Introduction: The lack of policy, practice and research action on physical activity and features of the physical (built and natural) environments in rural, remote and northern settings is a significant threat to population health equity in Canada. This paper presents a synthesis of current evidence on the promotion of physical activity in non-urban settings, outcomes from a national priority-setting meeting, and a preliminary call to action to support the implementation and success of population-level initiatives targeting physical activity in non-urban settings.

Methods: We conducted a "synopses of syntheses" scoping review to explore current evidence on physical activity promotion in rural, remote, northern and natural settings. Next, we facilitated a collaborative priority-setting conference with 28 Canadian experts from policy, research and practice arenas to develop a set of priorities on physical activity in rural, remote and northern communities. These priorities informed the development of a preliminary Canadian call to action.

Results: We identified a limited number of reviews that focused on physical activity and the built environment in rural, remote and northern communities. At the priority-setting conference, participants representing rural, remote and northern settings identified top priorities for policy, practice and research action to begin to address the gaps and issues noted in the literature. These priorities include self-identifying priorities at the community level; compiling experiences; establishing consistency in research definitions and methods; and developing mentorship opportunities.

Conclusion: Coordinated action across policy, practice and research domains will be essential to the success of the recommendations presented in this call to action.

Keywords: *rural health, remote health, health policy, environment design, physical activity, health equity*

Highlights

- Physical activity promotion must reflect the realities and context of rural and remote communities.
- Research literature on physical activity promotion in rural and remote communities does not yet provide adequate direction to communities or public health agencies.
- In November 2015, experts gathered to review existing evidence and to develop priorities to enhance physical activity promotion in rural, remote and northern settings in Canada.
- Priorities were summarized in a Canadian call to action that provides preliminary direction to support equitable action on rural and remote physical activity promotion across Canada, including the need for more culturally relevant, Indigenous-led research.

Introduction

Regular physical activity is an important determinant of health. Increased physical activity decreases the risk of several chronic diseases and improves overall well-being.[1] Yet, nearly 80% of Canadian adults do not complete the recommended 150 minutes of moderate-to-vigorous physical activity each week.[2] It is widely accepted that an individual's physical activity is influenced by various determinants, including the physical, built and natural environments (see Box 1 for definitions). Policies and changes in environmental infrastructure can play a meaningful role in creating supportive settings to increase population-level physical activity.[3]

There appears to be significant support among decision makers, politicians, bureaucrats, members of the media and policy advocates in Canada as well as the general public for population-level interventions that promote physical activity by

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BOX 1
Key definitions

The terms "physical environment," "built environment" and "natural environment" are variously defined in the literature and are often component parts of a single definition. For clarity in conducting this review, we used the following definitions:	
Physical environment:	the perceived characteristics of the physical setting in which individuals spend their time. This may include aspects of urban design, traffic density and speed, distance to and design of venues for physical activity, e.g. recreation facilities, weather and air quality, and crime and safety.[4]
Built environment:	features of the environment that are influenced by human design. This definition generally includes three main components: transportation systems; land development patterns; and the design and arrangement of buildings and other structures.[5]
Natural environment:	the aspects of the natural world largely untouched by humans. Natural environments can be viewed as a continuum between wild nature and areas under some human influence, such as public parks or cultivated fields.[6]

targeting the built and physical environment. For example, a 2016 survey conducted by members of our team found that 95.3% of policy influencers support improving opportunities for physical activity through neighbourhood revitalization programs.[7] Furthermore, 87.7% of policy influencers and 92.8% of the general public support implementing transportation policies designed to promote bicycling.

Despite general support for policies and built environment interventions to promote physical activity, significant evidence, policy and practice gaps exist in non-urban settings. Evidence on the promotion of physical activity at the environmental level has focused on urban settings, with little attention paid to settings outside of cities and metropolitan areas.[8] This is problematic as populations outside of urban areas have fewer resources or poorer accessibility to existing resources than their urban counterparts, which contributes to increased prevalence of adverse health outcomes in rural populations.[8-10]

Non-urban settings also experience inequities in the promotion of physical activity from both a practice and policy perspective. Communities with a population of less than 10 000 experience more barriers to accessing physical activity than larger communities with populations of 250 000 or greater.[11] Not surprising, a higher proportion of parents in rural, remote and northern regions report poor accessibility as a barrier to their children's physical activity compared to the Canadian average.[11] Local governments in rural, remote and northern regions may also have other challenges to do with infrastructure, such as limited revenue and financial capacity, short construction seasons and high cost of living.[12] This makes it difficult to provide community programming and create environments that support physical activity. In short, the *State of Rural Canada 2015* reports, "We have been neglecting rural Canada … Fundamentally, we have forgotten how to re-invest in rural and small town places…."[13, p. i]

Having a better understanding of the nuanced contexts of non-urban settings has the potential to improve health equity and contribute to more effective policies and environmental interventions that promote physical activity across settings. With this in mind, we conducted a synthesis of the review-level literature on the promotion of physical activity in non-urban settings from the perspective of the built environment. We then held a conference with invited experts to develop a set of priorities for practice, policy implementation and research to support physical activity in rural, remote and northern communities. Taken together, this process resulted in the collaborative development of a Canadian call to action, which is presented in this paper.

Methods

Part 1: Evidence synthesis

To understand what is currently known about the promotion of physical activity in non-urban settings from the perspective of physical, built and natural environments, we conducted a scoping review and synthesis of the literature at the review level. This "synopses of syntheses" is an approach recommended by the National Collaborating Centre on Methods and Tools (NCCMT) for assessing the state of evidence on public health interventions,[14] with searches of the highest quality sources conducted. Our intent was to scope and summarize the evidence on a specific topic area, using the findings of systematic reviews—reviews of reviews—as our starting point.

Data collection

The synthesis involved retrieving review articles from four major databases (Ovid MEDLINE, CINAHL, Academic Search Complete and SPORTDiscus) and four grey literature sources (Active Living Research, Bridging the Gap/Robert Woods Johnson Foundation, Children and Nature Network and Ohio Leave No Child Inside Collaboratives). We also reviewed references cited in key articles and retrieved via Google Scholar and additional reviews identified by the research team. To facilitate inclusivity, a broad range of terms related to physical activity and the physical, built and natural environments in non-urban settings was used in different combinations, as outlined in Table 1.

Inclusion criteria were reviews, including narrative reviews and summary papers, published after 2000, in English or French; articles on research, strategies and/or interventions related to physical activity in the context of the physical, built and natural environments; and findings and/or implications relevant to non-urban settings, including rural, remote, northern and natural settings.

The articles were initially screened by title and abstract review to eliminate irrelevant articles. We then conducted a full review and relevance assessment, followed by data extraction. Figure 1 presents a modified (i.e. for scoping reviews) PRISMA flow diagram of records collected during the screening process.

The search resulted in a total of 36 review articles that explored the promotion of physical activity in non-urban settings

TABLE 1
Literature search strategy

Topic	Search terms
Physical activity	active* commut* or active* transport* or bicycling* or biking* or exercis* or hike or hiked or hikes or hiking* or motor activity or physical activ* or physical fit* or physical inactiv* or recreation* or walk or walks or walked or walking
Rural settings	aboriginal communit* or aboriginal reserv* or arctic region* or biodivers* area* or biodivers* environment* or biodiverse landscape* or biodiverse location* or biodiverse setting* or biodiverse space* or built environment* or built landscape* or built setting* or countryside* or first nation* communit* or first nation* reserv* or forest* or great outdoors or Inuit* communit* or Inuit reserv* or land conserv* or land protect* or national park* or natur* area or natur* environment or natur* landscape* or natur* setting* or natur* space* or northern communit* or open area* or open country* or open environment* or open landscape* or open space* or outdoor area* or outdoor environment* or outdoor landscape* or outdoor space* or park* act or park acts* or provincial park* or remote area* or remote communit* or remote environment* or remote landscape* or remote setting* or remote space* or rural area* or rural communit* or rural location* or rural setting* or rural space* or territorial park* or trail presence or trail use* or unbuilt environment* or unbuilt landscape* or unbuilt setting* or wild area* or wild environment* or wild landscape* or wild location* or wild setting* or wild space* or wilderness*

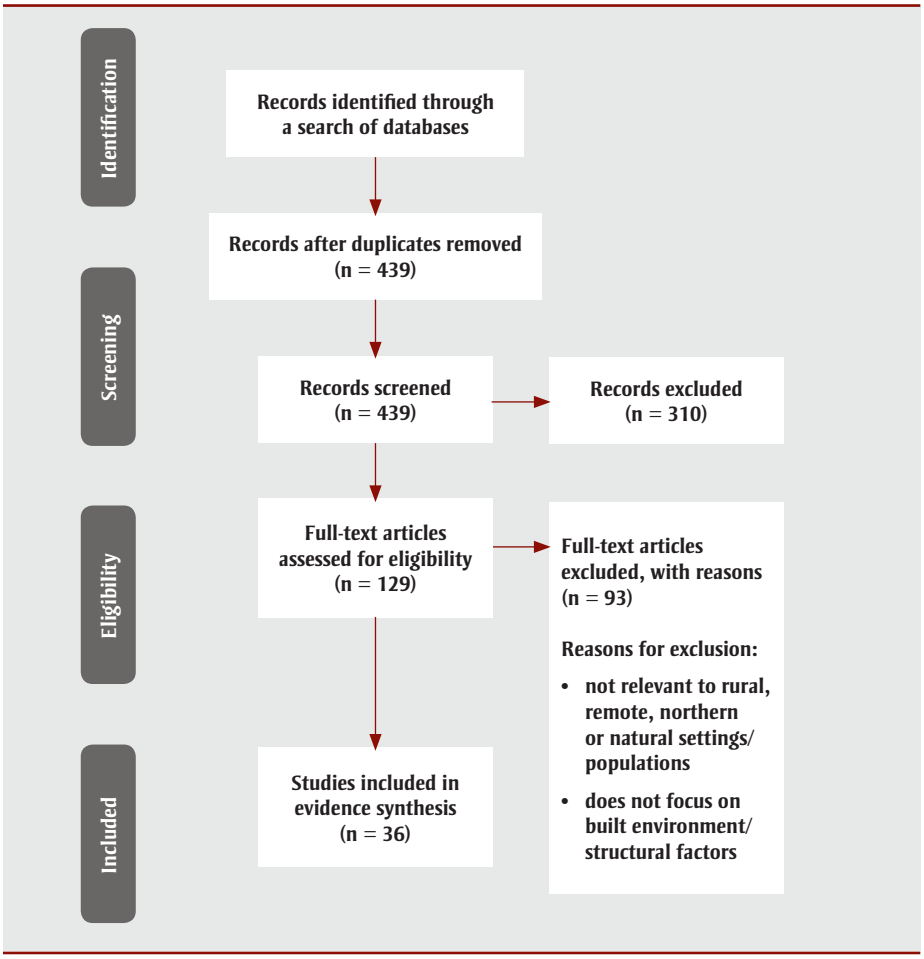
* Indicates a truncation command, allowing multiple forms of a given word (e.g. exercis* identifies exercise, exercised, exercises, exercising)

from the perspective of physical, built and natural environments. Of these, 13 focused explicitly on rural (n = 4), remote, northern or on reserve (n = 5) and natural (n = 4) settings. The remaining 24 review articles discussed findings and/or implications applicable to rural settings, even though this setting was not the primary focus of our review. Because of the limited number of directly relevant review articles retrieved in the literature search, we did not use data quality as an inclusion criterion.

Data analysis

The data extraction and analysis process involved first charting the data and then collating, summarizing and reporting results, based on Arksey and O'Malley's scoping review framework.[15] A summary of included review articles is presented in Table 2. Information from the review articles was themed according to setting type (rural; remote, northern or on reserve; and natural). Sub-themes within each setting type were identified in an emergent and iterative manner to comprehensively summarize results from the literature. To minimize any potential bias, two reviewers separately extracted and analyzed the data. Team meetings with the two principal investigators and the reviewers were held to discuss the analyses and to resolve any inconsistencies between reviewers.

FIGURE 1
Modified PRISMA Flow Diagram (for scoping review)



Of the 36 review articles included in the synthesis, only four specifically focused on rural settings (see Table 2). So, as a secondary focus of our review, we assessed the 24 broader review articles that discussed findings and/or implications applicable to rural settings. We also identified five review articles that focused on Indigenous health and included findings pertinent to remote, northern and/or reserve settings. (Reserves are commonly situated in non-urban settings and experience obstacles related to lack of access to health resources and community infrastructure.[16]) Lastly, we identified four review articles that contained findings related to natural settings outside of urban areas (i.e. wilderness areas and natural parks). Those natural settings described as being situated within rural areas were included in the rural settings category.

Part 2: Priority-setting conference

To build on the findings of the review and develop a set of priorities for practice and

TABLE 2
Summary of included review articles

Author / Article title Journal / Year	Type of review / Objectives	Relevant findings and implications
Review articles with a stated rural focus		
Boehm et al.[17] "Barriers and motivators to exercise for older adults: a focus on those living in rural and remote areas of Australia" *Australian Journal of Rural Health* 2013	Literature review To explore barriers and facilitators to exercise for community-dwelling older people living in rural and remote Australia. The review also explores how these barriers and facilitators relate to population-based exercise programs on falls prevention.	**Older adults (50 years+)** • The review includes 25 articles that explore barriers and facilitators to exercise for older adults. Five of the articles discuss rural or remote locations worldwide. None of the included articles focus on rural or remote locations in Australia. • Relevant environmental barriers identified in the rural and remote literature include poor built environment (i.e. no or poor footpaths, uneven road surfaces, poor lighting), lack of access to facilities, safety concerns, dogs, traffic, weather and lack of transportation. • Relevant environmental facilitators identified include accessible facilities and a built environment conducive to physical activity (i.e. presence of paved roads, good walking conditions). • The review states that the environment, which needs to be carefully considered in program design, is a significant issue in literature on rural and remote settings. • The review notes that the lack of literature about barriers and facilitators to exercise for older people in rural and remote Australia highlights a need for further research.
Frost et al.[8] "Effects of the built environment on physical activity of adults living in rural settings" *American Journal of Health Promotion* 2010	Systematic review To conduct a systematic review of the literature to examine the influence of the built environment on the physical activity of adults in rural settings.	**Adults (18+ years)** *Qualitative study findings* – used to identify barriers and motivators to physical activity in rural populations in 7 out of the 20 studies. • Barriers to physical activity include traffic, safety and uneven roads as well as lack of sidewalks, indoor facilities, parks and transportation. • Motivators to increased physical activity include increasing the number and quality of recreational facilities, creating facilities for women only, improving outdoor lighting, providing better walking conditions, providing more public transportation and building sidewalks, tracks, parks or trails. *Quantitative study findings* – outlined in 16 studies • Of the 11 built environment elements identified in the reviewed studies, those that demonstrated significant positive associations with physical activity included aesthetics (4 out of 4 studies), safety/crime (6 out of 9), recreational facilities (5 out of 10), trails (4 out of 6) and parks (3 out of 6). Positive relationships were found related to walkable destinations in 2 out of 5 studies. • Findings about sidewalks, shoulders on the road, traffic and street lighting were inconsistent and mixed. • No significant association was found around the use of shopping malls for physical activity. ***Conclusions*** The review found preliminary support for the understanding that features of the built environment associated with physical activity in rural and urban settings differ, but highlighted a need for more research. The reviews also called for the term "rural" to be more clearly defined in the literature.
Olsen[18] "An integrative review of literature on the determinants of physical activity among rural women" *Public Health Nursing* 2013	Integrative review To examine the determinants of physical activity levels among rural women in the USA.	**Rural women** The review • Included 21 studies; • Reported on three themes of physical environment determinants that acted as barriers to physical activity: access, safety and structures; • Noted that the definition of "rural" varied in the studies, and highlighted a need for additional research to more clearly and consistently define the term.

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TABLE 2 (continued)
Summary of included review articles

Author / Article title Journal / Year	Type of review / Objectives	Relevant findings and implications
Sandercock et al.[19] "Physical activity levels of children living in different built environments" *Preventive Medicine* 2010	Systematic review To review the available literature assessing differences in physical activity levels of children living in different built environments (rural, urban and suburban, where available) classified according to land use within developed countries.	**Children and adolescents (5–18 years)** • The literature does not show major differences in the physical activity levels of children from rural and urban environments, though there is some evidence for higher physical activity in children aged under 13 in rural settings. • Where discrete samples of suburban or small-town children were analyzed, they tended to have higher physical activity levels than their urban or rural peers. • There are differences in the types of physical activity that children from different environments engage in. • Simple examination of "urban" versus "rural" has the potential to lead to errors in some studies. The review also draws attention to the heterogeneous nature of "rural" and "urban" definitions. • Further research aimed at assessing differences in physical activity among children from different built environments should use detailed and logical geographical classification systems; be adequately powered; and take into account socioeconomic status, seasonal effects and racial factors.
Review articles from the wider literature with findings and/or implications relevant to rural settings		
Abraham et al.[6] "Landscape and well-being: a scoping study on the health-promoting impact of outdoor environments" *International Journal of Public Health* 2010	Scoping review / qualitative literature review To provide a scoping study of publications on the health-promoting influence of landscape.	**Population not reported** • To be perceived as an option for physical activity, rural green landscapes should be aesthetically appealing to their users.
Bauman et al.[20] "Correlates of physical activity: why are some people physically active and others not?" *The Lancet* 2012	Review of reviews To present knowledge about correlates and determinants of physical activity in adults and children.	**Adults (≥18 years) and children (5–13 years, depending on the study) or adolescents (12–18 years, depending on the study)** • Density of exercise facilities and urbanization (i.e. urban versus rural residences) are positively associated with physical activity.
Calogiuri and Chroni[21] "The impact of the natural environment on the promotion of active living" *BMC Public Health* 2014	Integrative systematic review To review the existing literature on the relationship between the natural environment and physical activity.	**Healthy, non-athletic adult population >16 years** • The perceived ability to walk to local natural environments is a predictor of physical activity among older adults living in rural areas. • Differences between rural and urban environments have been identified, with the natural environment–physical activity relationship stronger for people living in urban rather than rural areas, likely due to differences in land-use mix and connectivity.
Casagrande et al.[22] "Built environment and health behaviors among African Americans" *American Journal of Preventive Medicine* 2009	Systematic review To quantify the existing literature, acknowledge gaps that could affect future research and surmise any salient environmental characteristics that are associated with diet, physical activity and obesity in African Americans that may be important targets for environmental interventions.	**Population not reported** • Features of the built environment may vary considerably between rural, urban and suburban locations. These geographical differences are important to understand when conceptualizing and assessing the ways in which the built environment affects health behaviours (i.e. physical activity, diet, obesity). • The review calls for more investigation of the rural environment.
Cunningham and Michael[5] "Concepts guiding the study of the impact of the built environment on physical activity for older adults" *American Journal of Health Promotion* 2004	Comprehensive review To identify theoretical models and key concepts used to predict the association between built environments and seniors' physical activity on the basis of a comprehensive review of the published literature.	**Seniors** • Reports on findings from one study relevant to the rural setting. • States that this study is notable because it is the only study within the review that focused on a rural community.

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TABLE 2 (continued)
Summary of included review articles

Author / Article title Journal / Year	Type of review / Objectives	Relevant findings and implications
Ding and Gebel[23] "Built environment, physical activity and obesity: what have we learned from reviewing the literature?" *Health and Place* 2012	Literature review To evaluate the quality and key characteristics of the reviews, and to set the agenda for future research through identifying research gaps and areas of improvement.	**Population not reported** • More rigorous studies in specific population subgroups, such as seniors, ethnic minorities and rural residents, are needed.
Feng et al.[24] "The built environment and obesity" *Health and Place* 2010	Systematic review of the epidemiologic evidence To evaluate the extant literature for evidence of association between the built environment and obesity.	**Population not reported** • Includes 7 rural studies (related to physical activity, land use, transportation and/or the food environment overall). • Indicates that current literature has focused narrowly on metropolitan areas, while smaller towns, exurban areas and rural communities have been neglected.
Foster and Giles-Corti[25] "The built environment, neighborhood crime and constrained physical activity: an exploration of inconsistent findings" *Preventive Medicine* 2008	Review To summarize the individual, social and built environment characteristics that influence whether people feel safe; examines the association between real and perceived crime-related safety and their association with physical activity.	**Population not specified** • Findings relevant to the rural setting. • Higher levels of physical disorder tend to cluster in denser urban areas, which have more non-residential land uses, suggesting that the study context (i.e. urban, suburban, rural) and neighbourhood walkability may confound the relationship between disorder and physical activity. • The review indicates that the degree of urbanization (i.e. urban, suburban and rural) may affect exposure to factors that influence safety perceptions.
Galvez et al.[26] "Childhood obesity and the built environment" *Current Opinion in Pediatrics* 2010	Literature review, 2008–2009 To review the strength of the most current evidence with respect to the built environment and childhood obesity.	**Children (<18 years)** • The review reports on findings relevant to the rural setting. • Future research is needed on diverse populations that vary by key sociodemographics, including gender, race/ethnicity and income, and that consider subjective and objective measures of neighbourhood-level factors across urban, suburban and rural areas.
Hanson and Berkowitz[27] "Does the built environment influence physical activity?" Institute of Medicine of the National Academies, 2005	Report on an examination of the evidence To review and summarize the broad trends affecting the relationships between physical activity, health, transportation and land use.	**Population not reported** • Findings relevant to the rural setting. • Effective policies are likely to differ for different population groups (e.g. children, youth, the elderly, the disadvantaged), for different purposes of physical activity (e.g. transportation, exercise) and in different contexts (e.g. inner city, inner suburb, outer suburb, rural).
Humpel et al.[28] "Environmental factors associated with adults' participation in physical activity" *American Journal of Preventive Medicine* 2002	Review To explore quantitative studies examining the associations of particular environmental attributes with physical activity behaviours.	**Adults** • Findings from one study relevant to the rural setting.
Kaczynski and Henderson[29] "Environmental correlates of physical activity: a review of evidence about parks and recreation" *Leisure Sciences: An Interdisciplinary Journal* 2007	Review To review and critically examine evidence related to parks and recreation settings as features of the built environment and the relationship they have to physical activity.	**Population not reported** • Findings relevant to the rural setting. • Most of the active living research related to parks and recreation has involved middle class, mainly White adults living in urban and suburban settings.

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TABLE 2 (continued)
Summary of included review articles

Author / Article title Journal / Year	Type of review / Objectives	Relevant findings and implications
Lovasi et al.[30] "Built environments and obesity in disadvantaged populations" *Epidemiologic Reviews* 2009	Review To evaluate whether built environments might explain racial, ethnic and socioeconomic disparities in obesity and to derive implications from this evidence as to whether changes to the built environment might reduce obesity-related health disparities.	**Disadvantaged populations (low socioeconomic status, Black or Hispanic ethnicity)** • This review reports on findings relevant to physical activity in the context of the built environment and rural settings. • This review states that rural communities and cities do not provide the same opportunities or barriers and, based on this, health promotion interventions should be adapted to fit the local environment.
Matson-Koffman et al.[31] "A site-specific literature review of policy and environmental interventions that promote physical activity and nutrition for cardiovascular health: what works?" *American Journal of Health Promotion* 2004	Literature review To review selected and recent environmental and policy interventions designed to increase physical activity and improve nutrition as a way to reduce the risk for heart disease and stroke, promote cardiovascular health and summarize recommendations.	**Population not reported** • Findings relevant to physical activity in the context of the built environment and the rural setting.
Moran et al.[32] "Understanding the relationships between the physical environment and physical activity in older adults" *International Journal of Behavioral Nutrition and Physical Activity* 2014	Systematic review of qualitative studies To describe the characteristics and methodologies of qualitative studies conducted in this field, identify recurring physical environmental themes and factors possibly related to older adults' behaviours in relation to physical activity, and compare the emerging themes and factors according to the qualitative method used.	**Average age 65+ years** • Findings relevant to the rural setting.
McCrorie et al.[33] "Combining GPS, GIS and accelerometry to explore the physical activity and environment relationship in children and young people" *International Journal of Behavioral Nutrition and Physical Activity* 2014	Review To synthesize and summarize research where a combination of GPS, GIS and accelerometry has been used to investigate the physical environment/physical activity relationship among young people and identify gaps in knowledge that future research should address.	**Young people (5–18 years old)** • Findings relevant to the rural setting.
Ferdinand et al.[34] "The relationship between built environments and physical activity" *American Journal of Public Health* 2012	Systematic review To review the literature examining the relationship between built environments and physical activity or obesity rates.	**Population not specified** • Includes 8 studies relevant to the rural setting. • Indicates that studies of rural populations are lacking, especially on park or trail use, school playgrounds usage and inactivity.
Papas et al.[35] "The built environment and obesity" *Epidemiologic Reviews* 2007	Review To examine the published empirical evidence for the influence of the built environment on the risk of obesity.	**Children and adult populations** • Reports on one study relevant to physical activity in the context of the built environment and rural settings. • When carrying out studies across large areas, creating metrics equally appropriate to different settings (rural, urban and suburban) is challenging.
Renalds et al.[36] A systematic review of built environment and health *Family and Community Health* 2010	Systematic review To review and summarize the literature on the built environment as it pertains to health.	**Population not reported** • Examines the relationship between the built environment and physical activity, obesity, social capital and mental health. Overall, most studies were conducted in an urban setting, and it is not known what findings would result in a rural setting. • Longitudinal studies and studies conducted in a rural setting are needed.

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TABLE 2 (continued)
Summary of included review articles

Author / Article title Journal / Year	Type of review / Objectives	Relevant findings and implications
Saelens and Handy[37] Built environment correlates of walking *Medicine and Science in Sports and Exercise* 2008	Review To review the research on the characteristics of the built environment that correlates with walking and discuss outstanding questions and policy implications.	**Population not reported** • Findings relevant to the rural setting.
Sallis et al.[3] "Role of built environments in physical activity, obesity, and cardiovascular disease" *Circulation* 2012	Review To describe multilevel ecological models of behaviour as they apply to physical activity; describe key concepts; summarize evidence on the relationship of built environment attributes to physical activity and obesity; and provide recommendations for built environment changes that could increase physical activity.	**Population not reported** • For rural residents, traffic safety and availability of recreation facilities and trails were most consistently associated with physical activity. • There are fewer studies focusing on rural populations, even though rural residents are at high risk of poor health outcomes.
Starnes et al.[38] "Trails and physical activity" *Journal of Physical Activity and Health* 2011	Literature review To examine whether trails (e.g. existing trails, new trail construction or trail promotion campaigns) have positive effects on physical activity.	**Population not specified** • Findings relevant to the rural setting. • A general limitation of the studies was that many did not report on the study setting (i.e. urban, suburban or rural) or sample characteristics (i.e. age, gender, race, education). • Future studies should include this information so that findings could be generalized.
Van Cauwenberg et al.[39] "Relationship between the physical environment and physical activity in older adults" *Health & Place* 2011	Systematic review To provide a comprehensive overview of studies investigating the relationship between the physical environment and overall physical activity and the following domains: recreational physical activity, total walking and cycling, recreational walking and transportation walking in older adults.	**Older adults** • Findings relevant to the rural setting. • Most of the included studies focused on urban older adults, despite that urban/rural dwelling has a moderating effect on the physical environment/physical activity relationship.
Van Holle et al.[40] "Relationship between the physical environment and different domains of physical activity in European adults" *BMC Public Health* 2012	Systematic review To provide an overview of the available European evidence from over the last decade.	**European adults (18–65 years)** • There was convincing evidence of a negative relationship, which means that people living in less urbanized areas tended to be more physically active. That said, the review found a positive relationship between urbanization and cycling and total walking. • The counterintuitive evidence regarding the degree of urbanization may be because occupational or domestic-oriented activities like gardening made the largest contribution to the total physical activity measures in the involved studies, and suburban or rural places lend themselves more to such pursuits than do urban ones.
Remote, northern and reserve settings		
Johnston et al.[41] "A review of programs that targeted environmental determinants of Aboriginal and Torres Strait Islander Health" *International Journal of Environmental Research and Public Health* 2013	Literature review To identify Indigenous health interventions that targeted environmental determinants of health.	**Aboriginal People and Torres Strait Islanders** • Several programs reported developing infrastructure for physical activity as a strategy. • Some discussion of interventions aimed to increase physical activity by targeting community infrastructure. For example, the review discusses the installation of swimming pools and the development of a "No School No Pool" policy in remote communities in Western Australia.

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TABLE 2 (continued)
Summary of included review articles

Author / Article title Journal / Year	Type of review / Objectives	Relevant findings and implications
Shilton and Brown[42] "Physical activity among Indigenous and Torres Strait Islander people and communities" *Journal of Science and Sport in Medicine* 2004	Review To present recently published evidence on effective interventions promoting physical activity in this population.	**Aboriginal People and Torres Strait Islanders** • A limited number of physical activity interventions are described in the peer-reviewed literature. • One of the interventions included in the review did not focus specifically on physical activity but was relevant to the promotion of physical activity. According to the review, this study assessed the impact of opening swimming pools in two remote Indigenous communities. While participation in physical activity was not assessed in the study, the review notes that the swimming pool study has the potential to promote more widespread participation in swimming. • The review calls for further well-designed research into the effectiveness of innovative strategies to increase physical activity among Indigenous people.
Towns et al.[43] "Healthy weight interventions in Aboriginal children and youth" *Canadian Journal of Dietetic Practice and Research* 2014	Literature review To identify and describe interventions aimed at reducing overweight or obesity risk among Indigenous children and youth and to present evidence of their effectiveness.	**Indigenous children and youth (0–18 years) or family health** • Of the 7 interventions explored, the Kahnawake Schools Diabetes Prevention Project (KSDPP) was the only one with a significant environmental component relevant to physical activity. • The goal of the KSDPP was to reduce rates of obesity and type 2 diabetes by improving children's knowledge, attitudes and behaviours regarding healthy diets and physical activity and to change school environments and the nutritional content of school meals. The intervention included classroom activities and teacher training as well as community activities. • The KDSPP strengthened an existing school nutrition policy and implemented new cycling and walking paths in the community. • Physical activity was increased in some years, but these had returned to baseline by year 8.
Teufel-Shone et al.[44] "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* 2009	Systematic review To describe physical activity interventions implemented in American Indian/Alaska Native populations in the USA and Canada.	**American Indians, Alaska Natives, Indigenous peoples of Canada, Native Hawaiians and/or Native United States Samoans** • Of the 64 interventions, 48 (75%) described an environmental resource or policy component aimed at modifying aspects of the social or physical environment. • Of these 48 programs, 6 involved developing fitness centres that offered access to exercise equipment and 2 involved the construction of walking paths.
Young and Katzmarzyk[45] "L'activité physique chez les Autochtones au Canada" *Applied Physiology, Nutrition, and Metabolism* 2007	Review To summarize available information on patterns of physical activity, their determinants and consequences, and the results of various interventions designed to increase the physical activity of Indigenous peoples in Canada and the USA.	**First Nations, Inuit and Métis in Canada** • Describes the Kahnawake Schools Diabetes Prevention Project (KSDPP), an intervention in a Mohawk community outside of Montréal, that includes a school nutrition and healthy lifestyle education program, community-wide events and environmental changes, such as the building of a recreational path, to promote walking and running. • Characterizes the intervention as a complex package with multi-setting strategies implemented through dynamic exchanges between a range of community partners. • Calls for more research in a number of areas related to physical activity, for example, to identify determinants of and barriers to physical activity in a variety of environmental and cultural contexts.

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TABLE 2 (continued)
Summary of included review articles

Author / Article title Journal / Year	Type of review / Objectives	Relevant findings and implications
Natural settings		
Abraham et al.[6] (see above)	Scoping review / qualitative literature review To provide a scoping study of publications on the health-promoting influence of landscape.	**Population not reported** • The landscape can be imagined as a continuum between "wild" nature and "designed" environment, for example, urban and rural forests, green spaces, parks, gardens, waters and neighbourhood areas. • Many of the studies show that forests play an important role when it comes to outdoor physical activity outside of cities, with people using forests mainly for recreation and exercise, including walking, hiking, kayaking and fishing. • More research is required to better understand the health-promoting impacts of different landscape characteristics.
Gladwell et al.[46] "The great outdoors: how a green exercise environment can benefit all" *Extreme Physiology & Medicine* 2013	Literature review To consider the declining levels of physical activity, particularly in the West, and how the environment may help motivate and facilitate physical activity.	**Population not reported** • Management of countryside, forests and more extreme environments needs careful consideration to ensure access for all without having too many people visiting these areas as this would potentially destroy the natural environment that elicits these health benefits. • The challenge for researchers in this field is not only to determine whether knowledge of nature's health benefits can act as a motivator for behavioural change, but also to ensure that the increased use of "nature as a therapy" is accompanied by a conservationist approach to ensuring preservation of the environment.
Maller et al.[47] "Healthy parks, healthy people: the health benefits of contact with nature in a park context" School of Health and Social Development, Faculty of Health, Medicine, Nursing and Behavioural Sciences, Deakin University Burwood, Melbourne 2009	Narrative review To review the potential and actual health benefits of contact with nature.	**Population not reported** • In terms of physical benefits, parks provide a variety of settings and infrastructure for formal and informal sport and recreation, such as picnicking, walking, dog training/walking, running, cycling, ball games, sailing, surfing, photography, birdwatching, bushwalking, rock climbing and camping. • There is a lack of awareness about opportunities for enhancing health provided by larger wilderness parks, such as national parks. • Some of the most important wilderness areas around the world are located in parks. National parks in Australia (such as Big Desert and Wabba Wilderness Park) are designed for conservation but are also ideal for self-reliant recreation.
Thompson et al.[48] "Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors?" *Environmental Science and Technology* 2011	Systematic review To provide an objective means of clarifying the value of outdoor green spaces in motivating physical activity and in conferring mental and physical well-being.	**Adults or children; no eligible studies involving children were retrieved** • The natural environment includes many different types of green space such as wilderness areas, allotments, urban parks, open countryside, country parks, woodlands and wildlife reserves. • While the impact of these different types of green space on well-being has begun to be investigated, the interaction of this impact with physical activity has yet to be clarified.

policy action in Canada, and to set a course for applied research on physical activity in rural, remote and northern communities to support that practice and policy action, we held a one-day priority-setting conference on physical activity in rural and remote/northern settings with 28 invited experts. These experts represented the spectrum of rural and/or remote/northern physical activity promotion-related research, policy and practice from across Canada. (Note: based on strong recommendations from the relevant experts, the remote and northern categories from the literature were combined for the conference.) Participants included an Indigenous elder as well as practitioners and senior decision-makers from the North and from across Canada; representatives from municipal and provincial public health agencies and municipal planning agencies; university or institute-based researchers; and experts from sport and recreation, community and medicine. The experts were identified through a search of the scientific and grey literature (e.g. policy documents and guidelines) on the topic and based on the recommendations of the Policy Advisory Group of the Policy Opportunity Windows – Engaging Research Uptake in Practice (POWER UP!) CLASP initiative, a panel of international experts on policy related to obesity and chronic disease prevention.

The scoping review results were provided to the participants in advance of the meeting so that they could review the evidence synthesis analysis and findings; critically

reflect on how that body of literature could inform enhanced action on physical activity in rural, remote and northern Canadian communities; and identify what was missing from the evidence synthesis. An overview of the findings was presented to the participants on the day of the conference.

While the evidence synthesis broadly explored rural, remote, northern and natural settings, the priority-setting conference narrowed that focus to specifically address rural and remote/northern settings based on recommendations from invited participants, recognizing that natural settings would be addressed as part of both.

This study was approved by the Health Panel of the Research Ethics Board at the University of Alberta.

Data collection

The priority-setting conference used a collaborative three-phased process that encouraged participants to generate priorities for action based on the available evidence and their own policy or practice-based experiences. Detailed notes were taken throughout the process. In the morning, presentations delivered by five experts focused on current research evidence and practice or policy-based experiences in rural and northern/remote settings, including one presentation that summarized findings from the evidence synthesis, and to unravel the nuanced, contextual nature of the issue of physical activity in rural and remote/northern settings. Two small group discussions organized by setting (rural and remote/northern) then took place simultaneously. In these discussions, the experts identified key priorities for the setting based on their own experiential knowledge and understanding of the research evidence, while also considering the information shared in the presentations and in the dynamic group discussions.

Data analysis

The analysis of priority-setting findings was collaborative. The participants reconvened as a large group to share their small-group priorities and to identify remaining issues. Then, working in new small groups, the experts selected their top three to five priorities for research, policy and practice. This provided them with another opportunity to share their perspective and expertise. To close the conference, the small groups came together to rank and finalize a set of priorities.

We then used this list of priorities alongside the evidence synthesis and consideration of relevant policy and practice documents to compile an initial Canadian call to action on the promotion of physical activity in rural, remote, and northern settings.

Results

Literature review

Rural settings

Review articles with a stated rural focus

We identified four review articles that focused explicitly on rural (or remote) settings[8,17-19] and that investigated the effects of the built environment on physical activity,[8] determinants of physical activity,[18] barriers and motivators to physical activity[8,17] and differences in physical activity in rural, urban and suburban built environments.[19] Demographic groups reported included children and adolescents,[19] women,[18] adults[8] and older adults.[17] Studies took place primarily in the United States of America (USA), as well as in Canada and Australia. One review incorporated studies from Cyprus, Iceland, Italy, Norway and Sweden.[19]

Defining rural

None of the four review articles provided explicit criteria on how they defined "rural." For example, Frost et al. [8] reviewed studies that identified the population as "rural," whereas Olsen et al.[18] used a varied definition, noting that one study limited the sample to communities of fewer than 1000 persons with no towns within a certain radius, while another included towns with up to 49 999 residents.

Barriers and motivators

Three out of the four rural-focused review articles discussed findings related to environmental motivators and/or barriers in rural settings. Examples of identified barriers included lack of sidewalks,[8,18] poor lighting/lack of streetlights,[17,18] safety concerns (i.e. crime, presence of hunters),[8,17,18] the weather,[17,18] dogs or wild animals[17,18] and lack of physical access to facilities, transportation[8,17,18] and parks.[8] For example, Boehm et al.[17] found that social and environmental barriers to exercise for older people—such as a poor built environment, presence of dogs and bad weather—were more common in rural and remote community settings. While additional research is necessary, the review articles suggest there is a need for (1) policy to address barriers to physical activity in terms of the built environment (i.e. transportation, safety), particularly in specific populations (e.g. rural women); (2) for environmental design to consider environmental motivators and barriers; and (3) for practitioners to explore strategies to overcome these barriers.[8,17]

Associations between physical activity and the built environment

In their review of 20 studies, Frost et al.[8] identified 11 elements of rural built environments associated with physical activity levels in adults: sidewalks, street lighting, private and public recreational facilities, parks, malls, aesthetics, crime/safety, traffic, walking destinations, trails and access to the environment. To varying degrees, these studies explored the following elements: aesthetics (4/4 studies); perceptions of safety/crime levels (6/9); and presence of recreational facilities (5/10), trails (4/6) and parks (3/6). All these elements were found to be associated with physical activity levels.[8] Frost et al. then compared findings from rural settings with those from 18 urban studies, and found that physical activity was positively associated with aesthetics in both settings, but that safety/crime levels, traffic and trails were better predictors of physical activity in rural settings.[8] This evidence suggests that built environment features associated with adult physical activity may differ between rural and urban settings.

Differences in physical activity between rural, urban and suburban built environments

Of the four rural-focused review articles we included in our synthesis, Sandercock et al.[19] had an explicit objective to compare differences in the physical activity levels of children living in urban and non-urban settings. Only 6 of the 18 studies Sandercock et al. reviewed explored physical activity beyond the rural/urban dichotomy and included suburban and/or small-town settings and/or populations. They found that physical activity levels of children in urban and, in some cases, rural settings were lower than those of children in suburban/small-town settings, a result (the authors suggest) of suburban and small towns sharing a mix of rural and urban characteristics. Suburban settings were also found to have fewer low

socioeconomic households and ethnic minority residents, two characteristics negatively associated with physical activity in adults.[19] Sandercock et al. recommended that future studies consider socioeconomic status, racial factors and seasonal effects relative to physical activity within different built environments.

Review articles from the wider physical activity literature, with relevant findings and/or implications for rural settings

It was a challenge to draw definitive conclusions from the diverse evidence base. Taken together, these 24 review articles reiterated the importance of understanding how geographical differences can influence relationships between the built environment and health-related behaviours, and recommended setting sensitive environmental interventions.

Remote, northern and reserve settings

We identified five review articles on Indigenous health that included findings relevant to remote, northern and/or reserve settings (we did not find any review articles relevant to remote or northern settings that did emphasize Indigenous health). Four of these review articles discussed interventions to promote physical activity, either alone, or as an aspect of obesity or set of health outcomes. The fifth review article discussed physical activity correlates and patterns among Indigenous peoples in Canada and the USA, and provided an overview of intervention studies.[45] Studies included in the review articles took place in Australia,[41,42] the USA[43-45] and Canada.[43-45]

Environmental interventions to promote physical activity in Indigenous communities

The five review articles on Indigenous health discussed different interventions aimed at promoting physical activity that included an environmental component. For example, of the seven interventions aimed at promoting healthy weights among Indigenous children and youth that Towns et al.[43] identified, only two were multicomponent interventions involving an environmental or policy change. In contrast, Johnston et al.[41] and Shilton and Brown[42] reported on the building of swimming pools in two remote Indigenous communities in Western Australia, where the goal was to increase school attendance and improve primary health outcomes. The review articles suggested that interventions like these demonstrate the value of implementing comprehensive strategies to meet a range of community needs in resource-limited remote communities.

Teufel-Shone et al. [44] found that the majority of physical activity interventions in remote regions in Canada and the USA (72%) took place on reservations, reserves or pueblo. About 75% of the 64 interventions described an environmental resource or policy component aimed at modifying aspects of the social or physical environment. Effective interventions had an impact at various levels, including on risk behaviours and on health and fitness. Key factors for success included support from local leadership and the incorporation of cultural traditions into public health practice.

The review articles highlighted the need for more culturally relevant research that focuses on the histories of rural and remote Indigenous communities across a greater variety of geographical and cultural contexts.[43-45] For example, the review articles revealed that barriers and opportunities for physical activity in Indigenous communities are not homogenous and that findings from one geographical region (e.g. country, province or community) or population (e.g. elders or children) may not readily apply to other regions or populations.

Natural settings

Four review articles that explore physical activity in natural settings (e.g. natural parks and wilderness areas) were identified. These review articles focused on a range of topics, including health benefits of contact with nature;[47] landscape as a resource for well-being;[6] physiological benefits of exercise in a green environment;[46] and effects of participation in physical activity in natural environments versus indoor settings.[48] These review articles suggest there is a lack of awareness of the role that natural environments play in promoting physical activity and enhancing health,[47] particularly when these settings are considered as a feature of rural, remote or northern communities. Yet, there is also growing evidence for the importance of connecting with nature for people's health. For example, natural landscapes were found to have a greater restorative effect on mental fatigue and be better able to improve the ability to concentrate than urban areas.[6] At the same time, there is concern about the sustainability of natural settings and the environmental impact of increased human presence,[46] which suggests there is a need for intervention design for communities in natural areas.

Overall, across all non-urban settings, continued and enhanced efforts are required to synthesize and translate available evidence to inform the work of Canadian practitioners and policy makers. Furthermore, there is a need for additional primary research that uses scientifically robust methods to address current research gaps and limitations on this topic.

Priority-setting conference outcomes

The conference resulted in the identification of key priority areas for action and applied research to promote physical activity in rural and remote/northern communities. The key priorities represent the immediate and longer-term evidence needs and priorities of practitioners and academics working in these distinct settings.

Rural settings

Community self-identification of priorities and needs through collaborative processes with researchers.

- Involve rural communities in identifying research and policy priorities that promote physical activity in these settings to ensure that outcomes are meaningful and actionable for researchers, practitioners and policy makers.
- Increase funding opportunities that create spaces for collaboration between community members, practitioners, researchers and policy makers.
- Take inventory (of what is already happening) and develop a database of best practices to support moving knowledge to action.
- Develop a national virtual infrastructure to house best practices from across Canada.
- Work with communities, researchers, practitioners and policy makers to identify gaps and promising practices.
- Simultaneously understand, act and continually move forward on what is already known about promoting physical activity in rural settings despite the limited, if emerging, evidence base.
- Capture context in rural settings through qualitative and descriptive research.

- Promote the use of focused qualitative and descriptively rich research to develop policies and programs that are relevant to the specific contexts of communities, given the heterogeneous nature of rural communities.
- Use qualitative and descriptive research to unravel the specific nuances of different rural contexts. These findings can subsequently be compared and contrasted across different settings to help address some of the extant challenges in defining "rural" in Canada.

Remote/northern settings

- Look at physical activity in rural, remote and northern communities through a holistic lens (e.g. as an integral part of daily life).
- Assist practitioners and policy makers in identifying a broader range of opportunities to showcase the value of physical activity.
- Integrate physical activity with other community initiatives (e.g. when promoting mental wellness).
- Develop culturally appropriate programs, for example, focusing on the connection between land and food; the role of physical activity in healing, resilience and well-being; and the preeminent focus on wellness as a starting place would be a way of promoting Indigenous leadership for culturally-relevant physical activity opportunities.
- Create more opportunities for leadership, mentorship and resource development.
- Support community members, including youth, who are promoting physical activity in their communities to enhance long-term sustainability.
- Identify a broader pool of community members—youth, community ambassadors and recreation leaders, among others—to support physical activity initiatives.
- Identify existing training opportunities that support physical activity (e.g. the Certificate in Aboriginal Sport and Recreation* at the University of Alberta trains people within their own communities to develop expertise).
- Carefully consider how capacity building is defined; who decides what capacity is needed; who the trainers are; and who needs support.

Compile experiences in a database

- Develop and share an inventory of the different programs, activities and policies across Canada that promote physical activity in remote/northern settings.
- Incorporate local knowledge and community voice to ensure that culturally relevant activities are captured as part of documentation and sharing processes.
- Ensure resources are readily available and shared in a variety of ways (different languages, formats, e.g. video as well as text) to enhance reach to multiple cultural and geographical contexts.

Discussion

Expert participants at the priority-setting conference saw the need to move beyond the limited guidance currently available through extant research on physical activity in rural and remote settings to make meaningful, equitable and timely progress on physical activity promotion in those settings. In addition to careful consideration and discussion of the evidence, the experts drew on their rich and deep experience of working in these settings as practitioners, decision makers and researchers. Thus, while building from the evidence synthesis, the call to action described above reports on expert recommendations that recognize the nuance, variation, process and contextual issues that transcend the evidence currently available in the literature.

While the evidence synthesis and priority-setting process revealed similar issues and priorities in rural, remote and northern settings, the experts drew on their knowledge of the issues to clarify and expound on the implications for physical activity research and practice in these settings. Future research must address the problematic lack of clarity, transparency and consistency in how the term "rural" is defined and conceptualized.[8,18,19] The lack of definition and conceptualization may limit the usefulness of the evidence and thus have a detrimental impact on the applicability of the findings for other rural settings.[8,17] This lack of transparency and consistency compromised the utility of the findings from the review articles and led conference participants to deliberate on why it is complicated to define "rural." For example, noting that rural areas can vary greatly, Statistics Canada defines rural areas as "small towns, villages and other populated places with less than 1000 population according to the current census" and can include "agricultural lands" and "remote and wilderness areas."[49] Currently, Statistics Canada's definition has not been uniformly adopted by provincial/territorial health authorities or other governmental or organizational bodies concerned with rural or remote settings as other definitions may better align with particular service mandates or jurisdictional authority. While "rural" is a heterogeneous construct, further complications to the notion of a single definition are the similarities in the experience of rurality, despite wide differences in population-based or geographic characteristics often assigned to definitions of rural. A clear, consistent and transparent definition of "rural" would facilitate effective knowledge sharing across settings. The experts participating recommended the use of rigorous qualitative and mixed-method approaches as a starting point to unravelling this complexity.

The review articles noted the lack of peer-reviewed articles focusing on interventions targeting broader environmental levels for remote and northern settings.[41,43] While setting priorities, experts echoed this concern and called for more resources dedicated to systematically promoting physical activity in these settings. Participants acknowledged the wealth of existing practice and policy under way (that is not adequately represented in current academic literature) and emphasized the need to increase investment in long-term sustainable funding and develop innovative funding models to reinvest in promoting physical activity in rural, remote and northern communities (i.e. which is also emphasized in the ParticipACTION Report Card on Physical Activity for Children and Youth[50,51]); and document and share success stories and best practices in a more systematic way, including a focus on grey literature.

Experts described how this investment is particularly important in Indigenous rural or remote/northern communities to address the inequity of resources that promote physical activity[52] and to systematically measure and reveal how those resource inequities are related to poor

* https://www.ualberta.ca/kinesiology-sport-recreation/programs/undergraduate-programs/certificates/certificate-in-aboriginal-sport-and-recreation.

health and social outcomes. Further, efforts to document the wide range of sources of evidence related to physical activity in rural and remote settings should be governed by rigorous, transparent and culturally appropriate criteria, including Indigenous research methods that are led by the communities themselves.

Expert participants from both rural and remote/northern settings groups identified similar best processes when bridging research, practice and policy gaps, suggesting that local community members, practitioners and decision-makers be actively involved in identifying issues and developing and implementing solutions. While this was not a theme identified in the evidence synthesis, it is reflected in both the *State of Rural Canada 2015* report[13] and the 2016 *Pathways to Policy* report,[53] confirming the experts' rich process recommendations. Participants also raised the notion of community capacity to support physical activity in rural and remote/northern settings—an idea that echoes ParticipACTION's 2016 report card.[50] For example, they cited leadership development with youth and other community leaders in remote/northern communities as a key process to support long-term sustainability.

Expert participants carefully acknowledged the unique differences between rural and remote/northern settings. For example, experts from remote/northern settings emphasized the holistic nature of promoting physical activity, noting that action should reflect community culture and be integrated with core community priorities and Indigenous leadership. Experts stressed the importance of taking a strengths-based perspective and focusing on moving-to-the-land and on-the-land programs that involve traditional activities (e.g. hunting, snowshoeing) which embody physical activity and built environment concepts in ways that are relevant to the community. Priority-setting participants proposed focusing on resiliency-based programs (e.g. a return to connecting culture, the land and medicine) as one approach for moving forward.

Call to action

We present the following Canadian call to action, which outlines a focused direction to support the implementation and success of population-level and environmental initiatives targeting physical activity in rural, remote and northern communities (Table 3). This call to action emerged from the priority-setting meeting, which was informed by both the evidence synthesis and the experts' critical reflection—one that is based on their current policy and practice expertise. This call to action, which is intentionally coordinated across policy, practice and research domains, also reflects recommendations from the National Collaborating Centre for Aboriginal Health[52] to promote cultural relevancy and anti-oppressive practices as they relate to communication, knowledge generation and leadership.

To support timely knowledge translation with practitioners and policy makers, an earlier version of the evidence synthesis and the outcomes of the priority-setting conference were posted on the public website of the Alberta Policy Coalition for Chronic Disease Prevention, a partner in a funded project on policy interventions to address obesity and chronic diseases.

Strengths and limitations

There are potential limitations to this analysis. First, categorizing review articles by type of setting proved to be challenging because the terms used—"rural and remote," "rural" and "reserve"—were often conflated in the literature, despite having different operational meanings. Similarly, Canadian priority-setting participants used the terms "remote" and "northern" synonymously in their deliberations, yet these terms are used differently in the international literature dealing with rural and remote health. Second, the review process did not account for data quality as an inclusion criterion [i.e. to offset the limited number of review articles available; as well, while 13 directly related to non-urban settings (rural, remote, northern and natural), 24 were not directly related to these settings but mentioned rural or remote communities in their recommendations]. Thus, some included review articles may be of poor quality. Third, as this synthesis reported on evidence explicitly outlined within the review articles, relevant information reported at the study level might not have been captured.

The strength of this initiative lies in its integrated knowledge translation approach: we deliberately brought scholarly evidence together with experiential evidence

TABLE 3
Canadian call to action on the promotion of physical activity in rural, remote and northern settings

Policy	Increase long-term sustainable funding and develop innovative funding models to reinvest in promoting physical activity in rural, remote and northern communities. For example, flexible opportunities are needed for community members and practitioners to respond to local priorities and support communities across Canada to share success stories and best practices in a meaningful and accessible way, including the ability to work together across language barriers.
	Create opportunities to collaborate with community members, practitioners and researchers living and working in rural, remote and northern communities in policy development, implementation and evaluation.
Practice	Develop and implement training opportunities to strengthen local capacity and recognition and inclusion of Indigenous models of leadership to promote physical activity over both the short and long terms.
	Identify and engage a broad range of physical activity practitioners and informal leaders to collaborate in the development of culturally appropriate programs and policies (e.g. youth in the community and Indigenous elders).
	Contribute to the development of a culturally appropriate evidence base (recognizing different ways of knowing and learning) by fostering a dynamic system for sharing best practices and success stories across Canada.
Research	Work closely with community leaders, practitioners and policy/decision makers to identify gaps in knowledge and act as knowledge brokers between practice and policy domains.
	Promote the use of research methods in implementation and evaluation research that are designed to capture the unique context of different rural, remote and northern communities (e.g. qualitative and mixed methods as well as Indigenous research methods). Use of these methods will support scaling up initiatives across settings by identifying what works for who, where and why.

from practice and policy to shed light on this critical health equity issue. Synthesis findings were contextualized and enhanced by experts' knowledge to support future research and action on physical activity in non-urban settings. We recognize and are currently acting on the need to continue to engage stakeholders with additional perspectives to be part of future discussions and strategic planning on facilitating physical activity in rural, remote and northern settings.

To this end, we will be hosting a follow-up priority-setting conference to make headway on this new Canadian call to action. The meeting will convene a wider group of researchers, practitioners and policy makers working in the area of physical activity in rural, remote and northern settings to critically analyze this call to action; highlight examples of current practices and new gaps for each type of setting addressed in the call to action; and form working groups to begin addressing the specific actions noted in the call.

The need for anti-oppressive practices in the development and sharing of knowledge for the benefit of non-urban population groups, particularly Indigenous groups, will also be addressed at this meeting. Specifically, we will seek leadership and guidance from Indigenous community leaders (or members), local practitioners and experts in developing and hosting the event so as to not reproduce Canada's colonial legacy.

Conclusion

Access to supportive settings for physical activity is critical for promoting health and well-being. The lack of policy, practice and research action on physical activity and features of the physical, built and natural environments in rural, remote and northern settings is a significant threat to population health equity in Canada. To begin to address this challenge, we brought together experts from the research, policy and practice domains to develop a Canadian call to action based on a synthesis of evidence reviews that focused on physical activity promotion in rural, remote or northern communities. The call to action outlines a focused direction to support the implementation and success of population-level and environmental initiatives targeting physical activity in rural, remote and northern communities. Coordinated action across policy, practice and research domains will be essential to the success of these recommendations.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Authors' contributions and statement

All authors reviewed and approved the final manuscript. All authors except KK participated in the priority setting meeting. CN led the design and analysis of the review of reviews, chaired the priority setting meeting, drafted recommendations, and contributed to drafting and finalizing the manuscript; KA conducted the review of reviews, drafted recommendations, and contributed to drafting and finalizing the manuscript; KR contributed to drafting the recommendations and finalizing the manuscript; KK drafted the manuscript; and SB, WC, TG, JG, and JM presented evidence at priority setting meeting and contributed to drafting and finalizing the manuscript.

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Researchers from the Public Health Agency of Canada also contribute to work published in other journals. Look for the following articles published in 2018:

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