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Original qualitative research

Children's Oral Health Initiative: workers' perspectives on its impact in First Nations communities

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Abstract

Introduction: Since 2004, the Children's Oral Health Initiative (COHI) has been working in many First Nations and Inuit communities in Canada to address oral health disparities, specifically early childhood caries (ECC). The COHI community-based approach improves early childhood oral health (ECOH) by balancing prevention with minimally invasive dentistry. The goal is to reduce the burden of oral disease, mainly by minimizing the need for surgery. We investigated program success in First Nations communities in the province of Manitoba, from the perspective of COHI staff.

Methods: First Nations community-based dental therapists and dental worker aides participated in three focus groups and an in-depth semistructured interview. The collected data were thematically analyzed.

Results: Data from 22 participants yielded converging and practitioner-specific themes. Participants reported that dental therapists and dental worker aides provide access to basic oral care in their communities including oral health assessments, teeth cleaning, fluoride varnish applications and sealants. The participants agreed that education, information sharing and culturally appropriate parental engagement are crucial for continuous support and capacity building in the community programs. Low enrolment, difficulty accessing homes and getting consent, limited human resources as well as lack of educational opportunities for dental worker aides were identified challenges.

Conclusion: Overall, the participants reported that the COHI program positively contributes to ECOH in First Nations communities. However, increased community-based training for dental workers, community awareness about the program, and engagement of parents to facilitate culturally appropriate programming and consent processes are critical to improving program outcomes.

Highlights

- The Children's Oral Health Initiative (COHI) program is contributing to the promotion of early childhood oral health in Manitoba First Nations communities.
- COHI workers network with existing community programs and provide dental services, preventive oral health education and care through home and school visits.
- Difficulty accessing homes and getting consent, poor housing conditions, limited resources and inadequate training of dental worker aides are barriers to providing effective preventive oral health care.
- Increased community awareness, participation and support of workers are crucial to the effectiveness of the COHI program.
- Access to timely treatment of early childhood caries and increased and sustained oral health through COHI may help reduce the incidence or severity of caries.

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Keywords: *qualitative research, early childhood oral health, Indigenous people, dental care for children, community-based oral health, oral health promotion, Manitoba, Canada.*

Introduction

The Children's Oral Health Initiative (COHI) began as a community-based intervention in 2004. Sponsored by the federal government, COHI was implemented nationally by the First Nations and Inuit Health Branch (FNIHB) of Indigenous Services Canada in many First Nations and Inuit communities to promote early childhood oral health (ECOH) and prevent early childhood caries (ECC). This population health program was established to address the oral health inequities and disparities affecting Indigenous Peoples in Canada.[1,2] ECC in First Nations and Inuit children often progresses to severe early childhood caries (S-ECC).[3,4] COHI is directed towards children aged 0 to 7 years, their caregivers and pregnant women. Interventions include preventive and non-surgical care in community-based settings.[5]

As a community-based initiative, COHI emphasizes community ownership, with the health service administrations of participating communities hiring and supporting dental worker aides who deliver services within the community. This approach is in keeping with First Nations' self-governance and self-determination goals in health care[6,7] and recommendations of the United Nations Declaration on the Rights of Indigenous Peoples.[8]

The First Nations and Inuit Health Branch (FNIHB) of Indigenous Services Canada is responsible for providing the resources to support the implementation of COHI in communities in most Canadian provinces, including Manitoba.[9] COHI workers, that is, dental hygienists, therapists and aides, are hired through First Nations organizations or First Nations bands in those communities that have assumed responsibility for managing their health services; FNIHB operates COHI in other First Nations and Inuit communities.

COHI dental worker aides act as the community members' link to oral health care; they liaise and network with individuals and programs, raise oral health awareness and provide oral health education, collaborate with and schedule appointments with dental therapists and dental hygienists, and conduct general health promotion and disease prevention activities such as applying fluoride varnish.[5]

Previous evaluations of the COHI program targeted parents and caregivers with children in the program to assess their perspectives on the program's effectiveness in increasing access to preventive dental services.[10] The long-term effect of the services of COHI dental worker aides on access to the program's preventive dental services was also measured.[11] These studies reported that the program successfully increased access to oral health care.[10,11] The parents and caregivers who participated in one of these studies suggested that a community-based oral health prevention strategy had had a beneficial effect on the oral health knowledge and behaviours of the entire community.[10] Mathu-Muju et al.[11] also found that dental worker aides promoted enrolment and facilitated access to preventive dental services, especially where the program had been uninterrupted and consistently implemented over several years.

Until now, COHI workers' perspectives on their services as dental therapists, hygienists and aides have not been explored. In this current study, our aim was to evaluate the success of the COHI program in Manitoba First Nations communities through the observations and experiences of community-based COHI staff. The findings could inform decision-making regarding continuation, modifications and expansion of COHI to more First Nations and Inuit communities. Our overall objectives were to explore COHI worker's attitudes towards and experiences with the program, and to determine their perspectives on the impact the program has on First Nations and Inuit children's dental health, including what makes COHI successful and what the challenges are in delivering COHI.

Methods

Ethics approval

Ethics approval for the study was obtained from University of Manitoba Human Research Ethics Board (HS19539 - H2016: 096) and the Health Information and Research Governance Committee (HIRGC) at the First Nations Health and Social Secretariat of Manitoba (FNHSSM).

Study design and participant selection

This qualitative study consisted of one key informant in-depth interview and three separate, but consecutive, focus groups with COHI workers. We used purposive (criterion) sampling to select information-rich cases. FNIHB or individual First Nations organizations or bands in Manitoba employed all the COHI workers eligible to participate in this study. FNIHB helped the research team with purposive sampling and direct referrals of participants. This sampling method was deemed appropriate as FNIHB had an existing relationship with all the prospective participants.

In December 2019, the research team invited community-based COHI workers employed in Manitoba to participate in the focus groups in Winnipeg, Manitoba. We used grounded theory methodology to facilitate understanding of participants' experiences with the COHI program and determine their perspectives on the effect of the initiative on young First Nations and Inuit children's dental health. In this process, data were collected through interviews and preliminary analyses concurrently, with emerging themes applied to guide the next round of data collection sessions. Such constant comparisons are a key element in the grounded theory approach. Concepts and themes were constructed from the experiences and perspectives shared by participants in the study.

Study participants

Twenty-two COHI workers participated in the focus groups and interview. A key informant who was both a COHI coordinator and a hygienist and who worked with multiple First Nation communities was interviewed separately for their in-depth knowledge as they were unable to attend the focus groups.

Focus groups were in person and the key informant interview was conducted via telephone. Each focus group had seven participants, and sessions were approximately 90 minutes long. The focus groups were conducted at the RBC Convention Centre in Winnipeg, Manitoba, during a COHI training session. The participants received a small honorarium in appreciation for their time and participation.

The focus group procedure and interview guide were reviewed and approved by the

research team. Study information and consent forms were administered prior to starting the sessions. The participants were told that their participation was voluntary and that they could withdraw their consent at any time during the focus group and leave the session.

Data collection and analysis

Demographic questionnaires were administered at the start of the sessions, before the focus groups and the interview. The questionnaires were not shared with the qualitative researcher until all data had been collected, and the participants did not identify themselves or others throughout the focus group sessions.

The qualitative researcher (GK-A), a female from outside the communities with over 5 years of experience as a qualitative researcher, facilitated the focus group sessions along with two note takers. GK-A also conducted the key informant interview. Her not being a COHI worker put her in a position where she was able to generate themes and concepts without preconceived notions.

All the participants responded to 12 open-ended interview questions (shown in Table 1) to elucidate attitudes, beliefs and values associated with their work. The interview guide was validated through triangulation and consultation with experts in the field. Data were generated primarily through group interactions. The interview questions were intended as a guide, and the participants were encouraged to talk freely about the topic on their own terms.

The participants had a chance to review the notes taken during the focus groups and provide feedback. Interviews were audio-recorded and transcribed verbatim. Transcribed data arising from the focus groups and key informant interview were reviewed for accuracy, manually coded and assessed for distinct ideas and key themes by the qualitative reviewer (GK-A). The thematic analysis was completed with the goal of understanding the COHI workers' experiences and to determine their perspectives on the impact of COHI on young First Nations and Inuit children's dental health.

Data were uploaded and further analyzed using NVivo qualitative software version 12 (QSR International Pty Ltd., Melbourne, AU).[12]

TABLE 1
Interview guide for focus groups and the key-informant interview

Section A: Operation of COHI	
1.	In your own words, can you describe what the Children's Oral Health (COHI) program does in your community?
2.	Based on your personal experience working in COHI, do you think children benefit from COHI in your community?
3.	What motivates families to enrol their children in COHI?
Section B: Cultural safety and respect	
4.	Can you describe how COHI staff attempt to make participants feel comfortable or more at ease?
5.	In what ways do you think COHI staff demonstrate respect for culture and ways of treating one another?
Section C: COHI contribution to holistic vision of health and wellness	
6.	What are your thoughts about COHI's role in contributing towards general health and wellness of COHI clients?
Section D: Healthy children, families and communities	
7.	What are the ages of children who participate in COHI?
8.	Do pregnant women and new parents attend oral health education sessions in your community?
Section E: Impacts of COHI	
9.	Do you think that COHI has changed (improved) children's dental health in your community?
10.	Do you think dental surgeries for children are reducing in your community?
Ongoing professional development	
11.	What are your thoughts on professional development for COHI staff?
12.	Are there any other comments or experiences that you would like to share?

Abbreviation: COHI, Children's Oral Health Initiative.

Results

Demographic data

Of the 22 COHI workers who participated in the focus group discussions and interview, only 17 completed their demographic questionnaires. Fourteen participants identified as First Nation. Seven COHI workers were dental therapists, two were dental assistants, one was a dental hygienist, three were dental worker aides and one was a dentist. One participant indicated that she was trained as a "community health educator." Two did not specify their level of training.

Except for one participant, who represented six First Nations communities, and another who represented 11, participants represented one community each. Overall, approximately 25 First Nation communities were represented.

The mean (SD) age of the participants was 47.4 (10.8) years (range: 25–62 years). Sixteen were female and one preferred not to disclose their sex/gender. Participants had worked in the program for an average (SD) of 11.4 (3.5) years (range: 3–15 years).

Key themes

Key themes identified by the qualitative researcher based on data from the focus groups and the key informant interview, with detailed quotes supporting each, are shown in Table 2.

Results from the thematic analysis of the focus groups and interview are presented in two over-arching categories: COHI workers' attitudes and opinions on the impact of COHI on communities; and COHI workers' challenges when delivering the COHI program.

Thematic analysis: COHI workers' attitudes and opinions on the impact of the program on communities

All COHI workers said they primarily target children aged 0 to 7 years old. They also work with expectant mothers and

TABLE 2
COHI workers' attitudes towards and opinions of the impact of the COHI program

Themes	Quotes
Providing dental services	In my community, I just work by myself for the COHI program. So, I provide services for children from 0 to 7 [years], and I do work at the daycare with consent forms. I also provide fluoride applications in a school-based environment, right in the classrooms. But I also work with prenatal [and] postnatal [moms], and I do presentations for both those groups. I do one-on-one oral hygiene education with the children and also with the parents as a one-on-one while we do the screenings and the fluorides. Everything all in one shot. The screenings are done in my office with appointments. [A007]
	Prevention of early childhood tooth decay. Early detection of any dental disease […] Early dental visits and applications of fluoride varnish. I don't do a lot of home visits, but [people] do come to my office. [B002]
	I guess it would depend on your population where you're working... for you're more north and I'm south, so for me, our rate is not that high and the habits are different […] So, for us it works really well. [But] I find if you're trying to take stats and so you're looking at a big, big picture [...] there's two people living in a house, there's people that have 8 kids… so, the social status is all different... So this program we have works for me because I may have a kid that has two temporary fillings that need to be done. Ok, well I saved them from losing a tooth if I put that temporary in there, but we may have a kid that needs multiple extractions and pulpotomies and general anesthesia. So, it differs. For me it works. I like the program. [B003]
Providing dental hygiene products	All COHI students are supplied with toothbrushes up to Grade 2, so they have their toothbrushing program in the classrooms. And when I'm in there doing their screening and fluorides, there's stickers I give them and they're pretty excited to get a sticker after. If they say they don't [have a toothbrush] […] I tell them to come find me after and I'll give them one to take home. [B001]
	At the events, I hand out kits for the parents and the children. An adult kit with the children's materials. In the school, I don't […] For each classroom involved with the toothbrushing program, toothbrushes are given for the teacher to use in the toothbrushing program and to keep them supplied for the whole year. At the daycares, they have that as well. In the schools it's a little hit or miss, some teachers are very keen on it and [for] others it's a chore… I keep working at. There is one community, I was surprised. The principal is totally against a toothbrushing program [...] He shut me down. I was talking to the teachers about the toothbrushing program, when I mentioned it to him, he said, "The more we do in the school, the less the parents are doing at home." It kind of took me by surprise because the first question he asked me was, "How are the kids' teeth?" I had only seen a few but I had seen worse, so I said they seem to be not too bad. He took that and thought, "Okay, well we don't need a toothbrushing program." [D00TPST]
Providing preventive oral health education	Well, the parents and the children, depending on age... We go to the Head Start [Aboriginal Head Start program] at [the] daycare, and we also work with the workers in those areas [urban and Northern communities]. And we show them proper oral hygiene procedures and how to dispense the toothpaste, brush… well, just the basics. [A001]
	We also provide education, like informing new mothers and those that are pregnant, on how to care for their own mouth and how it relates to the dental health of their unborn baby. So, what we really try to do is to educate at the community level with moms and dads or whoever comes into the clinic with the child. Yeah, sometimes [other programs in the community] ask us to do presentations to their prenatal classes or like, sometimes the daycare will ask us to come in and show how to brush and how to store the toothpaste and the brushes and stuff like that. [A006]
	The COHI program is like a prevention, like for the kids' teeth, and what I do is talk to the parents of the young children and I introduce them to what COHI does, like what it's for and like we're there to help the children and not have decay… I've been alone, there's no dentist there that's working with me right now. [I do] more education to the community because some of these young mothers I see, they say that they didn't know about this program and they liked it and that's how, they're going to bring their other kids that need it. [C002]
Conducting home and schools visits	We have a big group, and we have about, say – in the school, 500 maybe […] COHI-eligible children. So, we also go to the Head Start [Aboriginal Head Start program] and daycares. And, on the downtime, we […] reach out to the community, we go for home visits. [When we go on these home visits] we introduce oral health. Like, we try and correct the way they do home care or oral care at home. But many of them don't… they don't really do oral care at home. So we try and get them started. [A001]
	I work a lot with the students in their classrooms when they're just starting. I find they're more comfortable learning in their classroom setting rather than bringing them to the clinic. So, that's how I go in and I do [brushing] with them all so they at least know what they're doing when they get their toothbrushes… They just see me come and go, so it makes them comfortable to be with me rather than just being the dentist you see once or twice a year. [B001]
	Well, I teach the kids and I talk to the kids how to brush their teeth and I do home visits with young parents, I kind of tell them about how important it is to try and keep the kids teeth clean and attend regular visits to the dental therapist. [C003]
Referral to dentist and regular dental visits	[Are] the referrals for surgery considered part of COHI? […] even making those referrals and getting the kids in to get that done is a component that is necessary and done. [A004]
	The regular dental visits, yes, I guess, maybe. Like I see after they leave the COHI program, Grade 3s and Grade 6s get dental visits. But there's always that interaction with the kids when they're older because I was right in their schools. So, they approach me if they need any dental work done, any dental visits done. So, I think that early interaction with COHI is beneficial because they're aware, they know that dental care is available to them. [B002]
	It is definitely a possibility [that participation in COHI leads to regular dental visits]; I have no way of knowing if it's my program that results in them choosing to see a dentist more than if there was no COHI. I would think anything that brings awareness to oral health and the importance of keeping baby teeth and keeping a healthy mouth for overall health [helps]. I think if parents are aware at all, they are going to do what they can for their children. [D00TPST]

Continued on the following page

TABLE 2 (continued)
COHI workers' attitudes towards and opinions of the impact of the COHI program

Themes	Quotes
Networking with programs in the community to promote ECOH	What I understood as a dental worker aide is that it was my job to go make contact with the different programs and let the community know that I'm there. And so, you would think after 10 years or so with posters and being involved with families that other people would know that we were there. [A003]
	I would say the COHI program is bringing a lot of preventative services into my community. Where I spend the majority of my clinical days doing preventative stuff such as the varnishes and the sealants, when I have a dental worker aide we're able to get more education out there and tapping into the other programs, like the pre- and postnatal, etc. Teamwork… I am a team player with my visiting dentist… We always do a weekly debrief on the kids that we're seeing, the 0- to 4-[year-olds], any referrals, we cross-reference, we follow-up […] I have no problem accessing like 4 years and up and the daycare. [C005]
	I would absolutely say, yes. They welcome me in the community, the school community is very positive for the most part for having COHI. They all welcome me in the school to see the children and allow me to do the screening and fluoride and the sealants as well. [At the] health centre, most of them are positive. I generally check in with the health director when I go in. If they are not there, I usually just go in, there is no problem whatsoever. [D00TPST]

Abbreviations: COHI, Children's Oral Health Initiative; ECOH, early childhood oral health.

mothers of newborns. According to one participant:

> COHI is designed to provide preventive oral care for children from 0 to 7 years old. In the schools, [we're] seeing the children from nursery to Grade 2, and [in the] community, parents of children 0 to 4. [D00TPST]

Some participants said that they extend their services to older children. According to one:

> Yes, I am supposed to do COHI, but I don't limit my classroom presentations to Grade 2. I go all the way through to Grade 12 […] That's the only way I know that they're still getting the information. [A003]

The participants said that they provide dental services so that clients do not have to wait for care. They raise awareness of the importance of oral hygiene in young children, educating the children and their parents on oral health. They also distribute oral hygiene products where needed and conduct home and school visits to bring oral health information to parents and teachers.

The participating dental therapists described how the pressure to provide treatment often overshadowed COHI prevention and oral health promotion activities. As a result, they welcomed the support of dental worker aides' in expanding the educational aspects of ECOH:

> I've worked in the field as a dental therapist for very many years and all this COHI stuff always fell on us as a dental therapist to do it on our own. The biggest advantage of COHI is having a COHI aide that takes off your shoulders all the one-on-ones with the prenatal [moms], the one-on-ones with the parents, the presentations and doing all the networking in the community […] That takes a load off you for the preventative portion of your program. [C006]

Dental therapists said that they work alone, without dental worker aides, and tend to focus more on activities in the clinics, only sometimes extending their work to schools. Overall, they considered that COHI is helping to arrest ECC. All the participants reported seeing positive changes, with the COHI program doing what can be done to reach more people in the communities with services:

> [By] doing the annual fluorides, like we do three times a year, if we can […] I see a lot of arrested decay […] I see the extractions in [the] Grade 3s have come down quite a bit … So yeah, I do see [that] it's effective. [A007]

Thematic analysis: Challenges in delivering community-based oral health promotion and care

Some participants said that they face challenges in delivering services in the communities, finding it difficult to get access to homes and schools, to conduct oral health assessments or educational sessions with parents. Accessing homes may be hampered by an inability to locate where clients and patients live and not having enough time to include home visits in the schedule; families could be reluctant or embarrassed to be visited at home. COHI workers also expressed concerns about their safety and not knowing what may happen if they go to visit people at their homes, especially where dog attacks have been reported. Some believed patients should be directed to the local clinics for all preventive oral care:

> I don't […] do home visits, [the dental worker aide] doesn't […] do home visits... because there's [been] nurses that have gone out and they've had dog bites and stuff like that… some people don't feel comfortable. [B003]

> Like, I don't feel comfortable, someone just pulling up [into] my driveway and saying hi, I want to put varnish in your kid's mouth. Ok, well, no. And that's why the clinics are there […] I don't think we have to chase [clients]. [B003]

COHI workers reported the need for advocates in schools and community environments supporting the program:

> There is one community... The principal is totally against a toothbrushing program... He said, "The more we do in the school, the less the parents are doing at home." It kind of took me by surprise because the first question he asked me was, "How are the kids' teeth?" I had only seen a few but I had seen worse, so I said they seem to be not too bad. He took that and thought, "Okay, well we don't need a toothbrushing program. [D00TPST]

Another challenge to the effective delivery of COHI was the shortage of COHI workers and the need for more training of the available dental worker aides. Dental

therapists said they did not prioritize home visiting because of their busy schedules. According to one therapist:

> I'm not from the communities that I work in. I don't know where anybody lives, and I don't have a dental aid or anybody from the community that can take time out of their job to show me where anyone lives. Also… I usually have [clients/students] back [in] their class to get ready to go home by like 10 to 3 [...] that's the only time I see adults in the community, is after school hours. [B001]

Participants also reported that housing conditions are sometimes a barrier to caregivers adhering to oral health information. The COHI workers were concerned that the anticipatory guidance they provide during their education sessions is not being adopted and followed by parents:

> Oh, you can train [parents/caregivers] all you want, [it] doesn't mean they're going to do it. Their number one reason [is that they] don't have time or [they] don't have a sink in [their] bathroom. [B005]

Another genuine concern is that parents and caregivers in the communities have normalized the treatment of ECC under general anesthesia:

> I also find that it is almost like a rite of passage. It's just like we've got to have surgery done before we start school. Just like getting your immunizations. [A004]

> The parents think that [general anesthesia] is a normal part of life, part of childhood. [B005]

> Like, most of the children that I see […] already have gone through [general anesthesia]. [C001]

The loss of patient follow-up during referrals was a significant challenge. Participants said communication and coordination between community-based COHI workers and off-reserve dentists and dental offices is poor. For example, dentists and dental offices send patients requiring follow-up care back to their home communities without adequate documentation or preliminary information from the community-based dental workers:

> After the surgery some of the providers that do the treatment in the city do tell the parents to go in for an assessment in 2 weeks… but it doesn't get done. [Dental offices] send a report to the regional office and that report is sent to us. But sometimes [these] are like a month after the surgery [the 2-week period doesn't really happen]. And sometimes there is no report at all from the office. [A001]

The participants also reported difficulties and delays in obtaining consent forms before providing preventive oral care. Consent forms are mostly handed out to students in schools to be delivered to parents and then returned. Forms sometimes get lost in transit. Having more dental worker aides who can work more directly with families will be beneficial to getting timely consent by answering phone and community entry questions:

> I think if I can get the dental worker aide more involved, then she would be a great asset to phone people, to be the go-to person for parents to phone and ask questions, to get consent forms. The schools are very cooperative, they will send out consent forms […] but sporadically. If I go into the community, there will be maybe 3 or 4 more consent forms coming in, so they trickle in. While I'm in the community, when I fly in, I like to stay a little longer […] to allow time to send the consent forms out again, so there is time for them to come in while I'm in the community […] Having said that, it doesn't allow time for those extra consent forms to come in and see those children at the same time. [D00TPST]

Some participants said they are worried that there is not enough awareness of the program in the communities even after several years. Some dental therapists and worker aides reported feelings of despair as they worked hard to curb ECC, and yet the number of children with tooth decay was still high:

> You're creating more awareness in the community about dental health so they're receiving treatment sooner, at a younger age, but that doesn't necessarily mean the health of the children is improving because they're still getting decay. It's just being treated sooner […] the stats and the dmft [cumulative count of the number of decayed, missing and filled primary teeth due to caries] is not really changing […] I'm saying [that] COHI is making a difference, but slowly. [C005]

Overall, the participants considered the program to be helpful. They said that the changes expected of the program may not be massive, but they are addressing oral health problems in the communities:

> I think it's working, it's not […] overwhelming, like in your face, a big spat change, but it's slowly addressing small problems of the bigger issue… I am First Nation; I grew up in isolation, I know exactly what we're faced with […] But I love what I do. We try and get what we can done, and having the second set of hands to reach more people, I guess, within the working day helps. [C005]

COHI workers' descriptions of the challenges and barriers to effective delivery of oral health promotion and care are shown in Table 3.

Discussion

Investments in community-based health care to promote local control of care and improve Indigenous health outcomes are essential.[13,14] The COHI program was implemented, in 2004, in an effort to decrease the burden of ECC in Indigenous children.[5]

In this study, we evaluated the experiences of community-based COHI workers as well as their perspectives on the impact of the program on First Nations children and their families in Manitoba. The study participants said the COHI program helps to support ECOH and prevent ECC in First Nations communities. This complements the view of parents and caregivers of program beneficiaries.[10] The participants described their specific tasks as benefiting children by providing opportunities to affect ECOH positively.[5]

A key reason for the ongoing successes of the COHI program is the sustained presence of dental worker aides in participating communities.[5,11] Dental worker aides provide culturally sensitive oral health promotion activities and community outreach

TABLE 3
COHI program challenges and barriers according to COHI workers

Themes	Quotes
Difficulty getting access to homes	There's just so many families and so much children that home visits are unfortunately not possible. I don't do it, and one barrier as well is just like that reluctance from families… I'm from my community, I know where a lot of people do live, but I have given that option to parents when they do come […] We are aware that a lot of them do not call or do not let me know nor let my aide know. [B002] A lot of them don't have phones so it's a hit and miss if you volunteer [to phone] first. And if you arrive there unexpectedly, they're embarrassed usually by whatever their conditions may be. You're just waking them up, or they're embarrassed because they're not cleaned up or whatever. That's a barrier. You don't know where they are at or what they do. [B004]
Poorly educated workers	I also have been working for a great many years, and as far as I know I've been doing the COHI program since I've been a dental therapist… [This program] has been in existence for a long time, only it's called COHI now and it's for 0- to 7-year-olds and they brought a worker in. But, I really feel that some workers are good, and then there are other workers that need a bit more education, and more [are needed] with a dental background. Although the COHI worker I have right now [is] very good because she knows her community, she knows where everybody lives, she knows what works and what doesn't in her community in the way of getting through to parents on their attitude towards their health, particularly the dental health […] and like I said they should get a little bit more training, but I really feel COHI is a good service for the communities. [C007]
Not enough workers	We have an average of 150 babies born every year. Maybe the highest that I counted was… 168 per year. But never below 140 per year [which means that there are not enough workers to care for them all]. [A002] When we go do the screenings in the classrooms we have a relationship with the teachers, but otherwise we did have a brushing program and then it went downhill because of the teachers. But you also have to understand a lot of kids in those classrooms on First Nation reserves […] The balance between those kids in those classrooms is hard so it's stressful already for a teacher, now you want to throw a brushing program at them [...] So it's too hard for them […] And it's nice when they're willing […] [B003] I'm from [a remote community] and the population is very high. It's from 4000 to 5000 and it's very transient also. I would say there [are] up to 500 [transient] people. And it's a very young population, and the birthrate per year [is] up to 80 per year, but some of this is off reserve… there's a large off-reserve number too. And my current COHI program is mostly schoolchildren because I haven't had a COHI worker for a while […] But when she was there it was mostly school because she had difficulty accessing zero- to four-year-olds. I think we only went out in the community once for the school year. So, most of the time she was in the clinic with me, whereas we have like […] 60 to 80 four-year-olds and about 60 kindergartners, and we have about 60 Grade 1s. So, it's approximately, I would say, 250 to 300 COHI kids in the school. And then […] I would say between 150 to 200 zero- to four-[year-olds] that we should be seeing. [C007]
Obtaining consent	It is hard to get prenatal [moms]. The community I'm from is not an isolated community, [but] a lot of people [leave] the community to give birth. So, the health centre doesn't necessarily have a master list. The band office does, but again, I'd have to go to the band office with my eligibility list and they're telling me who resides in the community and who isn't in the community. So yeah, I have to find them myself. [A003] Well… if we have their consent form from nursery to Grade 2, that kid is seeing you every year. Then Grade 3 you have to hand out that consent form every year, and the kid is responsible for taking that consent form and returning it. It gets lost. Then that kid starts school in Winnipeg from Grade 9. [B005]
Poor housing conditions	Oh, you can train [parents/caregivers] all you want, [it] doesn't mean they're going to do it. Their number one reason [is that they] don't have time or [they] don't have a sink in [their] bathroom. [B005]
Persistent decay in primary teeth	So, with me, I mean I'm getting out there. I'm reaching out, I'm hitting all the programs. I'm doing the presentations at school and with the postnatal [moms], but my numbers are still high. And there [are] so many factors… I just feel that we're taking the initiative out [of] parents when we're in the school. Because someone's going to say, well, why aren't you brushing with the kids? Well, that's your job. We do everything, but my numbers are still really high. I feel defeated almost. So, when they're asking me [if] I feel like the children are benefiting from this COHI program, I don't know [as] my numbers are still really high for oral surgeries. [A005]
Patients getting lost in referrals	After the surgery some of the providers that do the treatment in the city do tell the parents to go in for an assessment in 2 weeks […] but it doesn't get done. [Dental offices] send a report to the regional office and that report is sent to us. But sometimes [these] are like a month after the surgery [the 2-week period doesn't really happen]. And sometimes there is no report at all from the office. [A001]

Abbreviation: COHI, Children's Oral Health Initiative.

and engagement components, working alongside dental therapists, who focus on preventive dental procedures and, where available, dentists. The dental worker aide's role is essential in community-based oral health. They facilitate access to dental care and leverage social capital through knowledge of the community's culture and language, striving to reach children at schools and families at home and networking with other community health and social programs.[15,16]

Community-based oral health promotion activities are needed to support ECOH in Indigenous communities.[17] Hodgins et al.[18] previously evaluated the role of dental health support workers in promoting oral health in the community and linking targeted families with young children to a dental practice, as part of the Childsmile program in Scotland. Their findings suggest that children who received dental health support workers' intervention were more likely to attend a dental practice and to do so earlier than those who did not receive such an intervention.[18] This highlights the value of dental worker aides in building bridges between the community and the dental care provider.

Access to culturally safe health care is a significant challenge for rural and remote Indigenous communities.[19-21] Dental services provided in communities through COHI mitigate lengthy waits for care at dental offices outside of clients' communities.

Community-based COHI workers create awareness of the importance of oral hygiene in young children, educating children and their parents on oral health. They also distribute oral hygiene products where needed and conduct home and school visits to bring oral health information to parents and teachers.

Culturally sensitive oral health promotion by Indigenous champions, in the manner provided by COHI workers,[22] takes into account social determinants of pediatric oral health.[23] The health promotion builds on existing cultural knowledge and practices to prevent ECC in Indigenous communities.[24] COHI workers and therapists, many of whom are from the communities where they work, are sensitive to local conditions and holistic needs of the people they serve. Workers in the program understand and have pointed out that social determinants and parents' choices and behaviours go hand in glove; therefore, education must meet the right conditions to enable change. For example, people who are educated in the behaviours best suited to preventing ECC must be able to afford the products to support recommended oral hygiene.

A study evaluating the perspectives of dental therapists practising in Alaska's Yukon-Kuskokwim Delta reported that the community and oral health care providers noticed the benefits of the community-based education provided by the dental therapists and the improvement in access to dental care and knowledge about oral health over the years.[25] As in our study, Chi et al.[25] noted the benefit of having oral health care providers who understand the culture and needs of the local communities. Another study conducted in Alaska's Yukon-Kuskokwim Delta reported that the number of dental treatment days provided in the community by dental therapists was negatively associated with extractions and positively associated with preventive care utilization for children and adults, demonstrating the importance of dental therapists in oral health promotion in underserved communities.[26]

Recruiting and training more dental professionals so that they could function effectively in their roles would help build capacity, addressing some of the existing challenges. Information could be delivered through community-based workshops[27] and ongoing interprofessional collaboration across programs with similar goals of enhancing community-based resilience.[28]

Large communities may benefit from more dental worker aides to work with families and their children. Dental therapists and dental worker aides can proactively explain program availability and benefits. Awareness is key in health promotion and may serve the program by building on known avenues of community learning through interactions between people, with other community programs and through online sources.[17]

In a previous study by the same research team, parents in communities in Manitoba suggested the best ways to disseminate oral health-related information. These included information sheets and visual teaching aids in local languages plus the use of social media, provision of oral health products through community programs, and home visits for hands-on teaching.[17] In the present study, difficulty accessing homes was described as a barrier to delivering preventive oral health care, with COHI workers being concerned for their safety. A well-coordinated home visit, pre-visit phone calls, and virtual conferencing (where possible and appropriate) may help improve home access.

By increasing awareness among more families in communities, dental worker aides obtain more parental and caregiver consent for their children's enrolment in the program. To enroll children in the COHI program, parents and caregivers sign the required consent forms. However, COHI workers must be careful that all consent requested and obtained respect local protocols and individual expectations.[29] Meeting parents in person to explain the program and obtain written or oral consent would likely yield better enrolment than the current process of children being sent home with consent forms that lack sufficient context.

Participants also raised concerns about referring patients for follow-up care in the community after surgeries under general anesthesia. As some children require advanced oral care that cannot be performed by COHI staff, the program and staff need to build and maintain relationships with dental providers and specialists outside of the communities. More robust communication between COHI workers and dental offices could help improve patient referral pathways and enhance community-based follow-up schedules.

Strengths and limitations

Our study is the first to assess the perspectives of COHI community-based workers on the contribution and impact of the COHI program. The study provides an in-depth and first-hand account of structural and cultural determinants of health in the First Nations communities as they relate to children's oral health. COHI dental worker aides are knowledge keepers whose self-reported opinions and challenges provide valuable contributions to strategies aimed at improving the effectiveness of COHI programs.

However, although the qualitative approach to our study provides critical experiential insights of workers representing 25 First Nation communities altogether, the results may not be generalizable to other First Nations communities. In addition, some participants may have felt that some of the questions were leading, thereby influencing their responses. Further studies are needed to evaluate the impact of COHI workers' contribution on children's oral health by measuring changes in dental disease outcomes, such as the rate of dental surgery under general anesthesia and the proportion of children utilizing dental care in the communities.

Conclusion

Success with ECOH in Indigenous communities must continue to enhance culturally appropriate approaches to oral health that support both parents and children and ensure uptake. Dental worker aides are crucial to oral health promotion in First Nations communities, as they are usually from the communities, understand the local context, may speak the language, understand the culture and, in time, can become a household name in the community as the oral health educator.

Overall, COHI workers who participated in this qualitative study agreed that the COHI program delivers oral health services that result in meaningful ECC prevention and ECOH promotion in First Nations communities. Despite the favourable impact, some key issues still need to be addressed, such as improved and standardized training of workers and continuous support and capacity building in the ongoing community involvement.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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Authors' contributions and statement

RJS and MM: Conceptualization, Supervision, Funding acquisition, Investigation, Analysis, Writing – Original draft.

GK-A: Formal analysis, Investigation, Methodology, Writing – Original draft, Writing – Review & Editing.

JE, PW, HTN, MB, AH, KH-S, LS, WMF, KY, OOO, MEKM, VCJ: Visualization, Writing – Original draft, Writing – Review & Editing.

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Original quantitative research

An interrupted time series evaluation of the effect of cannabis legalization on intentional self-harm in two Canadian provinces: Ontario and Alberta

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Abstract

Introduction: Despite the association between cannabis use and higher prevalence of suicidal ideation and attempt, the effect of cannabis legalization and regulation in Canada on intentional self-harm has not been determined.

Methods: We used an interrupted time series of population-based rates of emergency department (ED) visits and hospitalizations for intentional self-harm per 100 000 in Ontario and Alberta from January/April 2010 to February 2020. Aggregate monthly counts of ED visits and hospitalizations for intentional self-harm (ICD-10 codes X60–X84, R45.8) were obtained from the National Ambulatory Care Reporting System and Discharge Abstract Database, respectively.

Results: The legalization and regulation of cannabis in Canada was not significantly associated with a change in rates of ED visits for intentional self-harm in Ontario (level = 0.58, 95% CI: −1.14 to 2.31; trend = −0.17, 95% CI: −0.35 to 0.01) or Alberta (level = −0.06, 95% CI: −2.25 to 2.12; trend = −0.07, 95% CI: −0.27 to 0.13). Hospitalizations for intentional self-harm also remained unchanged in Ontario (level = −0.14, 95% CI: −0.48 to 0.20; trend = 0.01, 95% CI: −0.03 to 0.04) and Alberta (level = −0.41, 95% CI: −1.03 to 0.21; trend = −0.03, 95% CI: −0.08 to 0.03).

Conclusion: Legalization and regulation of cannabis in Canada has not increased rates of ED visits or hospitalizations for intentional self-harm in Ontario and Alberta. Individual-level analyses that account for demographic characteristics and include other provinces and territories are needed.

Keywords: *cannabis, health policy, mental health, population health, substance-related harms, substance use, public health, self-harm*

Highlights

- Despite the known link between cannabis use and mental health outcomes, there have been few studies on the effect of cannabis legalization and regulation on mental health outcomes.
- Cannabis legalization and regulation did not lead to an increase in the rates of admissions to hospitals or emergency departments due to intentional self-harm in two Canadian provinces at the population level.
- These findings could help inform future research exploring the effects of cannabis legalization and regulation on intentional self-harm at the individual level as well as other mental health conditions that are largely understudied in this context.

Introduction

In October 2018, Canada became the second country, after Uruguay, to legalize cannabis for recreational purposes under the *Cannabis Act* (Bill C-45).[1] One of the main aims of the *Cannabis Act* was to reduce illicit cannabis activities and the subsequent burden on the criminal justice system as well as to allow quality-controlled and legal supply and production of cannabis for purchase by adults aged 18 and older in Canada.[1] Cannabis use, which was already increasing before legalization, has continued to increase since then, that is, between 2018 and 2020,[2,3] which may be explained by the increased access.[4,5]

Past-year cannabis use and cannabis use disorder are both associated with a higher prevalence of past-year suicidal ideation and attempt among young adults in the United States.[6] There is also increasing evidence that individuals are using cannabis to self-medicate for anxiety, mood problems and other medical conditions.[7] This is problematic given the existing burden of mental health conditions in Western societies, with an average of 12 deaths from suicide per day in Canada in the last 3 years.[8] Furthermore, cannabis use and intentional non-suicidal self-harm in adolescence are significantly associated, even

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when controlling for differences in sex, psychiatric disorders, frequent alcohol intoxication, other illicit drug use and parental psychiatric disorders.[9] Nevertheless, the effect of cannabis legalization and regulation on mental health outcomes is not well-established, with only two studies from the US reporting on the potential impacts of this policy change on emergency department (ED) visits and hospitalizations for intentional self-harm.[10,11]

Canada's experience with cannabis legalization and regulation is being observed internationally. One goal of the *Cannabis Act* was to set several clear legal requirements intended to protect against the risks associated with cannabis.[12] To establish national standards to protect public health and safety, it is necessary to understand the impacts of cannabis legalization and regulation on these outcomes and set the foundation for appropriate public health responses.

Through this study, we aim to determine the effect of cannabis legalization and regulation on rates of ED visits and hospitalizations for intentional self-harm in Ontario and Alberta. We hypothesized that the implementation of Canada's *Cannabis Act* would be associated with increased rates of ED and hospital presentations for intentional self-harm in both provinces.

Methods

Study design

We used an interrupted time series design to clearly visualize data and account for secular trends and autocorrelation. An interrupted time series is considered the most appropriate quasi-experimental study design for measuring the outcomes of a policy change when randomization is not possible.[13-15] The time series were constructed from monthly rates of ED visits and hospitalizations for intentional self-harm in Ontario and Alberta. We used visits and hospitalizations that were recorded in national population-based databases from January or April 2010 to February 2020.

Ethics approval

The Research Ethics Board (REB) at Unity Health Toronto reviewed and approved this study (REB 20-330).

Setting

We obtained Ontario and Alberta population-based data from the Canadian Institute for Health Information (CIHI), using the National Ambulatory Care Reporting System (NACRS) for aggregate level counts of ED visits and the Discharge Abstract Database (DAD) for aggregate level counts of hospitalizations for intentional self-harm. Submitting ED visit data to the NACRS is only mandated in some provinces (e.g. Ontario and Alberta, which have nearly 100% coverage of ED visits).[16] The DAD captures hospitalization data from all provinces and territories except Quebec.

Because we only had ED visit data from Ontario and Alberta, we chose to include only those two provinces in our analyses of both ED visits and hospitalizations for comparability. Because ED visits in Alberta were not recorded in the NACRS until 1 April 2010, whereas ED visits were recorded in Ontario as of 1 January 2010, results were reported separately for Ontario and Alberta. Hospitalizations in Ontario and Alberta were reported in the DAD as of 1 January 2010. Cells containing non-zero counts of less than 5 were suppressed.

Outcome

In both the DAD and the NACRS, each medical record includes at least one primary diagnosis based on the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada* (ICD-10-CA); the DAD also has optional fields for 24 additional diagnoses while the NACRS has optional fields for 9 additional diagnoses.[17] For this study, we defined intentional self-harm as an occurrence of at least one of the following ICD-10-CA codes in any field, used by CIHI to identify purposely self-inflicted poisoning or injury, including attempted suicide[17]: X60–X84 and R45.8. The proposed diagnostic codes have been used in previous studies.[10,11,18] For instance, Randall et al.[18] found diagnostic codes X60–X84 to have a specificity of more than 98% and a positive predictive value of more than 80% for both suicide attempt and self-harm.

Data analysis

We used an interrupted time series analysis with segmented regression to examine the effect of cannabis legalization and regulation on ED presentations for intentional self-harm that occurred between 1 January 2010 and 1 February 2020 in Ontario and between 1 April 2010 and 1 February 2020 in Alberta as well as hospital presentations that occurred between 1 January 2010 and 1 February 2020 in both provinces. Because ED visits in Alberta did not start being recorded in the NACRS until April 2010, we based analyses of ED visits in Alberta on 119 monthly observations (April 2010 to February 2020) instead of the 122 monthly observations (January 2010 to February 2020) in Ontario.

We defined the post-intervention period for all analyses as October 2018 (given that recreational cannabis legalization was enacted midmonth) to February 2020. Segmented regression was used to estimate and statistically test the changes in *y*-intercept level and slope in the post-intervention period compared to the pre-intervention period, that is, to quantify immediate (level) changes in the rate of the outcome (e.g. an increase or decrease after the intervention) as well as changes in the slope (trend) over time.[19] The models were predefined to estimate both a level and trend change. An interrupted time series can distinguish between the actual effect of a policy change and existing secular trends (e.g. increasing rates of outcomes over time) at a population level by comparing the post-intervention period with the pre-intervention period (the control).[13-15]

Monthly rates of ED visits and hospitalizations for intentional self-harm were calculated for all years of data for Ontario and Alberta separately and reported per 100 000 population. The numerator was the total number of ED visits or hospitalizations for intentional self-harm; the denominator was the total population in each province for the given month interpolated based on quarterly population estimates provided by Statistics Canada.[20] Given the difference in frequency and characteristics of presentations to the ED versus admissions to the hospital, we modelled rates of ED visits and hospitalizations separately, and presented these rates descriptively, as time series.

The main assumptions of an interrupted time series are that the trends are linear over time and the distribution of residuals is relatively normal. We checked both assumptions by inspecting the distribution

of the raw data points over time. An interrupted time series analysis can accommodate seasonal trends; we checked for these by inspecting the raw data points over time. To account for autoregressive and/or moving averages correlation, which can be present in time-based data, we inspected the autocorrelation function plots of the outcome variable to determine whether autoregressive and/or moving averages correlation structures needed to be added to the final model.

We used segmented regression with autoregressive-moving averages correlation structures. The following parameters were used for the autoregressive-moving averages models (p,q): ED visits in Ontario (12,0); ED visits in Alberta (1,0); hospitalizations in Ontario (12,0); and hospitalizations in Alberta (7,0). All statistical analyses were performed using RStudio, version *R* 3.3.0+ (packages used: nlme and car). An alpha value of 0.05 was used to establish statistical significance.

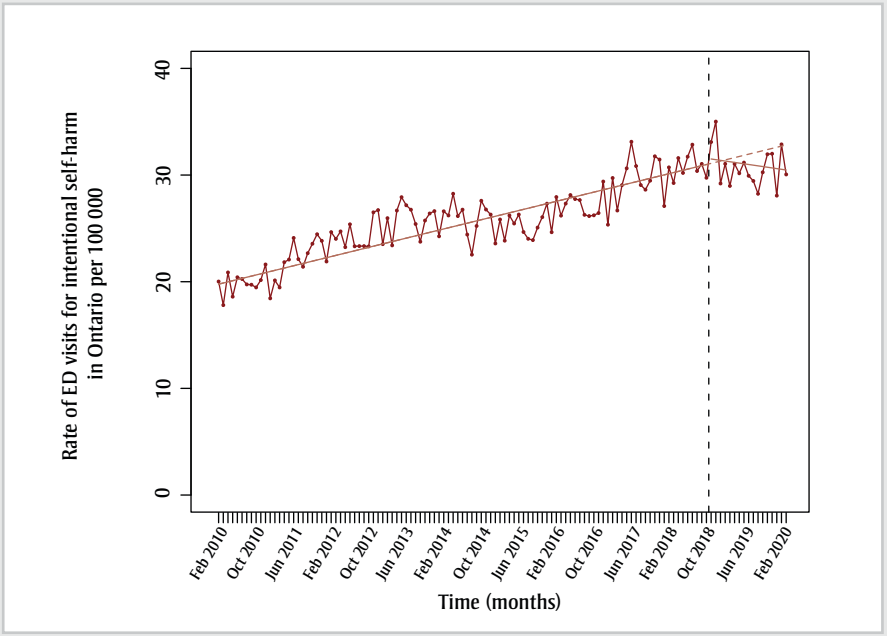
Results

There were no months with suppressed counts of ED visits or hospitalizations for intentional self-harm in either Ontario or Alberta. Models of rates of ED visits and hospitalizations for intentional self-harm did not require adjustments for nonlinearity or seasonality. All models were adjusted for autocorrelation. Adjusted interrupted time series models of rates of ED visits and hospitalizations for intentional self-harm per 100 000 population in Ontario and Alberta are depicted in Figures 1A, 1B, 2A and 2B. Both the level, referring to the immediate change, and the trend, referring to the slope change, were reported as an increase or decrease.

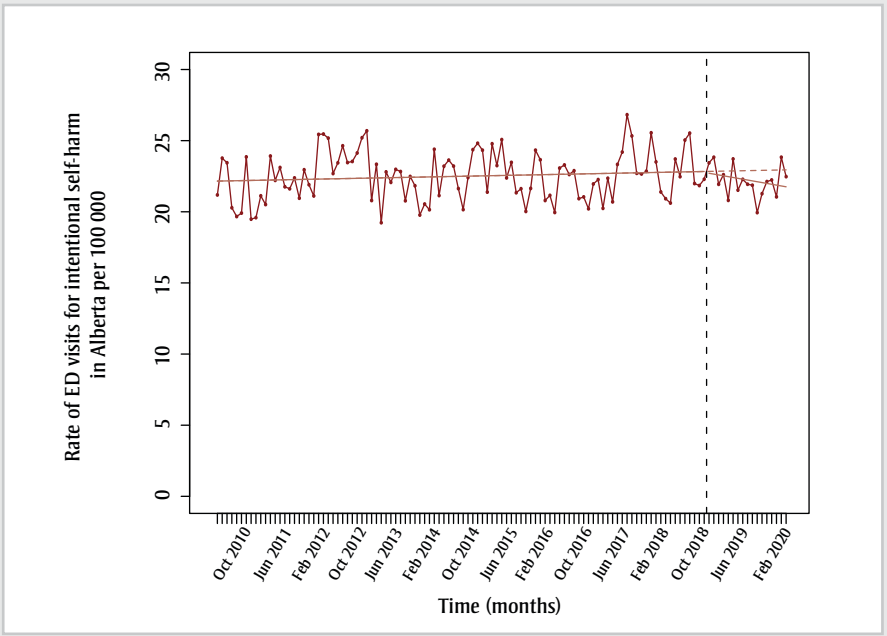
There was no statistically significant association between cannabis legalization and rates of presentations to the ED or hospital for intentional self-harm after legalization enactment in Ontario or Alberta. Rates of ED visits for intentional self-harm per 100 000 population were not affected by cannabis legalization in Ontario (level = 0.58, 95% confidence interval [CI]: −1.14 to 2.31, p = 0.51; trend = −0.17, 95% CI: −0.35 to 0.01, p = 0.06) and Alberta (level = −0.06, 95% CI: −2.25 to 2.12, p = 0.95; trend = −0.07, 95% CI: −0.27 to 0.13, p = 0.52). Similarly, hospitalizations for intentional self-harm per 100 000 population remained unchanged after cannabis legalization enactment in Ontario (level = −0.14, 95% CI: −0.48 to 0.20, p = 0.42; trend = 0.01, 95% CI: −0.03 to 0.04, p = 0.75) and Alberta (level = −0.41, 95% CI: −1.03 to 0.21, p = 0.20; trend = −0.03, 95% CI: −0.08 to 0.03, p = 0.38).

FIGURE 1
Adjusted time series plots of population-based monthly rates of emergency department visits for intentional self-harm per 100 000 population

A. Ontario, January 2010–February 2020



B. Alberta, April 2010–February 2020



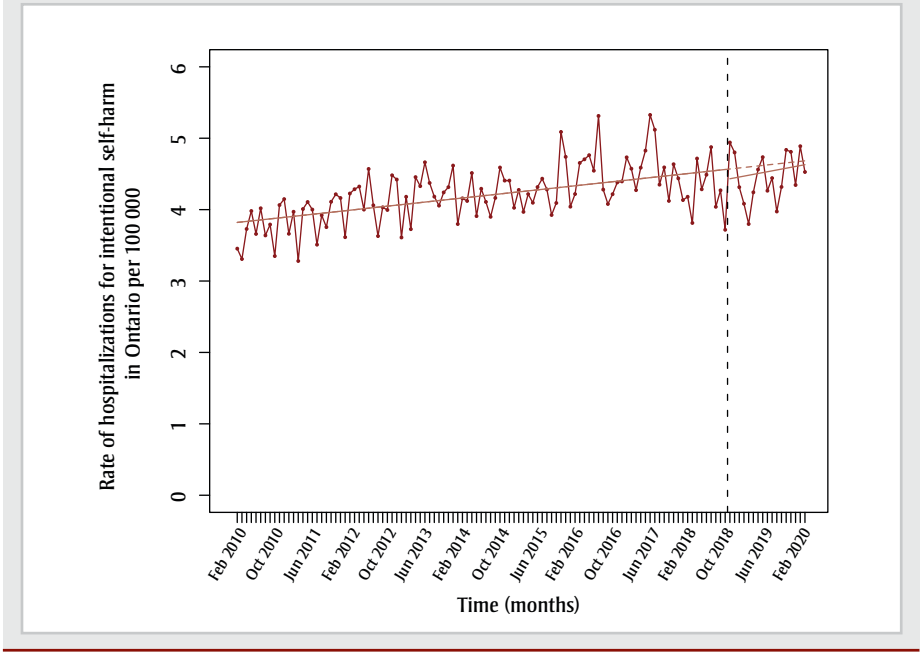
Notes: The black dotted vertical lines represent the enactment of recreational cannabis legalization (October 2018). The red dotted horizontal lines represent the counterfactual (extension of the pre-legalization period/underlying trend).

Discussion

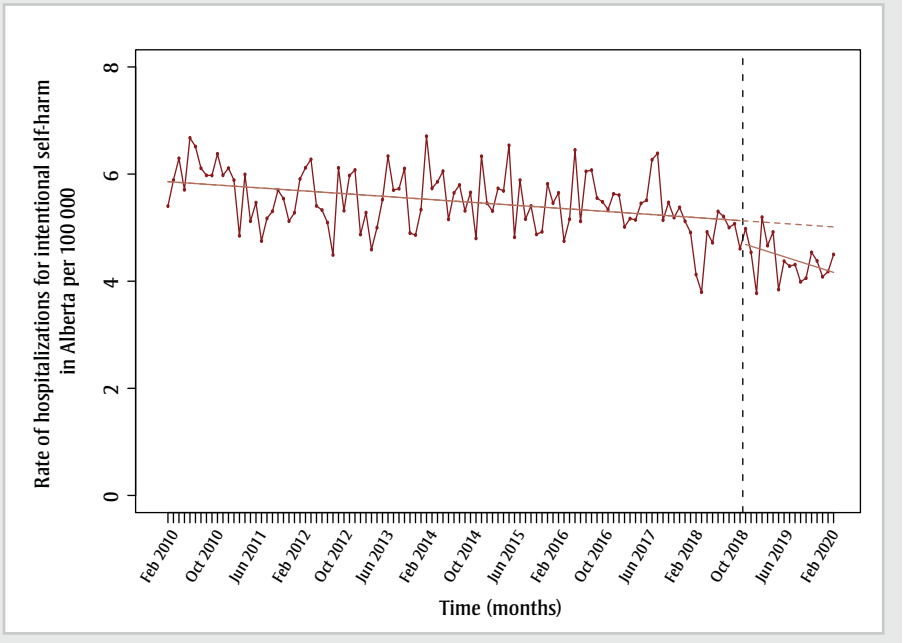
Our study demonstrated that cannabis legalization and regulation is not associated with increases in presentations to the ED or hospital for diagnoses related to intentional self-harm in Ontario and Alberta.

FIGURE 2
Adjusted time series plots of population-based monthly rates of hospitalizations for intentional self-harm per 100 000 population

A. Ontario, January 2010–February 2020



B. Alberta, January 2010–February 2020



Notes: The black dotted vertical lines represent the enactment of recreational cannabis legalization (October 2018). The red dotted horizontal lines represent the counterfactual (extension of the pre–legalization period/underlying trend).

There are many possible explanations for why cannabis legalization appeared to have a minimal impact on rates of intentional self-harm at the population level, despite the literature pointing to an association between cannabis use and mental health conditions. National public health measures have been implemented by Health Canada since the *Cannabis Act* came into force, including educational campaigns (e.g. evidence-based information tools, advertising and marketing campaigns, etc.) that highlight the health risks of cannabis use, including mental health impacts.[21] Also, access to cannabis for medical purposes has been permitted in Canada under various sets of regulations since 2001.

Our results align with findings from two US studies that found no change in total population rates of self-harm[11] and death by suicide[10] after recreational cannabis legalization and regulation. However, these studies showed increases for certain age groups[10,11] and male sex.[11]

Future directions

To better assess the effects of cannabis legalization and regulation on intentional self-harm, future studies should repeat these methods using individual-level data. There are known age, sex and socioeconomic differences for the prevalence of mental health conditions (e.g. attempted suicide is higher among females)[22-24] and risk of disordered cannabis use (e.g. higher risk for youth aged 15–24 years, males and lower-income populations).[25] Given this, demographic differences in the effect of cannabis legalization on intentional self-harm should also be explored.

Other mental health outcomes, including but not limited to cannabis use disorder, anxiety, depression, post-traumatic stress disorder and psychosis, should be studied in relation to cannabis legalization and regulation in all jurisdictions that have implemented cannabis legalization, including Canada. Future studies should also consider analyzing data across all provinces and territories or perform a combined nationwide analysis.

Limitations and strengths

Our study has several limitations that may affect the interpretation of results. First, our results are based on aggregate (population) data that limit inferences about individuals. Our study also did not consider important demographics, such as age and sex, that may modify any effect of cannabis legalization on intentional self-harm.

Since only ED and hospitalization data were considered, our study was unable to account for intentional self-harm events that did not end up in ambulatory care or the hospital during this period. Furthermore, study data were limited to Ontario and Alberta and patterns may not be generalizable to the rest of Canada and jurisdictions abroad.

Finally, our model did not take into account whether the impact of cannabis legalization might be lagged or delayed, as the modelling approach was determined a priori.

A major strength of our study is the use of an interrupted time series design, which is considered the strongest design for population-level health interventions when randomization is not possible.[26] Using this design, our study was able to account for secular trends, seasonality and autocorrelation, which are common concerns of using time series data.[13,14] Further, the NACRS encompasses almost all ED visits in Ontario and Alberta, providing an accurate estimate of the effect of cannabis legalization on ED visits for intentional self-harm for the Canadian population.

Conclusion

The findings of our study show that cannabis legalization and regulation in Canada did not impact rates of ED visits and hospitalizations for intentional self-harm. Analyses of individual-level data that account for demographics and from other provinces and territories are needed to confirm these findings.

Acknowledgements

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Additional information: Coauthor Dr. Robert Mann passed away on 3 May 2022, prior to the submission of this manuscript.

Conflicts of interest

MDC is a practising neurosurgeon who treats patients who sustained head injuries or trauma that may have been a result of substance use and intoxication, including due to cannabis. MDC had financial support from the Public Health Agency of Canada for the submitted work. MDC also received a grant from the Canadian Institutes of Health Research for a similar study, which might have an interest in the submitted work (RM and OS were listed as co-applicants). MDC and MW received a research grant from the Toronto Cannabis and Cannabinoid Research Consortium, which might have an interest in the submitted work. MC reports no financial interests, activities, relationships or affiliations that could appear to have influenced the submitted work. Each author confirms that this study has not been previously published in any form and is not currently under consideration by any other journal.

Authors' contributions and statement

MDC: Conceptualization, Methodology, Supervision, Writing – Original Draft, Writing – Review & Editing, Funding Acquisition

MC: Formal analysis, Investigation, Methodology, Writing – Original Draft, Writing – Review & Editing, Visualization

MW: Formal analysis, Investigation, Methodology, Writing – Original Draft, Writing – Review & Editing, Visualization, Funding Acquisition

OS: Conceptualization, Formal analysis, Methodology, Writing – Review & Editing

RM: Conceptualization, Methodology, Writing – Review & Editing

All the authors approved the final version of this paper and agree to be accountable for all aspects of the work presented.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

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Original quantitative research

Validating existing clinical cut-points for the parent-reported Strengths and Difficulties Questionnaire in a large sample of Canadian children and youth

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Abstract

Introduction: The Strengths and Difficulties Questionnaire (SDQ), for assessing behavioural and emotional difficulties, has been used internationally as a screening measure for mental health problems. Our objective was to validate the existing (British) SDQ cut-points in a sample of Canadian children and youth, and develop new Canadian SDQ cut-points if needed.

Methods: This study includes data from children and youth aged 6 to 17 years from the Canadian Health Measures Survey (n = 3435) and outpatient records from the Children's Hospital of Eastern Ontario (n = 1075). The parent-reported SDQ data were collected. We adjusted the existing SDQ cut-points using a distributional and receiver-operating characteristic (ROC) curve approach. We subsequently calculated the sensitivity, specificity and diagnostic odds ratio of the existing and new SDQ clinical cut-points to determine whether the new cut-points had better clinical utility, using both analytic approaches.

Results: Our data show differences in the screening effectiveness between the existing British and the Canadian-specific clinical cut-points. Specificity is maximized using the Canadian distributional cut-points, improving the likelihood of identifying true negative results. The total SDQ score met the threshold for clinical utility (diagnostic odds ratio > 20) using both the existing and new cut-points; however, the individual scales did not reach clinical utility threshold using either cut-points.

Conclusion: Future Canadian SDQ research should consider the new cut-points derived from our study population and the existing British cut-points to allow for historical and international comparisons.

Keywords: *child and adolescent, mental health, validation, hyperactivity, peer problems, prosocial behaviour, conduct problems, emotional symptoms*

Highlights

- This study validated the existing British SDQ cut-points in a large sample of Canadian children and youth and developed Canadian-specific cut-points using a distributional approach and receiver operating characteristic (ROC) curves.
- The Canadian-specific clinical cut-points (90th percentile) using the distributional approach demonstrated higher specificity than the ROC curve derived cut-points. For this reason, the distributional cut-points have better population-based utility.
- Both the existing British and the Canadian-specific clinical cut-points for the total difficulties score met the threshold for clinical utility to predict mental health diagnosis.

Introduction

In Canada, approximately 1.2 million children and youth are affected by mental illness, and a high percentage of children and youth are symptomatic, but do not meet full diagnostic criteria (i.e. they are symptomatic at a subclinical threshold).[1]

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Compared to 2019, the proportion of children and youth aged 5 to 24 years hospitalized for mental health conditions rose by 2% in 2020, and nearly 1 in 4 of all hospitalizations in this age group were due to mental health problems.[2] Furthermore, up to 70% of adult mental health problems begin in childhood, highlighting the need to identify and treat mental health vulnerabilities in early life.[1] The increasing rates of mental health problems among Canadians necessitates access to screening in populations and clinical settings with psychometrically sound mental health measurement tools.

The Strengths and Difficulties Questionnaire (SDQ) is a widely used measure of children and youth social, emotional and behavioural difficulties.[3] In clinical settings and epidemiological studies, the clinical cut-points for the SDQ are used as a baseline screening tool for mental health problems.[4,5] The SDQ comprises five scales that measure conduct problems, emotional symptoms, hyperactivity, peer problems and prosocial behaviour, as well as a total difficulties score that sums the scores from all these scales except prosocial behaviour. Each scale has established cut-points for borderline and clinical SDQ scores that were originally identified in a small sample of 403 British children and youth aged 4 to 16 years. The cut-points were chosen so that roughly 80% of the scores from the community were considered "normal," 10% were "borderline" and 10% were "clinical."[3]

The original 1997 British SDQ cut-points[3] have been widely used in Canada and internationally. They have been compared to population data in high-income countries, including the United States (US), Japan and Germany.[6-8] In the US, the established cut-points were similar to the existing British values with two exceptions: the total difficulties score was 1 to 2 points lower than the British values for the normal, borderline and clinical cut-points; and the prosocial score was 1 point lower in the borderline and clinical categories than the British cut-points.[7] In Japan, the cut-points for the total difficulties score were 2 to 3 points lower across the categories (normal, borderline and clinical) for both boys and girls aged 10 to 15 years compared to the existing British cut-points;[6] however, the existing cut-points correctly classified Japanese boys aged 7 to 9 years. Finally, using German normative data for boys and girls aged 6 to 16 years, the cut-points for the total difficulties score were also 1 point lower than the existing British values.[8] None of the studies recommended changing the existing cut-points. These varying country-specific results highlight the need to investigate the validity of the 1997 British SDQ cut-points among a sample of Canadian children and youth.

Since 2007, the parent-reported SDQ has been collected as part of the Canadian Health Measures Survey (CHMS), a national survey of health and well-being. In 2020–the five-factor SDQ demonstrated sound psychometric properties using data from approximately 7500 children and youth who participated in the CHMS.[9] The five-factor SDQ (i.e. conduct problems, emotional symptoms, hyperactivity, peer problems and prosocial behaviour) showed good fit with the data using confirmatory factor analysis and was invariant across sex (male, female) and age (children, youth). However, the clinical cut-points have not been validated in a Canadian population.

The overall objective for this study was to validate the British SDQ cut-points in a large sample of Canadian children and youth. To attain this objective, we completed this study in two phases. The aim of the first phase was to determine if the British cut-points for the SDQ appropriately classified a national sample of Canadian children and youth aged 6 to 17 years. We also examined the cut-points using receiver operating characteristic (ROC) curves as a data-driven approach to identify clinical cut-points. Adjustments were made to the British SDQ cut-points when needed to create new Canadian cut-points. In the second phase, we compared the differences in screening effectiveness (i.e. sensitivity and specificity) using the British SDQ cut-points and the new Canadian cut-points.

Methods

General population sample

This study utilized data from children and youth aged 6 to 17 years from cycles 3 (2012–2013) and 4 (2014–2015) of the CHMS household questionnaire. The CHMS is a cross-sectional, nationally representative survey of Canadians living in the 10 provinces. The CHMS does not collect information from individuals living in the three territories or on reserves, full-time members of the Canadian Armed Forces or those living in institutions (exclusions represented approximately 4% of the population).[10]

Ethics approval for data collection was obtained by Statistics Canada from the Health Canada and the Public Health Agency of Canada (PHAC) Research Ethics Board. Participation in the CHMS is voluntary.[11] Written informed consent prior to participation was obtained from the parent or guardians on behalf of the children aged 6 to 13 years. Assent from children aged 6 to 13 was also obtained.[11] Youth aged 14 to 17 years provided informed consent to participate. Further details about the CHMS are available elsewhere.[12]

In total, 3435 participants took part in this study—1720 individuals from cycle 3 (49.8% female) and 1715 individuals from cycle 4 (49.6% female). The SDQ was completed during the household interview by parents or guardians of children and youth aged 6 to 17 years (i.e. parent-reported SDQ). Slightly more than half (59.8%) of the sample were 6 to 11 years old, and the remaining 40.2% were 12 to 17 years old.

Clinical sample

We obtained clinical data of the children and youth aged 6 to 17 years who presented to an outpatient mental health clinic that was part of the Children's Hospital of Eastern Ontario (CHEO) between 25 January 2016 and 16 March 2020 (n = 1075). The majority of our sample was from the province of Ontario, with only a few out-of-province patients. The SDQ was completed as part of the mandatory baseline clinical assessment by the parent or caregiver during the first clinical appointment (i.e. parent-reported SDQ), and as a result, the response rate was greater than 85%.

Mental health diagnoses were made by a trained psychologist using ICD-10-CA codes.[13] Diagnoses recorded in the patient chart during the first clinical visit were used to classify children and youth into one or more diagnostic categories: mood disorders (ICD-10-CA:F30-39.*), anxiety disorders (ICD-10-CA:F40-49.*), pervasive developmental disorders (ICD-10-CA:80-89.*), conduct disorder (ICD-10-CA:F91.*) and attention deficit hyperactivity disorder (ADHD) (ICD-10-CA:F90.*). Patients with more than one diagnosis were retained in

the sample, and their data were used in multiple categories.

Ethics approval

Ethics approval for using the CHEO clinical sample was obtained from the CHEO Research Ethics Board (21/97X) and the PHAC Research Ethics Board (2021-032P). Written informed consent was obtained from parents or legal guardians, and assent was obtained from each child for their data to be used for research purposes. A formal data-sharing agreement was implemented between the CHEO Research Institute and PHAC to send clinical data to PHAC for this study. Clinical data from this study will be kept on a secure PHAC server for 7 years before being destroyed.

Measures

Strengths and Difficulties Questionnaire

The SDQ is a 25-item questionnaire designed to measure problematic behaviours, emotions and relationships.[3] It has demonstrated evidence of validity and reliability with Canadian children and youth.[9] All items are scored on a three-point Likert scale with the following response options: 0 ("not true"), 1 ("somewhat true") and 2 ("certainly true"). Higher scores indicate a greater difficulty for all scales except the prosocial behaviour scale, in which lower scores indicate greater difficulty. The conduct problems, emotional symptoms, hyperactivity and peer problems scores were summed to create a total difficulties score (and hence a scale).

Goodman (1997)[3] established score cut-points for normal, borderline and clinical mental health difficulties based on a sample of children and youth from London, England, United Kingdom.

Demographic variables

We summarized the characteristics of each sample with descriptive statistics. Demographic data in the general population sample comprised biological sex (male/female), age (years), highest level of household education (less than high school / high school or college / university), household income (less than $40 000 / $40 000 to $79 999 / $80 000 or more), self-perceived general health (poor or fair / good / very good / excellent) and self-perceived mental health (poor or fair / good / very good / excellent). Self-perceived general and mental health were only available for youth aged 12 to 17 years. Age was the only demographic characteristic available for the clinical sample.

Statistical analyses

For the general population sample, we calculated descriptive statistics stratified by sex (male and female). We conducted sensitivity analyses to determine if SDQ scores, stratified by sex and age group, changed between cycle 3 and cycle 4 of the CHMS (data available on request from the authors). Few differences between groups justified combining data from cycles 3 and 4. We also combined SDQ data for all age and sex groups, in line with the approach originally conducted by Goodman.[3] For the full clinical sample, we calculated mean SDQ scores for each scale and the prevalence of each mental health diagnosis.

Analyses were conducted using SAS Enterprise Guide 7.1 (SAS Institute Inc., Cary, NC, US).

Phase 1: Establishing cut-points

Distributional technique

First, using the general population sample, we calculated the percentage with 95% confidence intervals (CI) of children and youth in the CHMS with scores that fell within the existing cut-points for the normal, borderline and clinical categories for each SDQ scale. In cases where the general population did not align with the 80%, 10%, 10% framework, we selected new Canadian cut-points based on visual inspection of density plots and manually adjusting cut-points to determine the best alignment to the framework. In cases where the percentages were either slightly below or above the target percentage, we chose scores below the target percentage while prioritising accuracy in the clinical group, following the example of Bourdon et al.[7] All distributional analyses used bootstrap and survey weights provided by Statistics Canada to generate nationally representative estimates.

ROC curve technique

We calculated ROC curves using the PROC LOGISTIC command in SAS Enterprise Guide with the "outroc" function. We used the SAS ROCPLOT macro (https://support.sas.com/kb/25/018.html) to calculate the sensitivity and specificity for each possible cut-point. We selected the cut-point that maximized both sensitivity and specificity, otherwise known as Youden Index. The ROC curve analyses were not considered representative of the Canadian population because they were calculated using unweighted data.

Phase 2: Comparison of the existing British and the Canadian-specific cut-points

We used sensitivity and specificity calculations to validate the existing British and the Canadian-specific clinical (90th percentile) cut-points for each SDQ score. In previous studies, the 90th percentile cut-points were associated with 12 times higher odds of service use for a mental health difficulty[7] and 15 times higher odds of a diagnosed mental health disorder.[14]

Sensitivity (or true positive) is the proportion of the sample that is correctly identified as having a mental health diagnosis (CHEO clinical sample). Specificity (or true negative) is the proportion of the sample that is correctly identified as having no mental health diagnosis (general population sample). Scores above 0.5 indicate that the measure is better than chance at discriminating those with the outcome of interest.

Phase 2: Additional sensitivity analyses

We conducted additional sensitivity analyses to determine the accuracy of our results. First, we limited both datasets to those aged 12 to 17 years, and we retained those in the general population sample who had self-reported their mental health as being very good or excellent[15] (general population sample, n = 1021; clinical sample, n = 790). Limiting to very good or excellent mental health in the general population sample provides us with a more distinct positive mental health group to use for comparison.

Next, using the full age range (i.e. 6 to 17 years), we used the specific mental health diagnosis in the clinical sample to determine how well the existing British and the Canadian-specific cut-points discriminated between those with mood disorders, anxiety disorders, conduct disorder, ADHD or pervasive developmental disorders. For these specific mental health diagnoses, we also calculated the positive predictive value (PPV; the probability of having a mental health problem if meeting the clinical cut-point) and the negative

predictive value (NPV; the probability of not having a mental health problem if not meeting the clinical cut-point). In community-based screening, a test with high specificity or NPV will reduce the number of false positives and allow for monitoring or treatment to begin early if a positive result is detected.[16]

Finally, we calculated the diagnostic odds ratio (DOR) for candidate SDQ scales that aligned with specific clinical diagnoses. For instance, the conduct scale aligned with conduct disorders, the hyperactivity scale aligned with ADHD, the emotional symptoms scale aligned with mood or anxiety disorders, and the peer problems scale aligned with pervasive developmental disorder. Vugteveen et al.[5] have described using these candidate SDQ scales and their matched diagnoses. The DOR is a single measure that incorporates both sensitivity and specificity and is relatively independent of changes in the prevalence of mental health diagnoses.[17] DOR values greater than 20 identify a test that is potentially useful for influencing clinical decision-making.[18]

Results

Characteristics of general population sample

Descriptive statistics for the population sample, stratified by sex, are provided in Table 1. Based on overlapping 95% CIs, there were no differences between sex for any of the demographic variables. There were sex differences for three of the five SDQ scales. Females had higher (worse) emotional symptoms scores compared to males (2.30 [95% CI: 2.15–2.45] vs. 1.78 [95% CI: 1.63–1.93]) and higher (better) prosocial behaviour scores compared to males (9.25 [95% CI: 9.18–9.33] vs. 8.86 [95% CI: 8.74–8.98]). Males had higher hyperactivity scores compared to females (3.18 [95% CI: 2.96–3.39] vs. 2.48 [95% CI: 2.34–2.63]). Despite these differences, we decided not to stratify further analyses by sex to be consistent with the original SDQ development and other country-specific cut-points (as described in previous literature[3,7,8]).

Characteristics of the clinical sample

Descriptive statistics for the clinical sample are also provided in Table 1. Sex or gender was not obtained to maintain the sample anonymity, and so descriptive statistics are presented for the total population.

For all SDQ scales the clinical samples scored significantly worse than the general population sample. The mean scores for the emotional symptoms, peer problems and the total difficulties scales were in the clinical range according to the British cut-points. The most prevalent mental health diagnoses were anxiety disorders (59.1%), followed by ADHD (37.2%). Nearly half of the clinical sample presented with more than one diagnosis (43.9%).

Phase 1: Establishing cut-points

Table 2 shows the proportion of the general population sample that fell within the existing SDQ cut-points for each scale (i.e. the distributional technique). The existing cut-points for conduct problems and peer problems accurately classified the sample of Canadian children and youth into the borderline (80th percentile) and clinical (90th percentile) categories. For emotional symptoms and hyperactivity, the sample of Canadian children and youth were over-represented in the clinical category (13.9% and 13.0%, respectively). The existing cut-points for prosocial and total difficulties under-represented children and youth in the clinical category (1.5% and 8.1%, respectively).

We therefore created new Canadian cut-points for the three scales (emotional symptoms, hyperactivity and prosocial) and the total difficulties score that more accurately classified the sample of Canadian children and youth into the borderline and clinical categories (Table 3). The Canadian-specific clinical cut-points resulted in a range of 6 to 10 for emotional symptoms, 8 to 10 for hyperactivity, 0 to 6 for prosocial behaviour and 16 to 40 for total difficulties, differing by 1 to 2 points from the existing British clinical cut-points.

We also calculated clinical cut-points using ROC curves (Table 4). Apart from the prosocial behaviour scale, which was higher, the cut-points identified using this approach were consistently lower than those identified using the distributional approach. The cut-points identified using ROC curves had improved sensitivity and reduced specificity across all scales compared to the distributional approach.

Phase 2: Comparison of the existing British and the Canadian-specific cut-points

We calculated the sensitivity and specificity for each SDQ scale to determine if the Canadian-specific clinical cut-points (distributional and ROC curve), compared to the existing clinical cut-points, performed better at discriminating between the clinical and general population samples of children and youth (Table 4). The sensitivity for the existing British cut-points ranged from 0.17 to 0.74, the Canadian distributional cut-points ranged from 0.44 to 0.79, and the Canadian ROC curve cut-points ranged from 0.67 to 0.83. The specificity for the existing British cut-points ranged from 0.87 to 0.99, the Canadian distributional cut-points ranged from 0.90 to 0.94, and the ROC curve cut-points ranged from 0.75 to 0.87. We observed significant differences (calculated by non-overlapping 95% CIs) in the sensitivity and specificity scores between the existing and new distributional cut-points for emotional symptoms, hyperactivity and prosocial behaviour, but not for total difficulties. For the emotional symptoms and hyperactivity scores, sensitivity decreased and specificity increased for the Canadian cut-points. For the prosocial scale, the sensitivity increased while the specificity decreased for the Canadian compared to the existing cut-points. All the ROC curve Canadian cut-points were significantly different from the existing British cut-points.

Phase 2: Additional sensitivity analyses

After limiting the sample to those aged 12 to 17 years old and those reporting very good or excellent mental health in the general sample, the sensitivity and specificity results follow the same trend as the full dataset, but with slightly improved sensitivity and specificity values (data available on request from the authors).

Tables 5 and 6 show the screening effectiveness for the existing British and the Canadian-specific clinical cut-points for identifying those with mental health diagnoses in the clinical sample. The specificity was not reported because it is the same as the values reported in Table 4. There were limited differences in the ability of the existing or new clinical distributional cut-points to discriminate between individual mental health diagnoses. The ROC curve cut-points demonstrated significantly

TABLE 1
Descriptive statistics of the population and clinical samples

Variable	CHMS general population sample			CHEO clinical sample
	Males (n = 1729)	Females (n = 1706)	*p* value	(n = 1075)
	% or mean (95% CI)	% or mean (95% CI)		% or mean (95% CI)
Mean age, years	11.2 (11.1–11.3)	11.3 (11.1–11.4)	0.566	12.4 (12.2–12.5)
Parent education				
< High school	1.9 (0.7–3.2)[E]	3.63 (1.9–5.4)[E]		–
High school or college	13.0 (10.1–15.9)	9.64 (7.1–12.2)	0.050	–
University	85.1 (81.9–88.2)	86.7 (83.0–90.5)		–
Household income, $				
0–39 999	19.8 (15.1–24.5)	17.8 (14.3–21.3)		–
40 000–79 999	28.6 (22.5–34.8)	29.7 (24.0–35.4)	0.735	–
≥80 000	51.6 (45.9–57.2)	52.5 (45.7–59.4)		–
Self-perceived general health[a]				
Poor/fair	4.2 (2.6–5.8)[E]	4.8 (3.0–6.5)[E]		–
Good	21.1 (17.4–24.8)	18.9 (15.7–22.1)	0.478	–
Very good	38.8 (34.2–43.5)	37.5 (32.9–42.2)		–
Excellent	35.9 (31.8–39.9)	38.8 (35.1–42.5)		–
Self-perceived mental health[a]				
Poor/fair	6.0 (2.7–9.4)[E]	7.8 (4.4–11.2)[E]		–
Good	18.3 (13.9–22.7)	19.1 (13.0–25.2)	0.237	–
Very good	40.7 (36.1–45.2)	35.9 (30.6–41.2)		–
Excellent	35.0 (31.5–38.6)	37.2 (32.7–41.7)		–
SDQ scores (mean)				
Conduct problems	1.1 (1.0–1.2)	1.0 (0.9–1.1)	0.052	4.0 (3.8–4.1)
Emotional symptoms	1.8 (1.6–1.9)	2.3 (2.2–2.5)	< 0.001	6.1 (5.9–6.2)
Hyperactivity	3.2 (3.0–3.4)	2.5 (2.3–2.6)	< 0.001	6.5 (6.3–6.6)
Peer problems	1.2 (1.1–1.4)	1.1 (1.0–1.3)	0.067	4.2 (4.1–4.4)
Prosocial behaviour	8.9 (8.7–9.0)	9.3 (9.2–9.3)	< 0.001	6.7 (6.6–6.9)
Total difficulties	7.3 (7.0–7.8)	7.0 (6.6–7.4)	0.064	20.7 (20.3–21.1)
Mental health diagnosis[b]				
Mood disorders	–	–		22.7 (–)
Anxiety disorders	–	–		59.1 (–)
Conduct disorder	–	–	–	14.7 (–)
ADHD	–	–		37.2 (–)
Pervasive developmental disorders	–	–		18.9 (–)
Comorbidity[c]	–	–		43.9 (–)

Abbreviations: ADHD, attention deficit hyperactivity disorder; CHEO, Children's Hospital of Eastern Ontario; CHMS, Canadian Health Measures Survey; CI, confidence interval; –, data not available.

[a] Self-perceived mental and general health are reported for youth aged 12–17 years only.

[b] Percentages include those with multiple diagnoses and, as a result, do not sum to 100%.

[c] % of children and youth diagnosed with more than one of the five listed mental disorders.

[E] Interpret with caution due to high sampling variability.

improved sensitivity across all mental health diagnosis groups. This translated into significantly lower positive predictive values across nearly all scales for all five mental health diagnosis groups, with only small, but significant improvements in the negative predictive values.

To determine the clinical utility of candidate SDQ scales for predicting mental disorders, we calculated the DOR for the existing British and the Canadian-specific distributional and ROC curve clinical cut-points (data available on request from the authors). None of the candidate SDQ scales were useful for predicting their matched mental health diagnosis as determined by DOR of less than 20; however, the total difficulties score had clinical utility for predicting any of the five mental health diagnoses using either the existing British, new Canadian distributional or ROC curve

TABLE 2
Proportion of Canadian children and youth in normal, borderline and clinical SDQ categories based on existing British cut-points (n = 3435)

SDQ scale	Normal (80%)		Borderline (10%)		Clinical (10%)	
	British score[a]	CHMS % (95% CI)	British score[a]	CHMS % (95% CI)	British score[a]	CHMS % (95% CI)
Conduct problems	0–2	86.6 (84.6–88.7)	3	6.3 (4.6–8.0)	4–10	7.1 (5.5–8.6)
Emotional symptoms	0–3	77.9 (74.8–80.9)	4	8.2 (6.7–9.8)	5–10	13.9 (11.4–16.4)
Hyperactivity	0–5	82.4 (79.9–84.9)	6	4.6 (3.6–5.5)	7–10	13.0 (11.0–15.0)
Peer problems	0–2	83.6 (81.1–86.1)	3	6.9 (5.8–8.0)	4–10	9.5 (7.2–11.9)
Prosocial behaviour	6–10	96.8 (95.7–98.0)	5	1.7[E] (0.9–2.5)	0–4	1.5[E] (0.7–2.3)
Total difficulties	0–13	85.8 (83.5–88.1)	14–16	6.2 (5.0–7.3)	17–40	8.1 (6.1–10.0)

Abbreviations: CHMS, Canadian Health Measures Survey; CI, confidence interval; SDQ, Strengths and Difficulties Questionnaire.

[a] Existing British cut-points are from Goodman.[3]

[E] Interpret with caution due to high sampling variability.

clinical cut-points. The DOR for the total difficulties score for the British clinical cut-point ranged from 31.1 (95% CI: 20.5–50.0) to 46.0 (95% CI: 27.3–81.6); the DOR for the Canadian distributional clinical cut-point ranged from 31.9 (95% CI: 23.0–43.1) to 43.9 (95% CI: 25.6–74.2); and the ROC curve cut-points ranged from 34.8 (95% CI: 25.8–44.8) to 45.1 (95% CI: 27.7–77.0).

Discussion

In this study using a large sample of Canadian children and youth, we derived Canadian-specific distributional cut-points for three of the five SDQ scales and the total difficulties score. We also calculated new cut-points for each of the SDQ scales using a ROC curve technique; to the authors' knowledge, this is the first time this technique has been applied to SDQ data. We then tested the screening effectiveness by comparing the new cut-offs with the British cut-offs in a Canadian clinical sample. Our data demonstrated small differences in screening effectiveness between the existing British and the Canadian-specific distributional clinical cut-points. Large differences were identified when using the ROC curve technique, which contributed to substantially reduced positive predictive values. When using the SDQ cut-points to screen for five different mental health diagnoses, we found that neither the existing British, nor the new Canadian-specific distributional or ROC curve clinical cut-points for the individual SDQ scales had a DOR above 20. This suggests that the individual SDQ scales may not be useful for screening those with mental health diagnoses. The total difficulties score was useful for predicting mental health diagnoses, indicated by DORs higher than 20, with no significant differences between the existing British and the Canadian-specific distributional or ROC curve clinical cut-points.

Phase 1: Establishing cut-points

The existing British SDQ cut-points did not accurately classify the sample of Canadian children and youth using the distributional technique for the emotional symptoms, hyperactivity and prosocial behaviour scales and the total difficulties score. This general finding was consistent with other studies that used country-specific data.[6-8] Our results align with data from Germany and the US, which found that a cut-point of 16 or higher to be more accurate in identifying the 90th percentile of children and youth in the total difficulties score, compared to the existing cut-point of 17 or higher.[7,8] However, our results diverge slightly from the German and US data for the prosocial scale, which ranged from 0 to 4 and 0 to 5, respectively, for identifying the 90th percentile, compared to 0 to 6 in our study.

Comparison of the existing British and the Canadian-specific SDQ cut-points

The Canadian distributional cut-points provide a slightly better ability to rule out false positives (improved specificity) than the existing British cut-points for the emotional symptoms and hyperactivity subscales.

TABLE 3
Proportion of Canadian children and youth in normal, borderline and clinical SDQ categories based on Canadian cut-points identified using the distributional technique (n = 3435)

SDQ scale	Normal (80%)		Borderline (10%)		Clinical (10%)	
	CHMS score	% (95% CI)	CHMS score	% (95% CI)	CHMS score	% (95% CI)
Conduct problems	0–2	86.6 (84.6–88.7)	3	6.3 (4.6–8.0)	4–10	7.1 (5.5–8.6)
Emotional symptoms	0–3	77.9 (74.8–80.9)	4–5	13.8 (11.8–15.8)	6–10	8.3 (6.4–10.2)
Hyperactivity	0–5	82.4 (79.9–84.9)	6–7	8.8 (7.1–10.5)	8–10	8.8 (6.9–10.7)
Peer problems	0–2	83.6 (81.1–86.1)	3	6.9 (5.8–8.0)	4–10	9.5 (7.2–11.9)
Prosocial behaviour	8–10	86.7 (84.5–88.9)	7	6.8 (5.3–8.3)	0–6	6.5 (4.7–8.3)
Total difficulties	0–11	79.7 (76.7–82.7)	12–15	10.6 (8.8–12.5)	16–40	9.7 (7.6–11.8)

Abbreviations: CHMS, Canadian Health Measures Survey; CI, confidence interval; SDQ, Strengths and Difficulties Questionnaire.

TABLE 4
Screening efficiency for existing and Canadian SDQ clinical cut-points using the distributional and ROC curve techniques to discriminate between clinical and general population samples in Canadian children and youth[a]

SDQ scale	SDQ clinical cut-point	Sensitivity (95% CI)	Specificity (95% CI)
Conduct problems			
British/Canadian (Distributional)	≥ 4	0.54 (0.51–0.57)	0.94 (0.93–0.94)
Canadian (ROC curve)[b]	≥ 3	0.67 (0.64–0.70)[c]	0.87 (0.86–0.88)[c]
Emotional symptoms			
British	≥ 5	0.74 (0.71–0.76)	0.87 (0.85–0.88)
Canadian (Distributional)	≥ 6	0.61 (0.58–0.64)[c]	0.92 (0.91–0.93)[c]
Canadian (ROC curve)[d]	≥ 4	0.82 (0.80–0.85)[c]	0.78 (0.77–0.79)[c]
Hyperactivity			
British	≥ 7	0.54 (0.51–0.57)	0.87 (0.86–0.88)
Canadian (Distributional)	≥ 8	0.42 (0.39–0.45)[c]	0.91 (0.90–0.92)[c]
Canadian (ROC curve)[e]	≥ 5	0.76 (0.73–0.78)[c]	0.75 (0.73–0.76)[c]
Peer problems			
British/Canadian (Distributional)	≥ 4	0.60 (0.57–0.63)	0.91 (0.90–0.92)
Canadian (ROC curve)[f]	≥ 3	0.74 (0.71–0.76)[c]	0.84 (0.83–0.85)[c]
Prosocial behaviour			
British	≤ 4	0.17 (0.14–0.19)	0.99 (0.98–0.99)
Canadian (Distributional)	≤ 6	0.44 (0.41–0.47)[c]	0.94 (0.93–0.95)[c]
Canadian (ROC curve)[g]	≤ 8	0.73 (0.70–0.75)[c]	0.76 (0.74–0.77)[c]
Total difficulties			
British	≥ 17	0.74 (0.71–0.77)	0.92 (0.91–0.93)
Canadian (Distributional)	≥ 16	0.79 (0.76–0.81)	0.90 (0.89–0.91)
Canadian (ROC curve)[h]	≥ 14	0.86 (0.84–0.88)[c]	0.86 (0.85–0.87)[c]

Abbreviations: CI, confidence interval; ROC, receiver operating characteristic; SDQ, Strengths and Difficulties Questionnaire.

[a] Outcome is clinical sample compared to general population sample. General sample n = 3435; clinical sample n = 1091.

[b] Area under the curve = 0.827.

[c] Significantly different from the British cut-points. Sensitivity is the proportion of true positives identified by the cut-point. Specificity is the proportion of true negatives identified by the cut-point.

[d] Area under the curve = 0.877.

[e] Area under the curve = 0.815.

[f] Area under the curve = 0.853.

[g] Area under the curve = 0.814.

[h] Area under the curve = 0.928.

However, the sensitivity for both scales were reduced. Compared to a previous study using clinical data from a Dutch sample and the existing British cut-offs for each score, both the existing and Canadian distributional cut-points in the current study had better specificity and slightly poorer sensitivity for combinations of candidate SDQ scales and mental health diagnoses.[5] The Canadian ROC curve cut-points demonstrated reduced specificity for all scales, and a substantially lower positive predictive value across all five mental health diagnoses groups. Strong specificity reduces the risk of misclassifying children and youth not at risk for mental health problems and allows those who test positive to go on for further assessment and treatment. For this reason, we believe the cut-points identified using the distributional technique provides better population-based utility.

Similar to previous work, the DORs for the combinations of candidate SDQ scales and mental health diagnoses did not reach the threshold for clinical utility (> 20).[7] However, the DOR for mood disorder, anxiety disorder, pervasive developmental disorder and conduct disorder all have 95% CIs that cross 20, indicating that the reported DOR is not significantly different from the greater-than-20 threshold. In addition, our results perform better than the results reported by Vugteveen et al.,[5] who found DORs between 3.82 and 5.79 for the same candidate SDQ scales and mental health diagnosis combinations. The predictive ability of the SDQ could be improved by including multiple informants instead of only the parent-reported SDQ scores included in our study. A previous study with a community sample showed better sensitivity when using a combination of parent, teacher and self-report SDQ scores compared to only the parent-reported SDQ scores.[19]

Strengths and limitations

This is the first study to investigate the effectiveness of the existing British SDQ cut-points in a large sample of Canadian children and youth to determine if they appropriately categorized the population into normal, borderline and clinical SDQ categories. This study also applied ROC curves to identify new SDQ cut-points, a novel approach in this area, based on the literature.

The use of a large, population-based sample allows for greater generalizability to the population of children and youth in Canada compared to using a small or convenience sample. Our study is also strengthened by combining a general population sample with a large clinical sample of diagnosed mental health conditions to validate the cut-points. We also compared two validated methods of quantifying cut-points, making the internal validity of our results more robust.

This study also has limitations. First, the original cut-points from Goodman[3] were developed using a sample of children and youth aged 4 to 16 years, while we used a sample aged 6 to 17 years. While these age ranges only differ slightly, they may account for some of the prevalence differences observed between the cut-points.

Second, we used data collected from the general population aged between 7 and 10 years old at the time of our data analysis and when creating the Canadian cut-points. It is possible that the prevalence of clinical-level symptoms on the SDQ scales has increased over the past 10 years. The existing British clinical SDQ cut-points for the emotional symptoms and hyperactivity

TABLE 5
Screening efficiency for existing and Canadian SDQ clinical cut-points from the distributional and ROC curve techniques: mood, anxiety and pervasive developmental disorders in the clinical population compared to the general population of children and youth[a]

SDQ scale	SDQ clinical cut-point	Sensitivity (95% CI)	PPV (95% CI)	NPV (95% CI)
Mood disorder				
Conduct problems				
British/Canadian (Distributional)	≥ 4	0.61 (0.54–0.67)	0.40 (0.35–0.45)	0.97 (0.96–0.98)
Canadian (ROC curve)	≥ 3	0.72 (0.66–0.77)	0.28 (0.24–0.31)[b]	0.98 (0.97–0.98)
Emotional symptoms				
British	≥ 5	0.73 (0.67–0.78)	0.28 (0.24–0.31)	0.98 (0.97–0.98)
Canadian (Distributional)	≥ 6	0.63 (0.57–0.69)	0.35 (0.31–0.40)	0.97 (0.97–0.98)
Canadian (ROC curve)	≥ 4	0.80 (0.75–0.85)	0.21 (0.18–0.23)[b]	0.98 (0.98–0.99)[b]
Hyperactivity				
British	≥ 7	0.59 (0.52–0.65)	0.24 (0.21–0.28)	0.97 (0.96–0.97)
Canadian (distributional)	≥ 8	0.49 (0.43–0.56)	0.28 (0.24–0.33)[b]	0.96 (0.95–0.97)
Canadian (ROC curve)	≥ 5	0.80 (0.75–0.85)[b]	0.18 (0.16–0.21)[b]	0.98 (0.98–0.99)[b]
Peer problems				
British/Canadian (distributional)	≥ 4	0.60 (0.53–0.66)	0.33 (0.28–0.37)	0.97 (0.96–0.98)
Canadian (ROC curve)	≥ 3	0.75 (0.69–0.80)[b]	0.25 (0.22–0.28)[b]	0.98 (0.97–0.98)
Prosocial behaviour				
British	≤ 4	0.16 (0.12–0.22)	0.45 (0.34–0.56)	0.94 (0.94–0.95)
Canadian (distributional)	≤ 6	0.45 (0.38–0.51)[b]	0.34 (0.29–0.39)	0.96 (0.95–0.97)
Canadian (ROC curve)	≤ 8	0.74 (0.68–0.79)[b]	0.18 (0.15–0.20)[b]	0.98 (0.97–0.98)[b]
Total difficulties				
British	≥ 17	0.78 (0.73–0.83)	0.42 (0.37–0.46)	0.98 (0.98–0.99)
Canadian (Distributional)	≥ 16	0.82 (0.77–0.87)	0.38 (0.33–0.42)	0.99 (0.98–0.99)
Canadian (ROC curve)	≥ 14	0.87 (0.83–0.91)[b]	0.31 (0.27–0.34)[b]	0.99 (0.99–0.99)[b]
Anxiety disorder				
Conduct problems				
British/Canadian	≥ 4	0.52 (0.48–0.56)	0.60 (0.56–0.64)	0.91 (0.90–0.92)
Canadian (ROC curve)	≥ 3	0.65 (0.61–0.69)[b]	0.48 (0.44–0.51)[b]	0.93 (0.92–0.94)[b]
Emotional symptoms				
British	≥ 5	0.73 (0.69–0.76)	0.50 (0.47–0.53)	0.95 (0.94–0.95)
Canadian (Distributional)	≥ 6	0.62 (0.58–0.65)	0.58 (0.54–0.62)[b]	0.93 (0.92–0.94)
Canadian (ROC curve)	≥ 4	0.83 (0.80–0.86)[b]	0.41 (0.38–0.44)[b]	0.96 (0.95–0.97)[b]
Hyperactivity				
British	≥ 7	0.52 (0.48–0.56)	0.42 (0.39–0.46)	0.91 (0.90–0.92)
Canadian (Distributional)	≥ 8	0.41 (0.37–0.45)	0.46 (0.42–0.50)	0.89 (0.88–0.90)
Canadian (ROC curve)	≥ 5	0.75 (0.71–0.78)[b]	0.35 (0.33–0.38)[b]	0.94 (0.93–0.95)[b]
Peer problems				
British/Canadian	≥ 4	0.59 (0.55–0.63)	0.55 (0.52–0.59)	0.92 (0.91–0.93)
Canadian (ROC curve)	≥ 3	0.72 (0.68–0.75)[b]	0.45 (0.42–0.48)[b]	0.94 (0.93–0.95)[b]
Prosocial behaviour				
British	≤ 4	0.16 (0.13–0.19)	0.68 (0.60–0.75)	0.86 (0.85–0.87)
Canadian (Distributional)	≤ 6	0.43 (0.39–0.47)[b]	0.56 (0.52–0.61)	0.90 (0.89–0.91)
Canadian (ROC curve)	≤ 8	0.72 (0.68–0.75)[b]	0.35 (0.33–0.38)[b]	0.94 (0.93–0.95)[b]

Continued on the following page

TABLE 5 (continued)
Screening efficiency for existing and Canadian SDQ clinical cut-points from the distributional and ROC curve techniques: mood, anxiety and pervasive developmental disorders in the clinical population compared to the general population of children and youth[a]

SDQ scale	SDQ clinical cut-point	Sensitivity (95% CI)	PPV (95% CI)	NPV (95% CI)
Total difficulties				
British	≥ 17	0.73 (0.69–0.76)	0.63 (0.60–0.67)	0.95 (0.94–0.96)
Canadian (Distributional)	≥ 16	0.78 (0.74–0.81)	0.60 (0.56–0.63)	0.96 (0.95–0.96)
Canadian (ROC curve)	≥ 14	0.85 (0.82–0.87)[b]	0.53 (0.50–0.56)[b]	0.97 (0.96–0.97)[b]
Pervasive developmental disorder				
Conduct problems				
British/Canadian (Distributional)	≥ 4	0.51 (0.44–0.58)	0.32 (0.27–0.37)	0.97 (0.96–0.98)
Canadian (ROC curve)	≥ 3	0.66 (0.59–0.73)[b]	0.23 (0.19–0.26)[b]	0.98 (0.97–0.98)
Emotional symptoms				
British	≥ 5	0.75 (0.68–0.81)	0.25 (0.21–0.28)	0.98 (0.98–0.99)
Canadian (Distributional)	≥ 6	0.61 (0.54–0.68)	0.30 (0.26–0.35)	0.98 (0.97–0.98)
Canadian (ROC curve)	≥ 4	0.87 (0.82–0.91)[b]	0.19 (0.16–0.21)[b]	0.99 (0.99–0.99)[b]
Hyperactivity				
British	≥ 7	0.54 (0.47–0.61)	0.19 (0.16–0.23)	0.97 (0.96–0.98)
Canadian (Distributional)	≥ 8	0.38 (0.32–0.45)	0.20 (0.17–0.25)	0.96 (0.95–0.97)
Canadian (ROC curve)	≥ 5	0.75 (0.69–0.81)[b]	0.15 (0.13–0.17)	0.98 (0.98–0.99)[b]
Peer problems				
British/Canadian (Distributional)	≥ 4	0.65 (0.58–0.72)	0.31 (0.26–0.35)	0.98 (0.97–0.98)
Canadian (ROC curve)	≥ 3	0.78 (0.72–0.84)[b]	0.22 (0.19–0.25)[b]	0.98 (0.98–0.99)[b]
Prosocial behaviour				
British	≤ 4	0.16 (0.11–0.22)	0.40 (0.30–0.52)	0.95 (0.94–0.96)
Canadian (Distributional)	≤ 6	0.43 (0.36–0.50)[b]	0.29 (0.24–0.34)	0.97 (0.96–0.97)
Canadian (ROC curve)	≤ 8	0.75 (0.69–0.81)[b]	0.16 (0.13–0.18)[b]	0.98 (0.98–0.99)[b]
Total difficulties				
British	≥ 17	0.73 (0.67–0.79)	0.36 (0.31–0.40)	0.98 (0.98–0.99)
Canadian (Distributional)	≥ 16	0.79 (0.73–0.84)	0.33 (0.28–0.37)	0.99 (0.98–0.99)
Canadian (ROC curve)	≥ 14	0.88 (0.83–0.92)[b]	0.27 (0.24–0.31)[b]	0.99 (0.99–0.99)[b]

Abbreviations: CI, confidence interval; NPV, negative predictive value; PPV, positive predictive value; ROC, receiver operating characteristic; SDQ, Strengths and Difficulties Questionnaire.

[a] Outcome is clinical sample with specified mental disorder compared to general population sample.

[b] Significantly different from the British cut-points. Sensitivity is the proportion of true positives identified by the cut-point. PPV is the probability of having a mental health problem if meeting the clinical cut-point. NPV is the probability of not having a mental health problem if not meeting the clinical cut-point.

scales included 13.9% and 13.0% of the sample, reflecting the rising prevalence of mental health symptoms among Canadian children and youth, even 7 to 10 years ago. Therefore, it is likely that the existing clinical cut-points underestimate the true prevalence of mental health disorders in Canadian children and youth.

Third, the general population sample excluded those living in the territories and on reserves, whereas the clinical sample may have included these individuals. This reflects the differences in sampling techniques used in both samples. Fourth, we only used clinical data from a single institution, which may have contributed to the differences we observed. Together, limitations three and four limit the generalizability of our findings. Finally, the response rate for the CHMS was low. Despite applying survey weights to adjust for non-response bias, effects of residual confounding due to non-response bias may still exist.

Conclusion

The current study presents Canada-specific SDQ cut-points that more accurately categorizes the sample of Canadian children and youth. However, the existing British and the Canadian-specific distributional cut-points have small differences in screening effectiveness to predict mental health diagnoses in children and youth. Although we identified new Canadian cut-points using ROC curves, we do not recommend their use in practice due to lower specificity compared to the distributional approach. Future SDQ users may consider using the new Canadian distributional cut-points, to maximize specificity of the emotional symptoms and hyperactivity subscales, and the existing British cut-points to allow for historical and international comparisons.

TABLE 6
Screening efficiency for existing and Canadian SDQ clinical cut-points from the distributional and ROC curve techniques: conduct disorder and ADHD in the clinical population compared to the general population of children and youth[a]

SDQ scale	SDQ clinical cut-point	Sensitivity (95% CI)	PPV (95% CI)	NPV (95% CI)
Conduct disorder				
Conduct problems				
British/Canadian (Distributional)	≥ 4	0.61 (0.53–0.69)	0.30 (0.25–0.36)	0.98 (0.98–0.99)
Canadian (ROC curve)	≥ 3	0.72 (0.64–0.79)	0.20 (0.17–0.23)[b]	0.99 (0.98–0.99)
Emotional symptoms				
British	≥ 5	0.75 (0.67–0.81)	0.20 (0.17–0.24)	0.99 (0.98–0.99)
Canadian (Distributional)	≥ 6	0.61 (0.53–0.68)	0.25 (0.21–0.30)	0.98 (0.98–0.99)
Canadian (ROC curve)	≥ 4	0.81 (0.75–0.87)	0.15 (0.12–0.17)[b]	0.99 (0.99–0.99)[b]
Hyperactivity				
British	≥ 7	0.56 (0.48–0.64)	0.16 (0.13–0.20)	0.98 (0.97–0.98)
Canadian (Distributional)	≥ 8	0.46 (0.38–0.54)	0.19 (0.15–0.24)	0.97 (0.97–0.98)
Canadian (ROC curve)	≥ 5	0.77 (0.71–0.84)[b]	0.12 (0.10–0.14)	0.99 (0.98–0.99)
Peer problems				
British/Canadian (Distributional)	≥ 4	0.64 (0.56–0.71)	0.25 (0.21–0.30)	0.98 (0.98–0.99)
Canadian (ROC curve)	≥ 3	0.76 (0.69–0.83)	0.18 (0.15–0.21)[b]	0.99 (0.98–0.99)
Prosocial behaviour				
British	≤ 4	0.14 (0.09–0.20)	0.31 (0.21–0.43)	0.96 (0.95–0.97)
Canadian (Distributional)	≤ 6	0.46 (0.38–0.54)[b]	0.25 (0.20–0.31)	0.97 (0.97–0.98)
Canadian (ROC curve)	≤ 8	0.80 (0.73–0.86)[b]	0.13 (0.11–0.15)[b]	0.99 (0.98–0.99)[b]
Total difficulties				
British	≥ 17	0.80 (0.73–0.86)	0.32 (0.27–0.37)	0.99 (0.99–0.99)
Canadian (Distributional)	≥ 16	0.83 (0.76–0.88)	0.28 (0.24–0.33)	0.99 (0.99–0.99)
Canadian (ROC curve)	≥ 14	0.87 (0.82–0.93)	0.22 (0.19–0.26)[b]	0.99 (0.99–1.00)[b]
ADHD				
Conduct problems				
British/Canadian (Distributional)	≥ 4	0.53 (0.48–0.58)	0.49 (0.44–0.54)	0.95 (0.94–0.95)
Canadian (ROC curve)	≥ 3	0.68 (0.64–0.73)[b]	0.38 (0.34–0.41)[b]	0.96 (0.95–0.97)[b]
Emotional symptoms				
British	≥ 5	0.77 (0.72–0.81)	0.40 (0.36–0.43)	0.97 (0.96–0.98)
Canadian (Distributional)	≥ 6	0.62 (0.57–0.66)[b]	0.46 (0.42–0.51)	0.95 (0.95–0.96)
Canadian (ROC curve)	≥ 4	0.84 (0.80–0.88)	0.31 (0.28–0.34)[b]	0.98 (0.97–0.98)
Hyperactivity				
British	≥ 7	0.54 (0.49–0.59)	0.32 (0.29–0.36)	0.94 (0.93–0.95)
Canadian (Distributional)	≥ 8	0.41 (0.36–0.46)[b]	0.35 (0.31–0.40)	0.93 (0.92–0.94)
Canadian (ROC curve)	≥ 5	0.77 (0.73–0.81)[b]	0.26 (0.24–0.29)[b]	0.97 (0.96–0.97)[b]
Peer problems				
British/Canadian (Distributional)	≥ 4	0.62 (0.57–0.66)	0.45 (0.41–0.49)	0.95 (0.95–0.96)
Canadian (ROC curve)	≥ 3	0.77 (0.73–0.81)[b]	0.36 (0.33–0.39)[b]	0.97 (0.96–0.98)[b]
Prosocial behaviour				
British	≤ 4	0.18 (0.14–0.22)	0.59 (0.49–0.68)	0.91 (0.90–0.92)
Canadian (Distributional)	≤ 6	0.48 (0.43–0.53)[b]	0.47 (0.42,0.52)	0.94 (0.93–0.95)[b]
Canadian (ROC curve)	≤ 8	0.77 (0.73–0.81)[b]	0.27 (0.24–0.30)[b]	0.97 (0.96–0.97)[b]

Continued on the following page

TABLE 6 (continued)
Screening efficiency for existing and Canadian SDQ clinical cut-points from the distributional and ROC curve techniques: conduct disorder and ADHD in the clinical population compared to the general population of children and youth[a]

SDQ scale	SDQ clinical cut-point	Sensitivity (95% CI)	PPV (95% CI)	NPV (95% CI)
Total difficulties				
British	≥ 17	0.76 (0.71–0.80)	0.53 (0.49–0.57)	0.97 (0.96–0.98)
Canadian (Distributional)	≥ 16	0.79 (0.75–0.83)	0.49 (0.45–0.53)	0.97 (0.97–0.98)
Canadian (ROC curve)	≥ 14	0.88 (0.84–0.91)[b]	0.42 (0.39–0.45)[b]	0.98 (0.98–0.99)[b]

Abbreviations: ADHD, attention deficit hyperactivity disorder; CI, confidence interval; NPV, negative predictive value; PPV, positive predictive value; ROC, receiver operating characteristic; SDQ, Strengths and Difficulties Questionnaire.

[a] Outcome is clinical sample with specified mental disorder compared to general population sample.

[b] Significantly different from the British cut-points. Sensitivity is the proportion of true positives identified by the cut-point. PPV is the probability of having a mental health problem if meeting the clinical cut-point. NPV is the probability of not having a mental health problem if not meeting the clinical cut-point.

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Conflicts of interest

The authors report no conflicts of interest related to this study.

Authors' contributions and statement

JJL – Conceptualization, Project administration, Supervision, Methodology, Writing – Review & Editing, Data curation, Formal analysis.

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All authors approved the manuscript for publication.

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Commentary

Historical lessons for Canada's emerging national school food policy: an opportunity to improve child health

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Background

Canada lags behind most high-income countries in child nutrition.[1] Less than one-third of children in Canada consume the recommended daily servings of vegetables and fruit.[2] They also consume five times more sugar than recommended by the national guidelines and get more than half of their calories from ultra-processed foods.[3,4] Overall, Canadians are the second largest consumers of ultra-processed foods and beverages in the world.[5] Poor diet has been linked with nutritional deficiencies and the development of chronic diseases such as obesity, type 2 diabetes and heart disease.[6]

Poor access to nutrition is also associated with worse learning outcomes, contributing to broader social inequities as an upstream determinant of health.[7,8] School meal programs can address these challenges by encouraging healthy eating behaviours and food–body relationships as well as the development of lifelong nutrition literacy.[9,10] Internationally, school meals have been shown to be one of the most successful drivers of improved health, education and even economic growth, with the equivalent of a $3 to $10 return on every dollar invested.[11]

Despite these potential benefits, Canada is the only G7 country without a national school food program.[12] Following the Government of Canada's historic—but unfunded—commitment to develop a national school food program in the 2019 Budget, the Liberal Party recommitted to school food in its 2021 election platform by stating it would spend $1 billion over 5 years to "develop a National School Food Policy and work towards a national school nutritious meal program."[13,p.7] As Canadian policy makers develop a framework for such a program, they should consider the experiences of other countries.

The development and evolution of school meal programs in the United States (US) could offer Canada a series of lessons given the countries' geographical proximity and shared challenges with unhealthful food environments and persistent nutritional inequalities.[14,15] In 1946, the US established the National School Lunch Program (NSLP), which now feeds approximately 30 million children per year.[16] Although the NSLP has been successful in reducing child hunger in school environments, it has historically failed to meet minimum nutrition needs and perpetuated stigma and social inequalities.[17]

This commentary will draw on historical lessons from the NSLP and propose three priority areas to prevent unintended consequences and ensure a sustainable program in the Canadian context: (1) resisting corporatization and prioritizing health; (2) preventing stigma through universal access; and (3) ensuring cultural inclusion and appropriateness.

Highlights

- School meals are one of the most successful drivers of improved health and education.
- In 2021, the Canadian federal government committed $1 billion over 5 years to develop a national school food policy and work towards a national school nutritious meal program.
- Canadian policy makers should learn from the experiences of other countries, including the United States' National School Lunch Program.
- We propose 3 priority areas to maximize health improvements: (1) resisting corporatization and prioritizing health; (2) preventing stigma through universal access; and (3) ensuring cultural inclusion and appropriateness.

Keywords: *nutrition, students, school meal programs, Indigenous populations, immigrants, inclusion*

Priority 1: Resisting corporatization and prioritizing health

The primary intention of a national school meal program should be to ensure equitable access to nutritious food and to support the health and well-being of school-aged children. To achieve this, child health must be prioritized and, to the greatest extent possible, corporate interests curbed.

In the US, discourse on the need for school meal programs began as early as the mid-1800s, although it was not until the Great Depression that a nationwide school meal program emerged.[18] In 1933,

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the Federal Surplus Commodities Corporation was established to address the twin crises of plummeting crop prices and soaring child hunger by redistributing agricultural surpluses to schools. The program was popular among agriculturalists and child welfare advocates, and was made into a permanent fixture of the school system with the *National School Lunch Act* of 1946.

While the program was considered a win-win for both children and farmers, it inextricably linked health with agricultural interests and paved the way for a program that primarily sought to "dump" surplus commodities, such as wheat and dairy products, rather than provide optimally nutritious meals to hungry children. These tensions are clear from the Congressional hearings that preceded the NSLP, such as the following exchange[19,p.33-34] between Representative Murray, a Republican from Wisconsin, and Representative Cooley, a Democrat from North Carolina.

> To my mind, I don't see where we are going to do much on the surplus problem. I was just wondering how far we can go down that road, Mr. Chairman, and still keep to our main objective, which is to see that the children of this country, regardless of their incomes, have at least the income to get a lunch. [Murray]
>
> Is that the objective? The main objective, as I understand it, is to dispose of surplus agricultural commodities, and the feeding of the school children is just collateral to that main objective… [Cooley]

To this day, corporate interests remain deeply embedded within the NSLP and serve as a barrier to prioritizing children's health. This focus on business has resulted in bizarre policies, such as changes to the NSLP's nutrition standards that classified ketchup and pizza sauce as vegetables to reduce program expenses.[20] In 1990, the United States Department of Agriculture (USDA) commissioned a comprehensive review of the NSLP; this found that only 1% of schools complied with the NSLP's guidelines for fat.[21] A similar study in 2015 found that NSLP meals still did not meet the agency's nutrition standards.[22] This has had troubling implications for child health, with one US study finding frequent school lunch consumption to be a greater risk factor for obesity than spending 2 or more hours a day watching television.[23]

Although a national school meal program offers opportunities for economic growth through regional food production and job creation, experiences in the US show that policy makers must draw clear boundaries so that agricultural and corporate interests remain secondary to child health.[24,25] In fact, agenda distortion, reciprocity and corporate capture are just a few of the perils of private partnerships.[26,27]

In December 2021, the federal government tasked the Minister of Agriculture and Agri-Food and the Minister of Families, Children and Social Development with developing the national school food policy and meal program, given their mandates over Canada's food system and social safety programs.[28] While it is important to engage a variety of stakeholders, Canada must remain vigilant about the commercial determinants of health, defined as "the systems, practices and pathways through which commercial actors drive health and equity."[29,p.1195] More specifically, it must protect students from corporate lobbying and the promotion of unhealthful products, especially as the historical record demonstrates how business interests can become insurmountable once ingrained.[30,31]

Priority 2: Preventing stigma through universal access

Social stigma is often underestimated as a threat to public health, despite the fact that it can undermine individual well-being and exacerbate population health inequities by producing discrimination and reluctance to seek help.[32,33] Policy makers must carefully consider how school meal programs are framed and financed to protect students in under-resourced communities from the shame, psychological distress and reduced health-seeking behaviours that can arise from participating in stigmatizing programs for the "poor" or "needy."

Although the US *National School Lunch Act* marked a major milestone in the development of America's social safety net, its reach in 1946 was significantly limited, especially for the most vulnerable communities. While the NSLP required that impoverished children receive free lunches, Congress did not initially pass any enforcement mechanisms or appropriate funds to achieve these goals.[34] The United States Department of Agriculture also did nothing to ensure that the program was accessible to Black schools in racially segregated districts.[34] As a result, most schools simply ignored the free lunch mandate and the NSLP largely remained a program for those that could afford to pay.

Hoping to close this gap, Congress passed the *Child Nutrition Act* in 1966, which expanded the NSLP and mandated that all participating schools provide free meals to children experiencing poverty. However, this well-intentioned rebranding of the NSLP as an "anti-poverty" program was equally harmful, as it stigmatized participation. Many families began to pull their children from the program so as not to be labelled "needy," "low-income" or "at risk." Between 1970 and 1973, an estimated one million paying students dropped out of the NSLP.[34]

By the middle of the 1970s, few children who had any choice ate school lunches, cutting off an important revenue stream. Faced with a massive budget shortfall, policy makers opened the NSLP to industrial food service companies and fast-food companies like McDonald's, Pizza Hut and Taco Bell, hoping they would keep the program afloat by reducing unit costs while enticing paying students back into the program with branded and highly processed foods.[34] American policy makers have since recognized the drawbacks of this poverty-based, multitiered system and have shifted, in the past decade, towards universal free meals by establishing Community Eligibility Provision (CEP) programs.[35]

These historical vignettes highlight the pitfalls of means-tested social programs and demonstrate how social stigma can undermine school meal programs, particularly when there is a clear divide between those receiving free and paid meals. Means-tested programs not only create feelings of shame among participants, undermining voluntary participation and psychological safety, they warp incentives away from nutrition towards the recruitment of paying "customers" while creating administrative costs and inefficiencies.[36,37] As such, Canada's policies should consider a model based on universal access

(i.e. providing school meals at no cost to all children who choose to participate).

In addition, school meals should not replace other income-based solutions that address the underlying social inequalities that result in household food insecurity and differences in healthy eating, obesity and chronic disease outcomes.[15] Like our health and education systems, the national school meal program should be thought of as a universal public service to improve well-being rather than as a narrow anti-poverty program or a potential revenue stream.[38]

Priority 3: Ensuring cultural inclusion and appropriateness

It is important that policy makers consider how culturally diverse and appropriate foodways will be incorporated into the national school food policy to take into account the heterogeneity of Indigenous and immigrant communities—who make up nearly a quarter of the population in Canada.

Given the strong relationship between food and identity, school meal programs have historically been used as part of broader assimilation efforts to coerce racialized communities into adopting Anglo-American tastes.[34] In American Indian boarding schools well into the 20th century, Indigenous students were forbidden from practising their food traditions in order to "kill the Indian, save the man."[39,40] Targeted efforts were also made to assimilate immigrant children, with one early Americanization textbook noting, "One's very food affects his Americanism. What kind of American consciousness can grow in the atmosphere of sauerkraut and Limburger cheese?"[41] Perhaps most dramatically, the US National Defence Advisory Commission established the Committee on Food Habits in 1940, which sought to imbue immigrants with common food habits, believing "the systematic exploitation of such cultural differences is part of the enemy tactic of war."[34] In the following decade, the committee recommended that school lunch menus "transform diverse ethnic food cultures into a national identity" and that school cafeteria tables be assigned a "host" and "hostess" to lead the meal according to Anglo-American social norms.[42]

Unsurprisingly, these efforts to impose cultural conformity had serious repercussions for the mental well-being and participation of students. Reflecting on her experience with school food in 1949, one second-generation Russian-Jewish immigrant lamented, "What came across was the idea that your home environment was no good and you had to make it different."[36] Today, innovative pilot programs have emerged across the US to provide culturally diverse meals. For example, the Cheyenne River Sioux Tribe's "farm-to-school" program provides locally sourced beef and buffalo to the five schools in its South Dakota reservation.[43] Many similar programs have since emerged that recognize the value of Indigenous sustainable food practices; however, in the absence of a national strategy, these efforts largely remain a patchwork.[43]

Benefiting from historical retrospection, policy makers should recognize that the lack of culturally appropriate foods in school meal programs can contribute to cultural erasure and limit uptake within racialized communities. Canada should be especially sensitive to these lessons given its own history of assimilationist immigration policies and the cultural genocide inflicted upon First Nations, Métis and Inuit children in residential and day schools.[44-46] As the Truth and Reconciliation Commission makes clear, to deny one's food is to deny one's culture.[47] Indigenous and immigrant knowledge keepers must therefore be equal partners at every step of the program planning, implementation and evaluation processes, with special efforts to protect and revitalize Indigenous foodways. Canada's emerging school food policy must further consider how it will meaningfully scale up the provision of culturally appropriate foods—whether through funding, local partnerships or farm-to-school activities—so that the burden of ensuring cultural inclusion does not fall solely on already overstretched schools.

Conclusion

A national school meal program is about much more than just food. Beyond serving as a social safety net, it offers opportunities to promote health equity, nutrition literacy and lifelong healthy eating habits. In addition, such a program can foster school environments that celebrate Canada's cultural diversity. Still, while the theoretical benefits of school meals are plentiful, the practical implementation of the program will be most consequential. Like their American counterparts, Canadian policy makers will inevitably face organizational and administrative dilemmas that determine whether the program strengthens or undermines students' physical and mental health. If child health is to be prioritized, Canadian policy makers must implement conflict of interest safeguards to prevent the food industry from marketing unhealthful products to students, increase funding across all levels of government to sustain a program built upon universal access, and scale up policies that enable culturally important practices like the harvesting of traditional foods to ensure cultural inclusion and appropriateness.[48]

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Conflicts of interests

None.

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In Memoriam – A tribute to Marie DesMeules

It is with a deep sense of loss that we announce the passing of Marie DesMeules, Publisher of *Health Promotion and Chronic Disease Prevention in Canada* (the HPCDP Journal).

During her career of over 30 years with Health Canada and the Public Health Agency of Canada (PHAC), Marie worked tirelessly to promote the importance of science and the need to understand and address the determinants of health in all policies. Marie was a pioneer in her work on gender equality, women's health, immigrant health, the health of Black Canadians and chronic disease epidemiology.

She was committed to conducting surveillance and research that provided a meaningful account of the social determinants of health and health outcomes for marginalized, yet resilient, populations in Canada. She also recognized the importance of sharing this information with key partners and decision-makers so that future public health actions would be based on sound evidence.

Marie led various teams across PHAC to fulfill many noteworthy achievements. These included numerous peer-reviewed journal articles that she authored and co-authored with leading internal and external researchers, as well as the formation and launch of the Canadian Best Practices Portal, which provided access to evidence-based interventions that addressed key determinants of health for chronic diseases.

In response to Canada's international commitments to strengthen capacity, evidence and action on social determinants of health and health equity, Marie led the development of the *Key Health Inequalities in Canada* report (2018), which has been accessed by users across Canada and in more than 80 countries. This report provided substantial new evidence on the most pronounced and widespread health inequalities, and a benchmark for ongoing monitoring and reporting of health inequities in Canada.

In June 2018, Marie received the Chief Public Health Officer Medal, the highest honour at PHAC for leaders in public health, for her achievements in linking social and economic factors to health inequalities.

Marie spent many years as the Director of PHAC's Social Determinants of Health Division. There she built an extensive network of collaborators from across every sector and was known for fostering strong and authentic relationships. Marie's expertise and leadership were integral in advancing key policy and program initiatives related to: the Pan-Canadian Health Inequalities Reporting initiative; the integration of Sex- and Gender-Based Analysis Plus; the promotion of evidence-based decision-making with a consideration for health, equity and well-being issues in all policies; and the design and implementation of innovative and equity-focussed community-based funding models. Marie chaired the Mental Health of Black Canadians Working Group at the time of its inception and her contribution was foundational to the development and implementation of this unique and impactful initiative. She will be remembered as a true champion of equity and inclusion.

For the past few years, Marie led the Centre for Surveillance and Applied Research through the COVID-19 pandemic, serving as a galvanizing force during the expansion of its mandate to address the wider health impacts of COVID-19, including post COVID-19 condition (long COVID).

Marie DesMeules was a leader, mentor and valued colleague to so many throughout her career. As Publisher of the HPCDP Journal, she was unafraid to tackle controversial issues and steered a course that protected the scientific integrity and editorial independence of our journal.

She will be missed by all who knew her.

Other PHAC publications

Researchers from the Public Health Agency of Canada also contribute to work published in other journals and books. Look for the following articles published in 2023:

Cibulsky SM, **Wille T**, **Funk R**, **Sokolowski D**, **Gagnon C**, **Lafontaine M**, […] **Russell DR**, **Jett DA**, et al. Public health and medical preparedness for mass casualties from the deliberate release of synthetic opioids. Front Public Health. 2023;11:1158479. https://doi.org/10.3389/fpubh.2023.1158479

De Rubeis V, **Jiang Y**, **de Groh M**, **Dufour L**, **Bronsard A**, **Morrison H**, et al. Barriers to oral care: a cross-sectional analysis of the Canadian longitudinal study on aging (CLSA). BMC Oral Health. 2023;23(1):294. https://doi.org/10.1186/s12903-023-02967-3

Garritty C, Tricco AC, Smith M, et al. Rapid Reviews Methods Series: involving patient and public partners, healthcare providers and policymakers as knowledge users. BMJ Evid Based Med. 2023:112070:bmjebm-2022-112070. https://doi.org/10.1136/bmjebm-2022-112070

Kamal A, Ferguson M, Xavier JC, et al. Smoking identified as preferred mode of opioid safe supply use; investigating correlates of smoking preference through a 2021 cross-sectional study in British Columbia. Subst Abuse Treat Prev Policy. 2023;18(1):27. https://doi.org/10.1186/s13011-023-00515-4

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Sing CW, Lin TC, **Bartholomew S**, […] **Doyon CY**, et al. Global epidemiology of hip fractures: secular trends in incidence rate, post-fracture treatment, and all-cause mortality. J Bone Miner Res. 2023 (Online ahead of print). https://doi.org/10.1002/jbmr.4821

Thaivalappil A, Coghlin R, Bell C, […] **Janicki R**, et al. A mixed-methods assessment of community-engaged learning in a Master of Public Health program. SAGE Open Med. 2023;11:20503121231176637. https://doi.org/10.1177/20503121231176637

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Zakaria D. Sociodemographic and health characteristics of cancer survivors in Canada between 2015 and 2018. J Public Health (Berl.). 2023;31(6):849-67. https://doi.org/10.1007/s10389-021-01621-y