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Original qualitative research

Systemic and organizational barriers to primary chronic disease prevention: a qualitative study of public health organizations in Canada

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Abstract

Introduction: Public health organizations in Canada play a central role in chronic disease prevention (CDP) but face persistent challenges, including system restructuring, persistent underfunding and shifting policy priorities. The growing complexity of these issues warrants qualitative insight to complement quantitative reports capturing CDP organizations' perspectives.

Methods: The Public Health Organizational Capacity Study (PHORCAST) is a repeat Canada-wide census of public health organizations engaged in primary CDP at national, provincial, territorial and regional population levels. In 2023, senior managers and staff with in-depth knowledge of their organizations' CDP activities completed a questionnaire that requested optional comments via an open-ended question. The responses were analyzed using qualitative descriptive methods and inductive content analysis to identify and organize recurring issues. Theme frequencies are reported descriptively to indicate prominence across organizations and not to quantify meaning.

Results: Across the 55 organizations, 125 coded references to barriers to CDP were synthesized into five key themes: organizational capacity and program delivery challenges (n = 38), including chronic underfunding, workforce shortages and limited infrastructure; COVID-19 pandemic disruptions causing staff redeployment and prolonged service interruptions (n = 30); policy and systemic barriers (n = 28), including political interference and poor interjurisdictional coordination; fragile partnerships and the need for stronger intersectoral collaboration (n = 16); and difficulties engaging diverse communities, digital access issues and lack of culturally responsive programming (n = 13).

Conclusion: CDP efforts in Canada are constrained by structural, operational and contextual barriers. Addressing these challenges requires sustained investment, coherent policies and stronger cross-sector partnerships.

Keywords: *chronic disease prevention, public health organization, organizational capacity, barrier, Canada, qualitative*

Highlights

- Chronic underfunding and workforce shortages are major barriers to primary chronic disease prevention (CDP) across Canada.
- Policy fragmentation, political interference and weak interjurisdictional coordination continue to undermine long-term CDP capacity.
- The COVID-19 pandemic intensified existing challenges through staff redeployment and disruptions to CDP programs.
- Reaching diverse communities is hindered by digital inequities and a lack of culturally responsive approaches.
- Partnerships are essential but remain fragile, which emphasizes the need for more stable, cross-sector collaboration frameworks.

Introduction

Chronic, non-communicable diseases, including cardiovascular disease, cancer, diabetes and chronic respiratory diseases, are leading causes of morbidity and mortality, globally. Public health organizations

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in Canada and elsewhere play a central role in developing and delivering chronic disease prevention (CDP) programs, policies and practices to reduce the chronic disease burden. Despite strong evidence supporting the cost-effectiveness of prevention, CDP remains underresourced and underprioritized within public health systems.[1-6] Acute care continues to dominate policy and funding agendas, limiting investment in prevention.[7-10] Short-term project-based funding contributes to policy instability, workforce turnover and loss of institutional memory, hindering the sustainability and scalability of evidence-informed CDP.[7-11] Further, the COVID-19 pandemic exacerbated these challenges through staff redeployment and prolonged disruptions to preventive services, particularly in marginalized populations.[12-14]

In Canada, CDP is delivered by many different organizations mandated to support population-level primary prevention and health promotion, including formally mandated government organizations such as public health units or agencies, health authorities, and non-governmental organizations such as health charities and not-for-profit organizations.[1-6] Collectively, these organizations operate within a public health system affected by decades of restructuring, fiscal constraint and shifting political priorities.

To monitor CDP capacity within this ever-evolving context, the Public Health Organizational Capacity Study (PHORCAST; https://www.celphie.ca/phorcast) was launched in 2004 as a recurring Canada-wide census of public health organizations that develop and/or deliver CDP initiatives at national, provincial, territorial and regional levels.[1,2,15-20] All PHORCAST organizations are mandated to conduct population-level primary CDP and/or healthy lifestyle promotion. While PHORCAST has provided valuable quantitative data on organizational capacity measures,[1,2,16] inter-organizational collaboration and resource networks[15] and trends in public health strategies for CDP and healthy lifestyle promotion,[17-20] less is known about how public health organizations experience systemic barriers to CDP.

In this qualitative sub-study of CDP organizations, we draw on PHORCAST data collected in 2023 to explore perceived pressures, including chronic underfunding, policy shifts, leadership transitions, staff redeployment and structural reforms. Drawing on the strengths of qualitative inquiry to illuminate organizational experiences and adaptations,[21,22] we aim to provide a contextualized understanding of the operational realities shaping CDP in Canada today.

Methods

A qualitative sub-study was embedded within PHORCAST 2023, which collects data from all national, provincial, territorial and regional public health organizations with mandates for primary CDP in Canada.[1,2,16,17,19] Organizations that are eligible to participate in PHORCAST include provincial, territorial and regional health authorities, public health units and agencies, government departments, para-governmental agencies (i.e. those financed by government but acting independently), national health charities and their provincial, territorial or regional chapters, other non-governmental and not-for-profit organizations, resource centres and professional associations. The inventory of organizations was compiled in 2004 and updated in 2010 and 2023.

We first generated an exhaustive list of candidate organizations in each province and territory and nationally, through rigorous Internet searches. We then validated the list to ensure completeness by consulting with experts with wide-ranging knowledge of the public health landscape at the national, provincial, territorial or regional levels in Canada. To update the inventory in 2010 and 2023, we confirmed the continued existence of organizations that did or did not participate in the previous data collection waves, including previously ineligible organizations, because organizational mandates can change over time. We then conducted further Internet searches and consulted other sources (i.e. provincial and territorial mailing lists, membership databases, experts in each province and territory as well as national experts) to identify organizations that began operations since the preceding census and confirmed their eligibility according to their mandate. We also confirmed the eligibility of existing organizations functioning with new CDP divisions or offering new types of activities; and those formed by the amalgamation of two or more previously participating organizations.

The inventory included public health organizations that develop or adapt primary CDP initiatives (e.g. programs, policies, practices) and transfer these initiatives to other organizations (referred to as "resource organizations"); and/or deliver or implement CDP initiatives for the population-at-large or specific subgroups (referred to as "user organizations"). Specifically, included were public health organizations with mandates for population-level primary prevention of chronic disease (cancer, cardiovascular disease, diabetes, chronic respiratory diseases) or healthy lifestyle promotion, or with a single-focus mandate for healthy eating, tobacco control or physical activity. Organizations that focused exclusively on secondary or tertiary prevention, research, fundraising, advocacy or knowledge translation were excluded as were those that operated only at the local level.[1,2,15-20]

In 2023, all eligible organizations (n = 335) were invited to participate. A senior manager from each organization was first contacted to confirm eligibility and to identify a key informant—defined as the individual most knowledgeable about the organization's CDP activities. Senior managers could nominate themselves or another staff member. The key informants were contacted by email to confirm their suitability and subsequently invited to complete the PHORCAST questionnaire, which was available online on the LimeSurvey platform (LimeSurvey GmbH, Hamburg, DE). They could complete the questionnaire independently or be interviewed by the study coordinator or an investigator via Zoom (Zoom Communications, San Jose, CA, US), in accordance with standard PHORCAST procedures.[23,24]

The key informants (henceforth referred to as "participants") were instructed to respond on behalf of their organization, reflecting collective experiences rather than their individual perspectives. Following closed-ended questions, the participants were invited to provide additional comments with a broad, non-directive, open-ended question: "Do you have any additional comments?"

This sub-study is based on written or verbal responses pertaining to barriers to CDP from 70 organizations. Of these, 15 were excluded because they focused solely on questionnaire feedback, which yielded an analytic sample of 55 participants.

We adopted a qualitative descriptive design to summarize organizational perspectives on barriers to CDP with minimal interpretive inference.[25,26] This approach was selected to provide a practice-relevant description of reported experiences that used the participants' language. Data were analyzed using an inductive content analytic approach, with codes derived directly from the data rather than imposed a priori. Two researchers independently coded all responses and developed a shared codebook through iterative discussion. Minor differences (12 of 125 coded references; 9.6%), typically reflecting the identification of an additional relevant category by one of the coders, were resolved through discussion.

Of the 55 organizational responses, 29 were provided verbally via Zoom interviews and 26 were submitted in writing. Verbal responses were generally more detailed (median of 236 words; range of 76–1604 words), whereas written responses tended to be shorter but substantive (median of 58 words; range of 9–178 words). Each response could be coded to more than one category. The frequency with which categories appeared across responses was tallied; this is reported descriptively to convey the distribution of reported issues across organizations.

Pattern identification was informed by the general principles of thematic analysis described by Braun and Clarke, particularly the identification of recurring meanings across a dataset through recursive engagement with the data, without adopting reflexive thematic analysis as a standalone methodological framework.[27] Analytic credibility was supported through independent dual coding, iterative team discussions and cross-checking of coding decisions made by researchers with different disciplinary and experiential backgrounds. We used reflexive discussions to support analytic transparency by considering how researchers' professional experiences in public health and system-level initiatives may have shaped analytic decisions, consistent with qualitative descriptive practice.

All transcripts were anonymized. Participant quotations are identified using the uppercase letter *P* and the anonymized participant number (e.g. P 50).

Ethics approval

Study procedures were approved by the Unity Health Toronto (21-240) Research Ethics Board and the CHUM Research Centre (2022-10366) Research Ethics Board. Informed consent was obtained from all participants.

Results

In 2023, PHORCAST surveyed 298 public health organizations with mandates for CDP, which represented 89% of those eligible. The median age of the 55 organizations that provided responses to the open-ended question was 50 years. Most (75%) were user organizations and 47% were formally mandated government organizations. Over half of the organizations (58%) were entirely dedicated to CDP and 42% housed CDP units. Organizations served diverse geographic areas, with the largest proportion operating at the regional (31%) or provincial or territorial levels (40%). About half (51%) served geographical areas with more than 500 000 inhabitants (Table 1).

Participants described multiple and overlapping barriers shaping CDP activities at the organizational level. Across the 55 organizations, 125 coded references were identified and subsequently synthesized into five key themes (Table 2). The most frequently mentioned barriers related to organizational capacity and program delivery (n = 38); COVID-19 pandemic disruptions of CDP activities (n = 30); and policies and systems (n = 28). Less frequently mentioned were barriers related to building collaborations and partnerships (n = 16) and engaging diverse communities (n = 13) (Table 2).

Organizational capacity and program delivery

Chronic underresourcing emerged as a central challenge. Participants described a chronic state of "doing more with less," exacerbated by inflation and flat budgets. Budget allocations often failed to reflect the growing scale and complexity of CDP work. One participant explained that despite rapid program growth:

> … we're still only getting the same money we've always gotten and there's no accommodation for cost of, you know, the consumer price index, in terms of things going up, you know, our consulting fees, that type of thing are going up [P 50, resource organization].

This financial stagnation created practical obstacles across all levels of implementation, particularly for smaller and more remote units. Some organizations described how geographic isolation complicated their ability to attract talent and secure adequate resources:

> We're a very small organization in our province, we are smallest, by just 35 000 people. And so it's always hard for us to get those resources. And we're also very, very far from most geographic centres so it's hard to get students that are willing to come or move or participate in that way [P 118, user organization].

Meanwhile, the demand for preventive services (e.g. community-based lifestyle programs, school and workplace health initiatives, chronic disease screening, public education or awareness campaigns) has rebounded considerably since pandemic restrictions eased, placing additional strain on limited personnel and infrastructure. Many organizations reported that their capacity to meet this demand has not kept pace: "As things opened up, the demand has been high for CDP, but training and resourcing of critical programs has been low" [P 165, user organization].

The result is a responsive workforce that is stretched to its limits, striving to meet rising community needs, but lacking the financial and human resources necessary to sustain existing programs, let alone innovate or scale new ones. Several organizations expressed frustration that, despite good ideas and intentions, structural constraints limited their ability to pursue ambitious or high-impact programming:

> There's so much when you're in a resource-constrained environment… you can be building the best program you can, but then you don't always have the funding to execute it at scale and spread it. We always have to make choices about where we can reach.… [P 197, user organization].

Another participant similarly reflected:

> We've had to do our budgets so that we don't have any money in there for training our activity coaches any

TABLE 1
Characteristics of CDP organizations that provided comments about barriers to CDP (n = 55), PHORCAST, Canada, 2023

Characteristics	Proportion
Median age, years (IQR)	50 (25–100)
User organization, %	75
Resource organization, %	15
FMO, %	47
NGO, %	53
Organizations entirely dedicated to CDP, %	58
Organizations housing CDP units, %	42
Geographic area served, %	
Subregion	7
Region	31
Province/territory	40
Multi-province/territory	11
Canada	11
Population size served, %	
< 50 000	7
50 000–99 999	2
100 000–199 999	27
200 000–499 999	13
500 000–1 000 000	13
> 1 000 000	38
Median number of full-time CDP staff, n (IQR)	67 (8–300)
Median number of volunteers, n (IQR)	25 (9–60)

Abbreviations: CDP, chronic disease prevention; IQR, interquartile range; FMO, formally mandated organization; NGO, non-governmental organization; PHORCAST, Public Health Organizational Capacity Study.

Note: Organizations categorized as "multi-province/territory" and "Canada" are distinct and do not overlap.

> more because we need to survive as an organization—but we have to go out and get other funding and more money to implement the activity coaching [P 50, resource organization].

These perspectives illustrate how limited funding not only impedes day-to-day operations but actively diverts organizations away from proactive capacity-building or long-term planning. As one participant put it, "we're just not resourced for that level of implementation" [P 197, user organization].

In short, while innovation and scale are aspirational goals, organizations remain entrenched in survival mode, making strategic trade-offs that prioritize feasibility over more ambitious programming.

TABLE 2
Themes in participants' descriptions of organizational barriers to CDP, PHORCAST, Canada, 2023

Key theme	Frequency, n
Organizational capacity and program delivery	38
COVID-19 pandemic impacts on CDP activities	30
Policies and systems	28
Collaboration and partnerships	16
Reaching and engaging diverse communities	13

Abbreviations: CDP, chronic disease prevention; PHORCAST, Public Health Organizational Capacity Study.

Note: A total of 125 coded references to barriers to CDP were identified across 55 organizations and synthesized into 5 key themes. The median number of themes mentioned by participants was 2, with a range of 1–5.

Policy and systemic barriers

Participants depicted a policy landscape that undervalues prevention and forces organizations to operate reactively rather than strategically. The funding environment was described as volatile, often driven by short-term political agendas rather than long-term health outcomes. This instability compels organizations to continually adjust their priorities to secure funding, a practice that undermines continuity and strategic planning:

> … if the federal government or provincial government have priority and then that's where you're going and then in the next year, they change the priority and you're chasing that money, you don't ever get momentum like you need because you're changing lifestyle[s]. It takes years…. You can't do it in a six-week program. It just doesn't happen [P 144, user organization].

This short-termism was echoed by others who described a fragmented policy environment that lacked overarching vision or coordination. Instead of integrated, evidence-based strategies, organizations often encounter a scattershot approach at the provincial or territorial level:

> What they've done is a patchwork of one-offs, as opposed to a comprehensive approach to this work.... I think there's significant opportunity for us in [Province Name], if the ministry and the provincial government were participatory in looking at some of these issues and bringing [the] resources that they have [P 57, user organization].

Participants also emphasized that political and organizational cultures tend to prioritize visible, easily quantifiable programs over upstream policy measures that promote population health. This focus on short-term optics undermines investment in longer-term prevention strategies:

> The lack of understanding, but also … politicians are very focused on programming to say, you know, they want to be able to count numbers and so they don't have the same recognition or understanding of how important healthy public policy is to creating a healthier population [P 185, user organization].

Similarly, frustration was expressed that despite consistent calls to rebalance funding from acute care toward prevention, health promotion continues to receive insufficient and only short-term investment:

> The lack of recognition that health promotion will pay off, will give dividends into the future … health care cost-saving initiatives target health promotion activities in the short term, which impact the long-term health and wellness of individuals.… Even though there's been numerous reports about the shifting of funding from acute care to health promotion and population health, that has yet to take place [P 118, user organization].

In addition to funding and policy gaps, broader structural constraints were highlighted. Public health units embedded within government structures often face limitations in their ability to communicate directly with the public, particularly around sensitive or politicized issues. This restriction limits the visibility of prevention efforts and hampers timely public health messaging:

> There's a lot of political interference in public health because it's not an independent office … but it makes it really difficult because … we do a lot of work in communications, social media, campaigns [and] all these sorts of things, developing fact sheets and infographics that would be helpful in knowledge transfer to the public. But they don't get released, because they get stopped by somebody at a senior level [P 185, user organization].

Such interference reinforces the long-standing imbalance between acute care and prevention, a theme raised repeatedly. Several participants noted that, despite chronic diseases accounting for the majority of morbidity and mortality, prevention efforts continue to be overshadowed by reactive care priorities: "I think CDP is hugely underfunded.… We lose more people to chronic diseases than to communicable diseases.…" [P 135, user organization].

In addition to political interference, participants described sector-specific structural challenges that hindered organizations' ability to deliver community-based prevention programming. One such issue was the loss of volunteers following the COVID-19 pandemic, a workforce that historically played a vital role in program delivery. As one participant explained:

> Volunteers have not returned. So whether it's [because] they don't want to get sick or whether it's [because] they had 18 months to 2 years of not volunteering, and they thought, like, this is great, I don't want to volunteer anymore.… We're trying to tease out exactly what's occurring at a community level [P 142, user organization].

Together, these accounts paint a picture of a system that is continually reset by shifting political winds and hampered by institutional barriers to communication and continuity. The cumulative effect is a CDP sector unable to realize its full potential due to inconsistent investment, insufficient autonomy and a policy environment that often prioritizes visibility and short-term gains over sustained population health improvements.

The impact of the COVID-19 pandemic on CDP activities

Participants generally described the COVID-19 pandemic as a profound disruption to CDP efforts, with impacts reverberating far beyond the acute crisis period. As public health systems pivoted toward emergency response, almost all CDP programs were paused, defunded or sidelined. Many organizations had their mandates temporarily suspended as staff were reassigned to outbreak management and vaccination efforts. As one participant explained, "From March 2020 to about, I would say, about March 2021, we really didn't do any chronic disease prevention work at all" [P 163, user organization]. Others described a near-total cessation of long-standing health promotion activities, resulting in a disconnect between organizations and the communities they serve; for example, "… a complete halt in all our Healthy Communities activities … [which left us] … at a disadvantage in understanding what has happened in our communities over the last number of years" [P 149, user organization].

In addition to halting service delivery, the COVID-19 pandemic caused cascading delays in program implementation, research and evaluation. The ripple effects of this disruption were felt across timelines, partnerships and strategic planning: "COVID-19 delayed and slowed timelines around some of the key transfer activities … it probably set teams back … 2 years" [P 79, resource organization].

Beyond operational setbacks, participants described lasting damage to internal cohesion and external collaboration. The redeployment of staff fragmented teams, diverted attention from core mandates and weakened organizational culture. Long-standing community partnerships were also strained or entirely lost: "The partnerships in the community have been affected. The relationships within the division … have been impacted … structural system changes … created barriers" [P 185, user organization]. These relational losses were compounded by a reluctance to return to in-person activities. While some organizations attempted to resume group-based programs, they encountered reduced participation and persistent fear: "The number one thing that we've seen … is the lack of people that want to come back after … because of the overall fear of being in groups … there isn't like a set solution for it" [P 175, user organization].

Although a few participants identified silver linings such as an increased awareness of the social determinants of health or the importance of stronger community ties during crises, most conveyed a sense of a sector still in recovery. For many, the transition back to routine CDP work remained partial or symbolic, constrained by unresolved bottlenecks and ongoing pandemic-related priorities:

> After a year, people agreed that … it's time to pull health promotion and let them get back to their own business, but it didn't really mean anything because we couldn't get anything released. It was still COVID-19 [P 185, user organization].

These reflections illustrate how the pandemic not only interrupted CDP activities in the short term, but also introduced additional systemic and relational barriers. The cumulative impact includes fractured teams, stalled innovations, weakened partnerships and lingering uncertainty about the future of prevention within public health systems still shaped by crisis response.

Reaching and engaging diverse communities

Participants highlighted ongoing barriers to ensuring that CDP efforts reach and

resonate with diverse communities equitably. Many reported that standard models of program delivery—especially those that rely heavily on digital platforms—risk excluding populations already underserved by the health system. While digital tools expanded reach for some, they introduced new barriers for others. As one participant observed, "We focus on racialized or marginalized communities, in particular Indigenous Peoples … a virtual world doesn't resonate with their cultural preferences" [P 69, user organization]. This insight reflects a broader recognition that technological solutions, while efficient, are not culturally neutral. For many communities, particularly those with distinct worldviews or histories of marginalization, digital engagement may feel disconnected or inaccessible.

Digital exclusion was also flagged as a major issue for older adults, who are often less comfortable or equipped to navigate online systems. Participants described the challenge of balancing innovation with accessibility, especially in rural or underserved areas with limited Internet infrastructure:

> We're still dealing with the 55-plus, 50-plus group—[they] have to use all mediums, including print and snail mail. A lot of things are only available online, [which is] not helpful, especially when parts of our province don't even have Internet … there are 87-year-olds who never had a computer and don't want one. Reaching out to certain people within a demographic … it's not a homogeneous group [P 172, user organization].

These digital and generational divides were compounded by rising economic pressures, which further limited access to programs and supports. One participant emphasized how financial strain—especially for people on fixed incomes—has deepened pre-existing inequities: "With rising costs of things, it's gotten worse in terms of accessibility for certain people … on fixed incomes … we see a lot of people having challenges now that they didn't before" [P 172, user organization].

Participants called for a shift away from narrow, individual-level interventions, and toward models that are more holistic, inclusive and community-driven. There was a clear push to embed equity, cultural safety and Indigenous knowledge systems into CDP practice. One organization described its evolving approach:

> We focus on community as client, not individuals, and are moving away from modifiable risk factors to equity, racial equity, built environment, etc. We're learning and growing … trying to be humble and open to Two-Eyed Seeing and new ways of knowing [P 61, user organization].

These accounts point to a growing awareness that achieving equitable CDP outcomes requires more than adaptation; it requires transformation. Programs must move beyond generic risk messaging and embrace delivery models that reflect cultural values, address economic realities and are co-designed with those they aim to serve. The call is not just for inclusion but for meaningful partnership, grounded in respect, reciprocity and relevance.

Collaboration and partnerships

Participants consistently emphasized that collaboration is both essential and challenging within the current CDP environment. While cross-sector partnerships are widely recognized as key to addressing complex determinants of health, many described a fragmented system where collaboration is encouraged rhetorically but unsupported structurally. Organizations often find themselves competing for limited funds, which undermines trust and shared action. According to one participant:

> It seems like everyone is singing the same song, but from different parts … we're all vying for the same grants and the same funding … we meet these organizations, and we say, how can we help each other, but then there's no funding to increase the capacity for organizations to grow together [P 95, resource organization].

In the absence of sustained funding and infrastructure to support partnership work, collaboration often remains informal, short-term or dependent on personal relationships rather than system-level design. The same participant proposed a model where funders would incentivize and coordinate joint efforts: "We'll give you a grant if you can play well together … and we'll have an intermediary placed with you, to help you…" [P 95, resource organization]. This vision suggests the need for intermediary structures—such as backbone organizations, neutral facilitators or conveners—that can bridge gaps between sectors and reduce the administrative burden on overextended CDP teams.

Others echoed the call for system-level coordination and saw a key role for provincial or territorial leadership in aligning local initiatives. Rather than massive new investments, participants advocated for smarter governance and facilitative leadership that could reduce duplication and increase collective impact:

> If the ministry and if the provincial government were participatory … and what I mean by that is not significant amounts of further investment…. I get the sense that people will move in a variety of directions, which creates a very chaotic environment [P 57, user organization].

The pandemic also brought into sharper focus the vital role of community-based relationships in responding to public health needs. In some cases, the crisis acted as a catalyst for deeper engagement and cooperation around the social determinants of health:

> [The COVID-19 pandemic] actually became an enabler, particularly around work that's happening in settings organized around social determinants of health. To be able to have broader stakeholders identify and recognize the need for action around social determinants of health [P 79, resource organization].

Several participants identified promising innovations, such as physician-linked activity coaching, that could benefit from stronger cross-sector infrastructure and investment. These models have the potential to bridge clinical and community care, but only if they are better integrated into broader systems of support:

> We need more resources to do our thing … activity coaching is really going to be a game changer … We're just sort of baffled as to why isn't there more out there in terms of support for, you know, what we do and having physicians and allied health professionals prescribing [P 143, user organization].

Overall, these reflections suggest that partnerships are lacking in the scaffolding required to make them sustainable and effective rather than in willingness to collaborate. Modest but strategic investments in coordination, shared infrastructure and policy alignment could enable a shift from ad hoc collaboration to more durable and influential collective CDP.

Discussion

This qualitative analysis extends earlier PHORCAST waves by highlighting what is newly salient in 2023, not simply what persists. Participants described the compounding effects of long-standing underfunding alongside post-pandemic inflation, workforce attrition and weakened partnership infrastructures, resulting in a qualitatively different form of capacity strain. The COVID-19 pandemic was consistently framed as an amplifier of pre-existing structural vulnerabilities, rather than a singular explanatory factor, accelerating processes already underway. Compared with earlier PHORCAST findings,[1,2,15-20] participants' accounts suggest that the erosion of CDP capacity appears more entrenched and less recoverable, with fewer organizational buffers available to absorb system shocks. The continued reliance on short-term funding cycles, combined with rising expectations for equity-oriented and community-responsive programming, places additional and novel strains on organizations operating in an increasingly volatile policy and fiscal environment.

A prevailing theme across responses was the unsustainable expectation for public health organizations to "do more with less," a situation exacerbated by inflation and stagnant budgets. These constraints not only limit the delivery of CDP initiatives but also diminish capacity for innovation, evaluation and scale-up. These concerns echo earlier critiques of the inadequate prioritization of health promotion within Canadian health policy frameworks.[3-8] As organizations are forced to triage basic service delivery over strategic development, the transformative potential of prevention is significantly undermined.

Policy instability and fragmentation emerged as additional threats to CDP capacity. Participants described an unpredictable funding environment that compels organizations to "chase the money" in response to shifting political priorities, precluding long-term planning and sustained momentum. This aligns with broader criticisms of Canada's fragmented public health governance and its consequences for system integration and health equity.[3-8] Without a stable and coordinated strategy for CDP at the provincial, territorial and federal level, efforts remain siloed and duplicative and are often limited to short-term initiatives that lack coherence.[28]

The COVID-19 pandemic further destabilized CDP operations, exposing long-standing vulnerabilities in public health infrastructure. Most organizations experienced widespread staff redeployment and program suspensions, with residual effects extending well beyond the acute phase of the crisis. These findings reflect global analyses of the pandemic's disruptive effects on prevention and health promotion sectors.[12] In addition to operational setbacks, participants reported long-term impacts on internal team cohesion and external partnerships—underscoring that CDP recovery must involve not just restarting programs but rebuilding organizational and relational foundations. These lessons also extend beyond pandemic recovery, highlighting the need for resilient CDP systems capable of withstanding other potential system disruptions such as climate-related emergencies (e.g. wildfires), economic downturns or digital infrastructure failures. Strengthening organizational flexibility and intersectoral coordination is essential to ensuring that prevention systems can adapt and continue to function in crises.

Equity-related barriers were also prominently described across organizations. While digital delivery models expanded during the pandemic, they often failed to engage older adults, low-income populations and culturally diverse communities. The participants emphasized the need for multimodal, culturally grounded approaches that go beyond individual risk messaging to address the structural determinants of health. This reflects a broader shift in public health discourse toward equity-centred and community-based frameworks.[29-31] Several participants called for the integration of Indigenous knowledge systems, such as Two-Eyed Seeing, highlighting the potential of reconciliation-informed models of CDP that honour diverse ways of knowing.

While collaboration was seen as essential for effective CDP, participants described it as difficult to sustain. They noted that current funding and governance arrangements offer little support for sustained partnership work. Previous research suggests that long-term success requires alignment across systems, supportive infrastructure and mechanisms for coordination.[32] Suggestions for intermediary supports and funding models that incentivize collaboration point to feasible, system-level changes that could unlock greater collective capacity without necessitating major new investments.

Our study findings align closely with recent calls for systems transformation in Canadian public health. The Chief Public Health Officer of Canada's 2021 report emphasized the need for a more resilient, equitable and integrated public health system capable of addressing complex population health challenges through sustained investment, improved data infrastructure and stronger intersectoral partnerships.[30] Similarly, the 2025 *Core Competencies for Public Health in Canada* reflects a modernized vision for public health practice that centres equity, complex problem solving, Indigenous engagement and digital capacity.[31] These priorities echo the work of Mondal et al.[33] who described organizational and leadership competencies such as systems thinking, strategic communication and the ability to adapt to complexities as foundational to public health capacity. Participants' calls for long-term, coordinated CDP funding, equity-informed program design and infrastructure to support collaboration mirror these national and scholarly priorities.

Finally, while participants frequently emphasized pragmatic strategies such as modest, targeted investments or local partnerships to sustain CDP within current constraints, their accounts also reflected a recognition that these efforts alone are insufficient. For example, several quotes highlight a need for a long-promised but still absent shift in priorities from acute care to prevention and from short-term deliverables to long-term population health outcomes. Chronic underfunding and structural fragmentation were seen as systemic issues requiring incremental adjustments and broader transformations of how prevention is valued and governed in Canada.

In sum, this study highlights the urgency of addressing the structural and systemic barriers that continue to undermine CDP in Canada. Without long-term investment, policy coherence and equity-driven design, the gap between public health goals and organizational capacity will only widen. As governments pursue post-pandemic health system transformations, positioning CDP as a foundational—not peripheral—component of population health is critical.

Strengths and limitations

Study strengths include the use of a descriptive qualitative design, which enabled contextual insights into how barriers to CDP are experienced by practitioners with in-depth organizational knowledge. Thematic analysis was conducted independently by two researchers, enhancing analytical rigour and interpretive validity.[34]

Limitations include reliance on a single respondent per organization, which may have constrained the diversity of the perspectives captured. While the open-ended prompt was intentionally broad to encourage spontaneous reflection, it likely introduced variability in response depth and focus. Future research could incorporate follow-up interviews or targeted prompts to systematically explore specific thematic areas.

All the participating organizations were well-established, with organizational age spanning from 25 to more than 100 years. Their perspectives likely reflect the experiences of mature organizations with greater resilience and the infrastructure to sustain CDP efforts despite chronic underfunding. Our findings may not fully capture the realities of newer or less-established organizations that ceased to exist between PHORCAST data collection waves. Future research should also examine how organizational age and maturity shape CDP capacity, especially under system stress.

Policy recommendations

Findings from this study support a more focused and evidence-anchored set of policy directions grounded in participants' accounts. Rather than broad system reform, the participants emphasized the need for pragmatic actions to sustain CDP under current conditions. Five priority areas emerged. First, governments should provide stable, inflation-adjusted core funding for CDP to support staffing, program continuity and basic operational capacity.[29,35] The participants consistently described flat or short-term funding as a central barrier that limits planning, scale-up and sustainability.

Second, greater policy coherence is needed to reduce frequent shifts in priorities that compel organizations to continually redirect efforts in response to changing political agendas. The participants emphasized that prevention requires long time spans that are incompatible with short-term funding cycles.

Third, intersectoral collaboration requires dedicated infrastructure.[32,36] The participants highlighted the absence of intermediary supports, coordination mechanisms and partnership funding as barriers to sustained collaboration, despite a strong willingness to work across sectors.

Fourth, CDP initiatives must be equity oriented and culturally responsive.[29] The participants emphasized the need for approaches that extend beyond digital-only delivery models and that better engage Indigenous communities, older adults, rural populations and other groups for whom standard modalities are poorly aligned.[37,38]

Fifth, rebuilding CDP capacity following pandemic-related disruptions remains an urgent priority.[39,40] The participants described lasting impacts on workforce stability, partnerships and institutional memory, indicating that recovery requires more than restarting programs.

Conclusion

This study underscores that, two decades after the launch of PHORCAST, Canadian public health organizations continue to face persistent and, in some cases, intensified barriers. Without sustained investment, coherent policy direction and support for collaboration and equity responsive practice, CDP will remain vulnerable to ongoing and future system shocks.

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Conflicts of interest

Jennifer O'Loughlin is a member of the Editorial Board for this journal, but was not involved in the review process and editorial decision-making for this article.

The authors have no competing interests.

Authors' contributions and statement

KM: Conceptualization, funding acquisition, methodology, project administration, supervision, writing—original draft, writing—review and editing.

MM: Formal analysis, writing—original draft, writing—review and editing.

EKO'L: Formal analysis, writing—original draft, writing—review and editing.

JO'L: Conceptualization, funding acquisition, methodology, writing—review and editing.

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Original quantitative research

Misclassification bias in chronic disease case ascertainment algorithms: a reclassification approach

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Abstract

Introduction: Use of administrative health data to identify chronic disease cases can cause misclassification bias. Reclassification-based exit rules may reduce misclassification bias.

Methods: Manitoban administrative health data (1995–2022) were used to ascertain multiple sclerosis (MS) and "juvenile diabetes" (JD) prevalence. We constructed multivariable logistic regression model-based algorithms and used a model-predicted probability exit rule to reclassify JD and MS case status annually. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and reclassification rates were estimated. Linear regression tested for differences in prevalence estimates for the model-based algorithm with an exit rule and an existing Canadian Chronic Disease Surveillance System (CCDSS) algorithm without an exit rule.

Results: The MS cohort included 60 228 individuals (608 cases, 59 620 non-cases) and the JD cohort 44 125 individuals (2506 cases, 41 619 non-cases). Model-based algorithm sensitivity was 0.62 to 0.85 for MS and 0.87 to 0.95 for JD. PPV for MS was 0.21 to 0.60 and for JD was 0.92 to 0.95. Specificity and NPV were consistently high (0.98–1.00). Non-cases were frequently misclassified; reclassification rates for non-cases were higher than for cases for MS (0.22–0.33 vs. 0.14–0.28) and JD (0.18–0.65 vs. 0.13–0.15). The model-based algorithm with an exit rule for MS, but not for JD, had a slower increase in prevalence than the CCDSS algorithm.

Conclusion: Case ascertainment algorithms with an exit rule can address misclassification bias when estimating chronic disease prevalence using administrative health data. Improvements are disease dependent.

Keywords: *misclassification, prevalence, algorithm, administrative health data, bias*

Highlights

- The performance of the algorithms that identify cases of multiple sclerosis in individuals 20 years and older and of diabetes (both type 1 and type 2) in individuals 18 years and younger in administrative health data was better when using health care covariates based on a higher number of years.
- An exit rule that uses probabilities to reclassify case status annually found that non-cases had a higher reclassification rate than cases.
- Prevalence trends for multiple sclerosis obtained using a model-based algorithm with an exit rule had a slower increase than the current algorithm used by the Canadian Chronic Disease Surveillance System.

Introduction

Administrative health data, such as physician billing claims and hospital discharge records, are frequently used to estimate prevalence and incidence of chronic diseases in the entire population. These estimates are obtained by applying a case ascertainment algorithm to the data; ideally this algorithm has been validated in a population with a known disease status.[1] Algorithm validation provides estimates of sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) that are used by researchers and policy makers to assess the magnitude of potential bias in estimates of disease prevalence and incidence.

Misclassification of disease cases in case ascertainment algorithms for administrative health data is common.[2] It can occur due to diagnosis coding errors, the use of nonspecific medication codes (i.e. medications for which the indication is not specific to a disease) and underuse of the health care system, among other reasons.[2-5] Misclassification may lead to biased estimates of disease burden: when

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sensitivity is greater than PPV, prevalence will be overestimated and when sensitivity is less than PPV, prevalence will be underestimated.[6]

Several methods have been proposed to adjust for misclassification bias in prevalence estimates, including correction factors and exit rules. Correction factors for prevalence estimates have been investigated for diabetes,[7,8] breast cancer[9] and acute myocardial infarction[8] using sensitivity and specificity estimates obtained from validation studies.[7,9] However, validation studies are often conducted in clinical cohorts with disease prevalence and health-care use patterns that do not reflect those of nonclinical populations,[10] and the resulting correction factors may not apply to the general population.[7]

Exit rules are deterministic or probabilistic rules used to identify and remove false positives at the individual rather than the population level. Exit rules have been applied in pharmacovigilance and genomics,[11-13] but, to our knowledge, not in the context of chronic disease surveillance using administrative health data. When estimating chronic disease burden, exit rules are well-suited to producing adjusted prevalence estimates that decrease potential overestimation bias that may accumulate over time.[7,14]

Peng et al. found that incorporating an exit rule into a hypertension case ascertainment algorithm using a reclassification approach produced results similar to those of a deterministic algorithm.[15] Whether these findings can be generalized to other chronic diseases is unknown. Given the variability in diagnostic criteria, clinical treatment and population prevalence, further studies to investigate other chronic diseases would be beneficial.

Our purpose was to develop and validate a model-based algorithm that incorporates a reclassification-based exit rule. Our objectives were to validate a logistic regression model-based case ascertainment algorithm; incorporate a reclassification-based exit rule into the algorithm and assess exit-rule performance; and compare prevalence trends for an algorithm with an exit rule to prevalence trends obtained using a previously validated algorithm without an exit rule.

Methods

Ethics approval

Ethics approval was granted by the University of Manitoba's Health Research Ethics Board (HREB No. HS23961). Data access approval was provided by the Provincial Health Research Privacy Committee (PHRPC No. 2020/2021-12); Manitoba Shared Health with the Winnipeg Regional Health Authority (RAAC2020:026); and Manitoba Primary Care Research Network.

Study design and data

We conducted a retrospective cohort study to compare two chronic diseases: diabetes in individuals aged 18 years and younger (referred to as "juvenile diabetes," or JD, in this article) and multiple sclerosis (MS).

MS is an immune-mediated disease of the central nervous system in which the protective myelin sheaths around axons and the axons themselves are damaged.[16] MS onset typically occurs between 20 and 40 years of age.[16] JD refers to both type 1 and type 2 diabetes diagnosed in individuals aged 18 years and younger. This disease prevents the body from producing insulin or from responding to the insulin it produces, resulting in unregulated blood sugar levels.[17]

Although the etiology of these chronic diseases differ, both are monitored by the Public Health Agency of Canada's Canadian Chronic Disease Surveillance System (CCDSS), which allows us to compare their algorithm and exit-rule performances.

Study data from 1 April 1995 to 31 March 2022 were obtained from the Manitoba Population Research Data Repository housed at the Manitoba Centre for Health Policy (MCHP) in Winnipeg. Manitoba has a system of universal health care; publicly insured health care services are available for most of the population in the province, and decades of provincial administrative health data have been recorded. These data are ideal for examining the impact of case ascertainment algorithms on chronic disease prevalence trends.

Study cohort sociodemographic information, including health insurance coverage dates, birth dates, sex and residential postal codes, was obtained from the Manitoba Health Insurance Registry. Postal codes from the Registry and average household income from the Statistics Canada census were used to calculate area-level income quintiles.[18]

We obtained the health-care use measures to construct the case ascertainment algorithms and exit rules from the hospital Discharge Abstract Database (DAD), the Medical Claims/Medical Services database and the Drug Program Information Network database. The DAD captures records of all inpatient stays; these were reported using *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) codes until 31 March 2004 and *International Statistical Classification of Diseases, 10th Revision, Canada* (ICD-10-CA) codes from 1 April 2004. The Medical Claims/Medical Services database stores ICD-9-CM code records of outpatient visits. The Drug Program Information Network database stores prescription medication dispensation records from community-based pharmacies, using the World Health Organization's Anatomical Therapeutic Chemical (ATC) codes.[19]

Three databases were used to construct the study cohorts and provide reference standards for identifying MS and JD cases: the Home Care Minimum Data Set (MDS) Assessment database, for MS cases and non-cases; the Diabetes Education Resource for Children and Adolescents (DER-CA) registry database, for JD cases; and the Manitoba Primary Care Research Network (MaPCReN) database, for JD non-cases.

The Home Care MDS Assessment database captures data on home care assessments of and utilization by all individuals receiving home care services delivered by the Winnipeg Regional Health Authority, which serves approximately 60% of Manitoba's population. The DER-CA registry database stores information on almost all the children in the province diagnosed with type 1 and 2 diabetes who are referred to the DER-CA program. The MaPCReN database stores electronic medical records from a subset of primary care providers (family physicians, nurse practitioners and community pediatricians) across all health regions in Manitoba. All databases can be linked at the individual level using an anonymized personal health identification number.

Study cohorts

The study period for the MS cohort was from 1 April 2004 to 31 March 2022 and

for the JD cohort was from 1 April 1995 to 31 March 2022. The study periods were based on data availability and access approvals.

MS cohort members met the following inclusion criteria: one or more assessments in the Home Care MDS Assessment database during the study period; an MS assessment field signed by a physician; an MS assessment that could be linked to the Manitoba Health Insurance Registry; no conflicting MS status indications (i.e. multiple assessments suggesting presence or absence of MS status); 20 years or older at time of assessment; and health care coverage on the MS assessment date and continuous health care coverage for at least 2 years (730 days) between the assessment date and cohort entry. This health care coverage requirement ensured that there were sufficient data to determine MS case status (case vs. non-case).

Cohort entry was the start of the MS study period (1 April 2004) or the start of health care coverage, whichever came later. Cohort exit was the end of health care coverage.

MS case status (case vs. non-case) was ascertained from interRAI assessments. This assessment tool is one of a suite of internationally recognized instruments used by clinicians to assess individuals' health; it has high sensitivity (0.94) and specificity (1.00) for identifying individuals with MS in the home care setting.[20] An interRAI assessment is required to be able to access home care in Manitoba.

The DER-CA registry database was used to identify JD cases and the MaPCReN database to identify the non-cases. Individuals categorized as JD cases met all of the following inclusion criteria: a record in the DER-CA database with a diagnosis date within the study period (1 April 1995 to 31 March 2022); an assessment that could be linked to the Manitoba Health Insurance Registry; a diagnosis date before their 18th birthday; health care coverage during the study period and before the individual's 18th birthday; and at least 2 years (730 days) of continuous coverage between their cohort entry and diagnosis dates.

Individuals categorized as JD non-cases met all of the following inclusion criteria: a record in the MaPCReN database within the study period; an assessment that could be linked to the Manitoba Health Insurance Registry; birthdate between 1 April 1990 and 31 March 2018; no diabetes codes in the MaPCReN data and no diabetes listed as a condition list before their 18th birthday; and at least 2 years (730 days) of continuous health care coverage between cohort entry and exit dates. JD case definitions in MaPCReN have high sensitivity (0.97) and specificity (1.00).[21] Individuals categorized as JD non-cases were also excluded if they had records in the DER-CA database.

For both JD cases and non-cases, the cohort entry date was the start of the study period (1 April 1995) or the start of health care coverage, whichever came later. To ensure age comparability between cases and controls, individuals were removed from the cohort on their 18th birthday. Therefore, cohort exit was defined as the individual's last health care coverage date or the date of their 18th birthday, whichever came first.

Study variables

Health care use variables included the number of general physician visits, the number of specialist physician visits, any hospitalizations (binary: yes or no) and any disease-specific health care use (i.e. any physician visit or hospitalization with an MS or JD diagnosis code or any MS- or JD-specific prescription medication). These variables were defined for each fiscal year (1 April to 31 March of the following calendar year) during the study period.

For the MS cohort, neurologist visits were excluded from the specialist physician visit count because visits to the provincial MS clinic were not recorded between 2000 and 2010.

MS diagnosis codes were ICD-9-CM 340 and ICD-10-CA G35. JD diagnosis codes were ICD-9-CM 250 and ICD-10-CA E10 to E14. ATC codes for MS- and JD-specific prescription medications are listed in the supplementary material (Table S1; available on request from the authors).

Algorithm development and statistical analysis

The sociodemographic characteristics of individuals categorized as cases and non-cases were compared using χ^2 tests for categorical variables and *t* tests for continuous variables. Logistic regression models fitted to the data for each cohort contained health-care use variables based on 1, 3 and 5 years of data. For the 3-year and 5-year models, case dates were defined as the last year of the period (e.g. for the 3-year model, data from fiscal years 2000 to 2002 were used to define covariates for 2002). To be included in model building and validation, individuals had to have at least one day of health care coverage in each year used to build the model. Model covariates also included sex and income quintile. Residence location was included as a covariate solely for the JD cohort, as the Home Care MDS Assessment database stores data of urban residents only.

To build and validate the model-based case ascertainment algorithms, the MS and JD cohorts were randomly split without stratification into 70% training and 30% validation cohorts. Algorithm building and validation required 1, 3 or 5 years of data, depending on the model; most individuals had more than 5 years of data available. Therefore, the data to build and validate algorithms were randomly selected for each individual (1, 3 or 5 consecutive years). Predicted probability cut points were determined using the top left value of the receiver operating characteristic curve. Algorithm validation metrics included sensitivity, specificity, PPV and NPV, with their respective 95% confidence intervals.

The reclassification-based exit rule involved applying the trained logistic regression model to each year of available study cohort data. This resulted in multiple classifications throughout the study periods—up to 18 MS and 27 JD classifications for the 1-year logistic regression model-based algorithm and 13 MS and 22 JD classifications for the 5-year logistic regression model-based algorithm. By reclassifying individuals numerous times, false positives could be removed from the case group. If an individual did not have health care coverage in a given year, they were not reclassified.

Reclassification performance was assessed using the reclassification rate (total number of reclassifications divided by total number of misclassifications); the average number of misclassifications (of individuals misclassified, the average number of misclassifications per individual); and the average time to reclassification (average number of years between misclassification and correct reclassification).

To assess the impact of the exit rule on prevalence trends, we repeatedly applied the model-based algorithm with the highest estimated validity over the study period to estimate disease prevalence. CCDSS algorithms currently used for MS and JD surveillance were also applied to the study data. The CCDSS algorithm for MS requires either one or more hospitalizations or at least five physician claims with an MS diagnosis code within 2 years.[22,23] The CCDSS algorithm for JD requires either one or more hospitalizations or at least two physician claims with a JD diagnosis code within 2 years.[23] Case dates were defined as the date of the hospital separation record or the last physician claim, whichever came first.

MS and JD prevalence estimates were calculated per 100 000 population using the model-based algorithm with an exit rule and the CCDSS algorithm. A single linear regression model was fitted to the annual prevalence estimates of MS and JD to test for differences in slope coefficient estimates between the model-based algorithm with an exit rule and the CCDSS algorithm. The model contained the year and algorithm type (i.e. model-based vs. CCDSS) main effects and their two-way interaction effect (i.e. intercept + year + algorithm type + [year × algorithm type]). To account for potential correlation within the model estimates, a statistically significant difference was based on nominal α level of .001.

Analyses were performed using statistical packages SAS version 9.4 (SAS Institute Inc., Cary, NC, US) and R version 4.3.0 (R Foundation for Statistical Computing, Vienna, AT).[24]

Results

The MS cohort included 60 228 individuals of whom 608 (1.0%) were cases; the JD cohort included 44 125 individuals of whom 2506 (5.7%) were cases (Table 1). Cohort flow charts are included in the supplementary material (available on request from the authors). Individuals categorized as MS cases included a higher percentage of females, were younger at cohort entry and had more years of health care coverage than those categorized as MS non-cases.

Individuals categorized as JD cases were older at cohort entry and had more years

TABLE 1
Characteristics of MS and JD cohorts, Manitoba, 1995–2022

Variable	Cases	Non-cases	*p* value
MS	**n = 608**	**n = 59 620**	
Sex, n (%)			
Males	195 (32.1)	22 130 (37.1)	0.0104
Females	413 (67.9)	37 490 (62.9)	0.0104
Period of MS assessment, n (%)			
2004–2009	331 (54.4)	22 691 (38.1)	< 0.0001
2010–2015	148 (24.3)	19 182 (32.2)	< 0.0001
2016–2021	129 (21.2)	17 747 (29.8)	< 0.0001
Income quintile,[a] n (%)			
Q1 (lowest)	101 (16.6)	14 245 (23.0)	< 0.0001
Q2	122 (20.1)	13 096 (22.0)	< 0.0001
Q3	125 (20.6)	12 112 (20.3)	< 0.0001
Q4	112 (18.4)	10 156 (17.0)	< 0.0001
Q5 (highest)	142 (23.4)	9542 (16.0)	< 0.0001
Age at cohort entry, mean (SD) years	54.2 (12.8)	69.4 (13.2)	< 0.0001
Age at assessment, mean (SD) years	61.2 (12.7)	77.9 (12.3)	< 0.0001
Total health care coverage, mean (SD) years	15.0 (4.2)	13.3 (4.7)	< 0.0001
Health care coverage before assessment, mean (SD) years	7.0 (4.9)	8.5 (4.9)	< 0.0001
Health care coverage after assessment, mean (SD) years	8.0 (5.0)	4.8 (3.8)	< 0.0001
JD[b]	**n = 2506**	**n = 41 619**	
Sex, n (%)			
Males	1234 (49.2)	20 710 (49.8)	0.6137
Females	1272 (50.8)	20 909 (50.2)	0.6137
Period of cohort entry, n (%)			
1995–2000	1483 (59.2)	11 722 (28.2)	< 0.0001
2001–2007	744 (29.7)	9816 (23.6)	< 0.0001
2008–2013	246 (9.8)	10 104 (24.3)	< 0.0001
2014–2019	33 (1.3)	9977 (24.0)	< 0.0001
Income quintile,[c] n (%)			
Q1 (lowest)	915 (36.6)	6647 (16.2)	< 0.0001
Q2	511 (20.5)	6823 (16.6)	< 0.0001
Q3	350 (14.0)	8707 (21.2)	< 0.0001
Q4	390 (15.6)	10 681 (26.0)	< 0.0001
Q5 (highest)	331 (13.3)	8217 (20.0)	< 0.0001
Age at cohort entry, mean (SD) years	1.8 (3.1)	0.9 (2.4)	< 0.0001
Age at diagnosis, mean (SD) years	11.2 (3.7)	NA	NA
Total health care coverage, mean (SD) years	15.0 (3.6)	12.1 (5.1)	< 0.0001

Source: Administrative health data from 1995 to 2022 obtained from the Manitoba Population Research Data Repository, Manitoba Centre for Health Policy, Winnipeg, MB.

Abbreviations: JD, juvenile diabetes; MS, multiple sclerosis; NA, not applicable; Q, quintile; SD, standard deviation.

[a] 371 cases in the MS cohort had missing income quintile information.

[b] JD ("juvenile diabetes") refers to both type 1 and type 2 diabetes in individuals aged 18 years and younger.

[c] 553 cases in the JD cohort had missing income quintile information.

of health care coverage than those classified as non-cases (Table 1).

For the MS cohort, "any MS-specific health care use" was the only covariate that was statistically significant across multiple models (Table 2). Specialist and general physician visits were statistically significant covariates in the 1- and 5-year models, respectively. Income quintile at baseline was statistically significant for the 1- and 3-year models, but not the 5-year model.

In the JD cohort, specialist physician visit, any JD-specific health care use, income quintile 1 and income quintile 2 were statistically significant covariates in all three models (Table 2).

For MS, all algorithms demonstrated high specificity and NPV (Table 3). Sensitivity was lowest for the 1-year algorithm (0.62) and highest for the 5-year algorithm (0.85). The 3-year algorithm had sensitivity (0.82) similar to the 5-year algorithm (0.85) and the highest PPV (0.60).

For JD, all the algorithms had high specificity and NPV (Table 3). The 5-year algorithm had the highest sensitivity (0.95) and the 1-year algorithm had the highest PPV (0.95).

In the MS cohort, the 1-year algorithm with an exit rule had the highest reclassification rate for non-cases (0.33) and cases (0.28) (Table 4). Rates were similar for the remaining two algorithms with an exit rule (0.22 for non-cases; 0.14–0.18 for cases). The average number of misclassifications was higher for MS cases than non-cases. The average was similar for all algorithms with exit rules for MS non-cases (3.73–3.77) and more variable across algorithms for MS cases (4.82–6.68). For both MS cases and non-cases, the 1-year algorithm with an exit rule had the lowest time to reclassification (cases: 2.50 years; non-cases: 2.08 years).

In the JD cohort, non-cases had higher reclassification rates and greater variability across the 1-, 3- and 5-year algorithms (0.18–0.65) than cases (0.13–0.15) (Table 4). JD non-cases also had a lower average number of misclassifications compared to cases; the 1-year algorithm with an exit rule showed the lowest average number of misclassifications per individual for both non-cases (1.71) and cases (2.88). The time to case reclassification varied from 1.45 to 3.43 years for JD non-cases and from 1.35 to 1.51 years for JD cases; the 1-year and 3-year algorithms with an exit rule had the shortest time to reclassification for non-cases and cases, respectively.

For both MS and JD, the 3-year model-based algorithm with an exit rule was selected for comparison with the CCDSS algorithm. The model-based algorithm with an exit rule calculated a higher prevalence than the CCDSS algorithm for MS and JD (Table 5). When assessing differences in slopes between algorithms (i.e. whether the change in population health is similar across algorithms), there was a statistically significant difference in the slopes for MS, where the model-based algorithm with an exit rule had a lower slope (i.e. slower increase in prevalence) compared to the CCDSS algorithm. There was no difference in slopes for JD. Model parameters are reported in Table 5 and prevalence trends for each algorithm are in Figure 1.

Discussion

The 3-year algorithm performed best for both MS and JD, with disease-specific health care use the primary predictor of disease status. Exit rules reclassified both MS and JD non-cases at a higher rate than the respective cases. The 1-year algorithm resulted in the shortest time to reclassification, irrespective of disease. When we compared the prevalence trend of the best-performing (3-year) logistic model-based algorithm with that of the disease-specific CCDSS algorithm, we only observed differences for MS, with the model-based algorithm with an exit rule having a lower slope (i.e. a slower increase in prevalence) than the CCDSS algorithm.

Previous validation studies of the CCDSS MS algorithm reported a sensitivity of 0.84 and a PPV of 0.86.[22] Nakhla et al. estimated the sensitivity of the CCDSS JD algorithm to be 0.98 and the PPV to be 0.79.[25] We estimated similar sensitivity in this study (0.82 for MS and 0.94 for JD based on the 3-year logistic regression algorithms). In contrast, we estimated the PPV for MS to be lower (0.60) and the PPV for JD to be higher (0.93) than that reported for the CCDSS algorithm.[25] The lower PPV for MS may be because we used a home care–based cohort of patients with MS; these patients can have higher rates of MS-adjacent conditions than the general population, making it difficult to differentiate between cases and non-cases. The lower PPV could also be due to our excluding codes from neurologist visits, often the source of MS-specific care. Both cohorts had low prevalence of disease (1% for MS; 6% for JD), which likely contributed to the observed low PPV and high NPV.

Previous research found no difference in prevalence trend estimates for hypertension when using an algorithm without an exit rule compared to an algorithm with a reclassification-based exit rule.[15] In contrast, we found prevalence trends for JD, but not for MS, to be similar when using the model-based algorithm with an exit rule and the CCDSS algorithm without an exit rule. For MS, differences in slope may result from the exit rule reclassifying false positives and reducing bias. Of note, MS had a lower PPV across all model-based algorithms compared to JD, suggesting that this algorithm may be susceptible to false-positive build-up in the absence of an exit rule. Alternatively, the slower increase in prevalence may be due to individuals not seeking MS-related care during periods of remission or due to MS-specific visits to neurologists not being captured, resulting in their exclusion from the case cohort.

Strengths and limitations

The MS study period began after the change in ICD versions used in the DAD, in 2004. Extending the MS study period to include data from before 1 April 2004 may influence the MS prevalence trends calculated using either the model-based algorithm with an exit rule or the CCDSS algorithm due to changes in clinical practice and direct changes to the codes themselves. However, given that the ICD-9-CM and ICD-10-CA diagnosis codes for MS convey similar levels of diagnostic specificity, the effect of the version change is likely minimal. Moreover, research validating MS case definitions (without exit rules) that covered the period before and after 2004 found no changes in disease incidence (a key contributor to prevalence estimates) despite the changes in ICD codes and diagnostic criteria.[26,27]

A strength of this study is the use of model-based case ascertainment algorithms, which are known to perform better than deterministic algorithms.[28] We used several methods to assess algorithm and exit-rule performance—common validation

TABLE 2
Logistic regression model odds for 1-, 3- and 5-year algorithms for the MS and JD cohorts, Manitoba, 1995–2022

Predictor	OR (95% CI)		
	1 year	3 years	5 years
MS			
General physician visit(s)	0.99 (0.98–1.01)	0.99 (0.99–1.00)	0.99 (0.99–1.00)*
Specialist physician visit(s)	0.98 (0.96–0.99)*	1.00 (0.99–1.01)	1.00 (1.00–1.00)
Any hospitalization	1.05 (0.74–1.49)	0.78 (0.6–1.01)	0.87 (0.72–1.04)
Any MS-specific health care use	Not estimated	114.48 (80.25–163.29)*	25.85 (20.44–32.70)*
Sex (female vs. male)	1.12 (0.83–1.52)	1.11 (0.76–1.64)	1.27 (0.84–1.90)
Income quintile			
Missing vs. Q5 (highest)	0.07 (0.01–0.35)*	0.09 (0.01–0.67)*	0.02 (<0.001–2.84)
Q1 (lowest) vs. Q5	0.44 (0.28–0.69)*	0.40 (0.22–0.73)*	0.56 (0.31–1.03)
Q2 vs. Q5	0.39 (0.24–0.61)*	0.42 (0.23–0.76)*	0.56 (0.3–1.03)
Q3 vs. Q5	0.71 (0.46–1.08)	0.81 (0.49–1.36)	0.98 (0.56–1.71)
Q4 vs. Q5	0.63 (0.40–0.99)*	0.80 (0.46–1.39)	0.94 (0.52–1.70)
JD[a]			
General physician visit(s)	0.95 (0.90–0.99)*	0.99 (0.97–1.00)	0.98 (0.97–1.00)*
Specialist physician visit(s)	1.05 (1.04–1.07)*	1.02 (1.01–1.03)*	1.01 (1.01–1.02)*
Any hospitalization	0.81 (0.52–1.26)	1.37 (1.06–1.77)*	1.30 (1.07–1.58)*
Any JD-specific health care use	Not estimated	559.83 (424.33–738.59)*	271.08 (209.78–350.3)*
Sex (female vs. male)	1.19 (0.93–1.52)	1.00 (0.76–1.30)	0.91 (0.70–1.18)
Income quintile			
Missing vs. Q5 (highest)	0.46 (0.05–4.08)	0.52 (0.05–5.26)	2.06 (0.17–25.06)
Q1 (lowest) vs. Q5	6.86 (4.43–10.63)*	4.57 (2.96–7.05)*	4.02 (2.60–6.22)*
Q2 vs. Q5	2.84 (1.76–4.59)*	2.42 (1.51–3.88)*	2.87 (1.81–4.54)*
Q3 vs. Q5	1.69 (1.03–2.79)*	1.28 (0.78–2.11)	1.36 (0.84–2.21)
Q4 vs. Q5	0.94 (0.57–1.57)	0.94 (0.58–1.52)	1.02 (0.63–1.66)
Residence location (rural vs. urban)	1.51 (1.16–1.95)*	1.24 (0.94–1.63)	1.12 (0.86–1.45)

Source: Administrative health data from 1995 to 2022 obtained from the Manitoba Population Research Data Repository, Manitoba Centre for Health Policy, Winnipeg, MB.

Abbreviations: CI, confidence interval; JD, juvenile diabetes; MS, multiple sclerosis; OR, odds ratio; Q, quintile.

[a] JD ("juvenile diabetes") refers to both type 1 and type 2 diabetes in individuals aged 18 years and younger.

* Odds ratios are statistically significant.

TABLE 3
Validity estimates for model-based algorithms using 1, 3 and 5 years of administrative health data for MS and JD, Manitoba, 1995–2022

Measure	1 year	3 years	5 years
MS			
Sensitivity	0.62	0.82	0.85
Specificity	0.98	0.99	0.99
PPV	0.21	0.60	0.44
NPV	1.00	1.00	1.00
JD[a]			
Sensitivity	0.87	0.94	0.95
Specificity	1.00	1.00	0.99
PPV	0.95	0.93	0.92
NPV	0.99	1.00	1.00

Source: Administrative health data from 1995 to 2022 obtained from the Manitoba Population Research Data Repository, Manitoba Centre for Health Policy, Winnipeg, MB.

Abbreviations: JD, juvenile diabetes; MS, multiple sclerosis; NPV, negative predictive value; PPV, positive predictive value.

[a] JD ("juvenile diabetes") refers to both type 1 and type 2 diabetes in individuals aged 18 years and younger.

metrics (sensitivity, specificity, PPV, NPV); reclassification rates and time to reclassification stratified by case status; and prevalence trend comparisons with the CCDSS algorithm. Moreover, we evaluated the performance of the algorithm plus exit rule with two diseases with different presentations, diagnostic procedures and affected populations, resulting in a comprehensive understanding of its application in estimating population health.

Limitations of this study include the use of a home care–based treatment population to define MS cases and non-cases. This may limit generalizability of the findings as this population tends to have greater health care needs than the general population. However, use of this cohort provided reasonable indication of MS status.

TABLE 4
Reclassification performance for model-based algorithms using 1, 3 and 5 years of administrative health data stratified by the reference standard-based MS and JD non-cases and cases, Manitoba, 1995–2022

Performance measure	Non-cases			Cases		
	1 year	3 years	5 years	1 year	3 years	5 years
MS						
Number of misclassifications, n	6310	1170	2151	1068	489	270
Number of reclassifications, n	2053	263	476	294	88	39
Reclassification rate[a]	0.33	0.22	0.22	0.28	0.18	0.14
Average number of misclassifications per individual, n	3.75	3.73	3.77	6.68	5.37	4.82
Time to reclassification, years	2.08	3.09	3.58	2.50	3.51	3.03
JD[b]						
Number of misclassifications, n	484	549	586	585	280	252
Number of reclassifications, n	313	161	105	74	40	39
Reclassification rate[a]	0.65	0.29	0.18	0.13	0.14	0.15
Average number of misclassifications per individual, n	1.71	2.76	3.51	2.88	3.08	3.50
Time to reclassification, years	1.45	2.58	3.43	1.47	1.35	1.51

Source: Administrative health data from 1995 to 2022 obtained from the Manitoba Population Research Data Repository, Manitoba Centre for Health Policy, Winnipeg, MB.

Abbreviations: JD, juvenile diabetes; MS, multiple sclerosis.

[a] Total number of reclassifications divided by total number of misclassifications.

[b] JD ("juvenile diabetes") refers to both type 1 and type 2 diabetes in individuals aged 18 years and younger.

Conclusion

Case ascertainment algorithms that incorporate an exit rule can reduce overestimation bias by allowing misclassified non-cases to be correctly reclassified at a later time. The advantages of this approach benefits diseases with low PPV, such as MS, more than the diseases with high sensitivity and PPV due to specific diagnostic codes, such as JD.

Availability of data and materials

The data used in this article were derived from administrative health data as secondary use. The data were provided to the investigators under specific data-sharing agreements and were only for approved use at the MCHP. The original source data are not owned by the researchers or MCHP and cannot be shared through a public repository. Approval for use of the original data is noted in the "Ethics approval" section. Where necessary, source data specific to this article or project may be reviewed at MCHP with the consent of the original data providers and the required privacy and ethical review bodies.

TABLE 5
Linear regression model parameter estimates and fit statistics comparing prevalence trends from the best-performing model-based algorithm with an exit rule and the CCDSS algorithm for MS and JD, Manitoba, 1995–2022

Predictor/statistic	Estimate (SE)
MS	
Intercept	846.38 (23.21)*
Year	57.01 (2.64)*
Algorithm (ref: CCDSS algorithm)	465.08 (32.83)*
Year × algorithm	−34.34 (3.73)*
Model fit: R^2	0.96
JD[a]	
Intercept	1598.74 (184.83)*
Year	75.24 (13.2)*
Algorithm (ref: CCDSS algorithm)	1166 (261.38)*
Year × algorithm	−20.58 (18.67)
Model fit: R^2	0.68

Source: Administrative health data from 1995 to 2022 obtained from the Manitoba Population Research Data Repository, Manitoba Centre for Health Policy, Winnipeg, MB.

Abbreviations: CCDSS, Canadian Chronic Disease Surveillance System; JD, juvenile diabetes; MS, multiple sclerosis; ref, reference; SE, standard error.

[a] JD ("juvenile diabetes") refers to both type 1 and type 2 diabetes in individuals aged 18 years and younger.

* $p < 0.001$.

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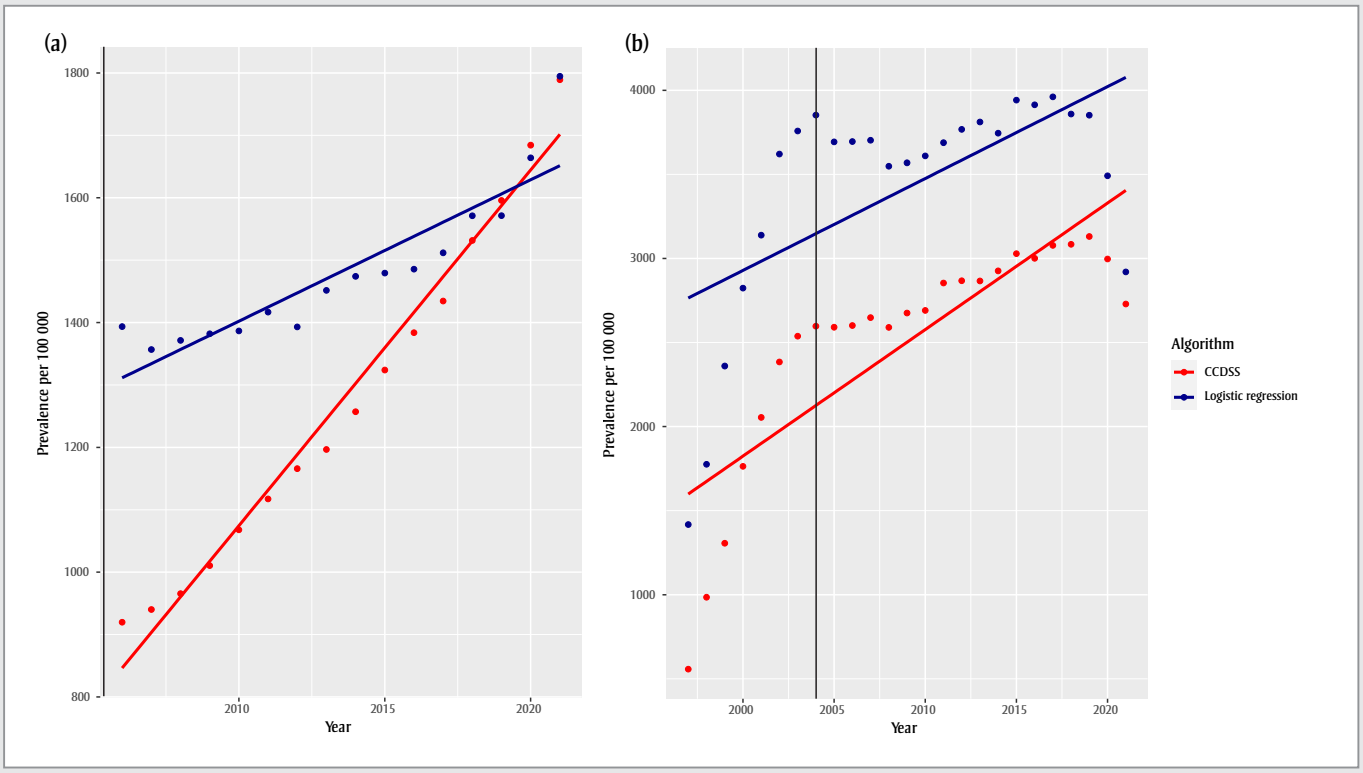
FIGURE 1
Prevalence trends for the CCDSS algorithm and the 3-year model-based algorithm with an exit rule for (a) MS and (b) JD[a], Manitoba, 1995–2022



Abbreviations: CCDSS, Canadian Chronic Disease Surveillance System; ICD-9-CM, *International Classification of Diseases, 9th Revision, Clinical Modification*; ICD-10-CA, *International Statistical Classification of Diseases, 10th Revision, Canada*; JD, juvenile diabetes; MS, multiple sclerosis.

Note: The change from ICD-9-CM to ICD-10-CA coding in the Discharge Abstract Database on 1 April 2004 is indicated by the solid black vertical line.

[a] JD ("juvenile diabetes") refers to both type 1 and type 2 diabetes in individuals aged 18 years and younger.

Conflicts of interest

Authors have no competing interests to declare. RAM is a co-investigator on a study funded in part by Biogen Idec and Roche Canada, but neither RAM nor her institution receive any funds from these organizations.

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Authors' contributions and statement

NCH: Conceptualization, formal analysis, methodology, writing—original draft, writing—review and editing.

RAM: Conceptualization, methodology, writing—review and editing.

DJ: Conceptualization, methodology, writing—review and editing.

PI: Conceptualization, methodology, writing—review and editing.

LLM: Conceptualization, funding acquisition, methodology, formal analysis, writing—review and editing, supervision.

All authors approved the final manuscript.

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Original quantitative research

Distinct and shared risk factors for mood, anxiety and comorbid disorders among Canadians: evidence from the 2019–2020 Canadian Community Health Survey

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This article has been peer reviewed.

Abstract

Introduction: Mood and anxiety disorders frequently co-occur, but few studies have differentiated their unique and shared risk factors. This study examines factors associated with mood disorders alone, anxiety disorders alone and comorbid mood and anxiety disorders among Canadians using 2019–2020 Canadian Community Health Survey data.

Methods: The analytic sample included 107 859 respondents, weighted to represent the Canadian population. Multinomial logistic regression with survey and bootstrap weights estimated adjusted relative risk ratios (aRRRs) for sociodemographic, socioeconomic, health-related and psychosocial factors.

Results: Prevalence was 4.17% for mood disorders alone, 4.99% for anxiety disorders alone and 4.85% for comorbid mood and anxiety disorders. Females had significantly higher risks across all categories (comorbidity aRRR = 2.284; 95% confidence interval [CI]: 1.951–2.673). Younger adults (18–34 years) had greater risks for anxiety disorders alone (aRRR = 3.036; 95% CI: 2.441–3.776) and comorbid disorders (9.311; 7.134–12.153) compared with those aged 65 years and older. Lower household income and poor perceived health were consistently associated with increased risks, with comorbid disorders showing the strongest associations (poor perceived health aRRR = 14.688; 95% CI: 9.908–21.775). Psychosocial factors, including low life satisfaction and a weak sense of community belonging, were also linked to higher risks, particularly for comorbid disorders.

Conclusion: Distinct and overlapping factors contribute to mood and/or anxiety disorders. Targeted prevention and intervention efforts addressing health status, socioeconomic disadvantage and psychosocial stressors—especially among younger people and females—are critical to reducing the burden of these mental health conditions in Canada.

Keywords: *mental health, anxiety disorder, mood disorder, comorbid conditions, comorbidity*

Highlights

- Mood and anxiety disorder comorbidity is as prevalent as mood disorders alone or anxiety disorders alone, affecting nearly 5% of Canadians.
- Younger adults (18–34 years) and females have a significantly higher risk for all three mental health outcomes and especially for comorbid mood and anxiety disorders.
- Lower household income, poor perceived health and unmet health care needs are consistently and strongly associated with increased risk for mental health outcomes.
- Psychosocial factors like low life satisfaction and a weak sense of community belonging are linked to a higher risk for mood disorders or anxiety disorders, and particularly for co-occurring disorders.
- These findings highlight the need for targeted mental health interventions that address social, economic and psychosocial stressors.

Introduction

Mood (e.g. depression, bipolar disorder) and anxiety disorders (e.g. generalized anxiety, panic disorder, phobias) are among the most common types of mental health conditions in Canada.[1-3] Their effects on daily functioning and quality of life are substantial.[3-5] The prevalence of diagnosed mood or anxiety disorders among people in Canada aged 12 years and older rose from 12% in 2015 to approximately 14% (equivalent to 4.4 million people) in 2019.[6]

A key complexity in mental health is the frequent co-occurrence of mood and anxiety disorders, known as psychiatric comorbidity.[7] This phenomenon suggests shared underlying psychological and neurobiological mechanisms[7-10] and heightened

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emotional reactivity.[11] Additional evidence also points to distinct etiological pathways, symptom profiles and social determinants of these disorders.[6,8-10] Mood disorders typically involve prolonged disturbances in mood, energy and motivation, whereas anxiety disorders are marked by excessive fear, worry and physiological arousal.[4,12-15] Individuals with comorbid mood and anxiety disorders often experience more severe symptoms, longer illness duration and greater treatment resistance than those with either disorder alone.[16] Aggregating mood and anxiety disorders into a single diagnostic category may therefore obscure important distinctions in risk factors and presentation.[17] Understanding both the shared and unique correlates of mood and anxiety disorders is essential for improving diagnosis, tailoring treatment and guiding public health strategies.[18]

Mental health outcomes reflect a broad set of determinants: sociodemographic (e.g. sex, age, immigration status),[16,17,19] socioeconomic (e.g. income and employment),[16,19,20] health-related (e.g. multimorbidity, unmet health care needs)[17,19] and psychosocial (e.g. stress, life satisfaction) factors.[17,19] Many factors relate to both disorders,[11] but some appear more specific: anxiety disorders have been associated with urban residence and childhood adversity, whereas mood disorders are more strongly linked to younger age, lower education level, being widowed or divorced and living in socioeconomically disadvantaged communities.[17,19] Mood disorders are generally more prevalent among females.[3,21] Multimorbidity, which is common among middle-aged and older adults, and unmet health care needs are especially relevant for mood disorders.[11,19,22-27] Chronic pain frequently co-occurs with mood and anxiety disorders, as cause or consequence (e.g. arthritis, chronic back pain and chronic headaches). The differences reported across the provinces and territories in Canada likely reflect variations in health system organization, service access and social environments across regions.[3] Finally, psychosocial factors like stress, poor perceived health and dissatisfaction with life are often modifiable, but cluster together and compound vulnerability.[28,29]

Despite growing research on mood and anxiety disorders in Canada, to the best of our knowledge, few studies have examined mood disorders alone, anxiety disorders alone and comorbid mood and anxiety disorders (henceforth referred to as "comorbid disorders") in a single, nationally representative sample. Using the most recent pre-COVID-19 Canadian Community Health Survey (CCHS) data (2019–2020), we investigated a range of sociodemographic, socioeconomic, health-related and psychosocial factors associated with these three mental health outcomes. Our findings provide an up-to-date baseline for understanding mental health risk profiles and can inform targeted prevention and intervention strategies.

Methods

Data source and study population

This study used pooled data from the 2019–2020 CCHS Annual Components, which were harmonized by Statistics Canada and analyzed as a single cross-sectional dataset.[30] The CCHS uses a multistage, complex sampling design to collect comprehensive socioeconomic and health-related data, including information on health status, access to and utilization of health services, and various determinants of health.[30-32] The survey sample included 108 252 people aged 12 years and older living in all the provinces and territories in Canada. The survey does not include people living on reserves and other Indigenous (referred to as "Aboriginal" in the CCHS) settlements, in specific remote areas or institutional settings and full-time members of the Canadian Armed Forces. Detailed descriptions of the CCHS methodology, design, instruments and sampling frame are available elsewhere.[31]

Study variables and measures

Outcome variable

The primary outcome was a four-category multinomial variable representing no reported disorder, mood disorders alone, anxiety disorders alone and comorbid mood and anxiety disorders, based on self-reported chronic (lasting, or expected to last, at least 6 months) diagnoses of mood and/or anxiety disorders by a health professional. Respondents were categorized as having a mood disorder if they answered "yes" to the question "Do you have a mood disorder such as depression, bipolar disorder, mania or dysthymia?" and as having an anxiety disorder if they answered "yes" to the question "Do you have an anxiety disorder such as a phobia, obsessive-compulsive disorder or panic disorder?" Respondents who answered "yes" to the question about having a mood disorder and "no" to the question about having an anxiety disorder were categorized as having a mood disorder alone, whereas those who answered "yes" to the question about having an anxiety disorder and "no" to the question about having a mood disorder were categorized as having an anxiety disorder alone. Respondents who answered "yes" to both questions were categorized as having comorbid disorders, and those who answered "no" were categorized as having no reported disorder.

Covariates

The covariates included the following sociodemographic factors: sex (male or female); age group (12–17, 18–24, 25–34, 35–50, 51–64 or ≥ 65 years); Indigenous identity (yes or no); immigration status (immigrant [either a permanent resident, referred to as "landed immigrant" in the 2020 CCHS, or a nonpermanent resident] or Canadian born); racialized identity (referred to as "visible minority," with yes or no indicators, in the CCHS public-use file, which collapses multiple self-identified ethnic and/or cultural categories into a binary indicator); marital status (married or living common law vs. single, i.e. never married, divorced, separated or widowed); educational attainment (less than high school graduation, high school diploma or equivalent, or postsecondary certificate, diploma or university degree); and region of residence (the 10 provinces and a combined territories category).

Socioeconomic factors included household income (< Canadian dollars [CAD] 20 000, 20 000–39 999, 40 000–59 999, 60 000–79 999 or ≥ 80 000), based on Canadian national income groupings; and household food security status (food secure, marginally insecure, moderately insecure or severely insecure).

Health-related factors included perceived health (excellent, very good, good, fair, poor); pain status (no usual pain or discomfort vs. usual pain or discomfort); number of chronic physical conditions (0, 1, 2 or ≥ 3 based on indicators for seven diagnosed conditions, i.e. asthma, arthritis, high blood pressure, diabetes, chronic respiratory diseases, musculoskeletal disorders and cardiovascular disease). Unmet health care need in the past 12 months (no/yes) was coded "yes" if the respondent reported needing but not receiving health care and experiencing one or more

barriers to receiving health care (e.g. waiting time, cost, lack of availability).

Psychosocial factors included sense of community belonging (very strong, somewhat strong, somewhat weak or very weak); life satisfaction (very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied or very dissatisfied); and perceived life stress (not at all stressful, not very stressful, a bit stressful, quite a bit stressful or extremely stressful).

Unless otherwise noted, covariates use Statistics Canada–derived variables in the 2019–2020 CCHS public-use file; nonresponse ("don't know," "refused") was coded as missing. Some variables (e.g. chronic conditions count, unmet health care need) were constructed from multiple CCHS items.

Conceptual framing

Psychosocial measures (life satisfaction, perceived stress, sense of community belonging) are treated as downstream social determinants shaped by broader social and economic conditions (e.g. poverty, discrimination or exclusion). We therefore interpreted associations involving these variables as conditional associations that may reflect accumulated structural disadvantage rather than purely individual attributes.

Statistical analysis

Descriptive analyses summarize respondent characteristics across the levels of the outcome variable. We report frequencies and percentages using survey- and bootstrap-weighted estimates to account for the complex survey design. Crude associations were examined with bivariate multinomial logistic regression; adjusted associations were estimated with survey-weighted multinomial logistic regression to obtain adjusted relative risk ratios (aRRRs) and 95% confidence intervals (CIs). Associations were considered statistically significant if the 95% CI for each aRRR did not include 1. All analyses incorporated the CCHS-provided sampling weights to account for the complex survey design and to ensure population-level representativeness.[30] Multicollinearity among explanatory variables was assessed using the variance inflation factor,[33] with values exceeding 2.5 indicating potential multicollinearity concerns.

Analyses were performed using STATA version 17 (StataCorp LLC, College Station, TX, US).

Ethics approval

This study used publicly available, de-identified secondary data from the CCHS, and is therefore exempt from institutional ethics review.

Results

In the analytic sample of 107 859 respondents, 4503 (4.17%) reported being clinically diagnosed with a mood disorder alone, 5381 (4.99%) with an anxiety disorder alone and 5226 (4.85%) with comorbid mood and anxiety disorders (Table 1). Females were more prevalent in all the groups, and younger adults (18–34 years) were particularly represented in the anxiety alone and comorbid disorders groups.

The comorbid disorders groups generally exhibited greater social and health disadvantages, including higher proportions of respondents identifying as Indigenous, single or with poorer perceived health, usual pain or discomfort, unmet health care needs, weaker sense of community belonging, lower life satisfaction and higher perceived stress. Household food insecurity had substantial missing data (about 16 700 respondents; 15.5%) and was excluded from the regression analyses to avoid reducing the analytic sample.

Table 2 shows unadjusted associations.

After adjustment, females had higher aRRRs for all three outcomes: mood disorders (aRRR = 1.688; 95% CI: 1.487–1.916); anxiety disorders (1.956; 1.712–2.234); and comorbid disorders (2.284; 1.951–2.673) in particular (Table 3 and Figure 1).

Age was strongly associated with mental health outcomes: young adults (18–34 years) had more than three times the risk for anxiety disorders (aRRR = 3.036; 95% CI: 2.441–3.776) and more than nine times the risk for comorbid disorders (9.311; 7.134–12.153) than older adults (≥ 65 years). Adults aged 35 to 64 years also had higher risks across all outcomes, though to a lesser extent than younger adults.

We tested an exploratory age-by-sex interaction term in the multinomial model; the global Wald test was not statistically significant ($\chi^2(12) = 7.82$; $p = 0.80$), indicating that the associations between sex and mental health outcomes did not differ significantly across age groups, contrary to previous Canadian surveillance findings that indicated higher mental health burden among younger females.[3]

Indigenous identity was associated with higher comorbid disorders (aRRR = 1.410; 95% CI: 1.048–1.896), but not with mood and anxiety disorders individually. Canadian-born respondents had higher risks than immigrants, particularly for comorbid disorders (1.984; 1.544–2.551). Racialized respondents were significantly less likely than nonracialized respondents to report mood disorders alone (0.525; 0.410–0.671), anxiety disorders (0.478; 0.354–0.645) and comorbid disorders (0.423; 0.308–0.581). Single respondents had higher risks across all outcomes compared with those who were married or in common-law relationships.

Compared with respondents with less than high school education, postsecondary graduates had higher risks for mood disorders alone (aRRR = 1.473; 95% CI: 1.179–1.841) and comorbid disorders (1.456; 1.108–1.913). High school graduates had a significantly increased risk for comorbid disorders (1.394; 1.049–1.853).

Regional differences in risks for mood and/or anxiety disorders were significant across five provinces. Relative to those in Ontario, respondents in Saskatchewan (aRRR = 1.591; 95% CI: 1.228–2.062) and Alberta (1.241; 1.036–1.486) showed a higher risk for mood disorders alone. Those in Nova Scotia had greater risks for comorbid disorders (1.547; 1.139–2.102) and anxiety disorders alone (1.305; 1.001–1.700). Conversely, respondents in Quebec had lower risks for mood disorders alone (0.799; 0.660–0.968) and comorbid disorders (0.462; 0.368–0.581) and those in Manitoba had lower risk for comorbid disorders (0.736; 0.554–0.978). Estimates for the territories combined are not reported due to very small cell sizes.

Lower income was linked to higher risks, especially for those with an income less than CAD 20 000 (highest risk across the disorder categories). Mid-income effects were mixed and often nonsignificant for these diagnosed with anxiety disorders alone.

TABLE 1
Characteristics of respondents with mood and/or anxiety disorders or no reported mood or anxiety disorder,[a] CCHS, 2019–2020

Variables	No reported disorder		Mood disorders[b]		Anxiety disorders[c]		Comorbid mood and anxiety disorders[b,c]		Total	
	n	%	n	%	n	%	n	%	n	%
Total	92 749	85.99	4503	4.17	5381	4.99	5226	4.85	107 859	100
Sociodemographic factors										
Sex (n = 107 859)										
Male	47 594	51.32	1834	40.73	1963	36.48	1878	35.93	53 269	49.39
Female	45 155	48.68	2669	59.27	3418	63.52	3348	64.07	54 590	50.61
Age, years (n = 107 859)										
12–17	6880	7.42	109	2.43	579	10.76	253	4.84	7822	7.25
18–34	23 415	25.25	1034	22.97	1713	31.83	2164	41.42	28 327	26.26
35–49	20 999	22.64	1044	23.19	1257	23.36	1253	23.97	24 553	22.76
50–64	21 920	23.63	1354	30.07	1106	20.56	1114	21.31	25 494	23.64
≥ 65	19 534	21.06	961	21.34	726	13.50	442	8.46	21 663	20.08
Indigenous identity (n = 104 880)										
No	87 814	97.36	4181	94.96	4996	95.49	4674	92.50	101 665	96.93
Yes	2378	2.64	222	5.04	236	4.51	379	7.50	3215	3.07
Immigration status (n = 105 728)										
Immigrant[d]	26 020	28.65	685	15.39	723	13.61	595	11.61	28 023	26.50
Canadian born	64 815	71.35	3769	84.61	4590	86.39	4532	88.39	77 705	73.50
Racialized identity[e] (n = 104 902)										
Yes	21 659	24.04	487	11.02	597	11.30	575	11.29	23 317	22.23
No	68 453	75.96	3932	88.98	4684	88.70	4517	88.71	81 585	77.77
Marital status (n = 99 800)										
Married/living common law	55 775	65.11	2373	54.18	2616	54.56	2115	42.64	62 879	63.00
Single[f]	29 890	34.89	2007	45.82	2179	45.44	2845	57.36	36 921	37.00
Educational attainment (n = 102 176)										
Less than high school	3769	4.28	199	4.67	231	4.57	197	4.06	4396	4.30
High school graduate	10 634	12.08	608	14.26	582	11.52	817	16.85	12 642	12.37
Postsecondary graduate	73 605	83.63	3457	81.06	4239	83.90	3836	79.09	85 138	83.32
Region of residence (n = 107 859)										
Newfoundland and Labrador	1293	1.39	69	1.54	97	1.80	84	1.62	1543	1.43
Prince Edward Island	377	0.41	22	0.49	25	0.47	31	0.60	456	0.42
Nova Scotia	2236	2.41	159	3.52	171	3.18	253	4.84	2818	2.61
New Brunswick	1817	1.96	114	2.52	157	2.91	138	2.64	2225	2.06
Quebec	21 625	23.32	802	17.80	1437	26.71	637	12.20	24 501	22.72
Ontario	36 326	39.17	1747	38.80	2026	37.64	2273	43.50	42 372	39.28
Manitoba	3132	3.38	167	3.71	168	3.12	183	3.50	3649	3.38
Saskatchewan	2614	2.82	203	4.50	154	2.87	153	2.93	3124	2.90
Alberta	10 539	11.36	588	13.06	515	9.57	699	13.38	12 342	11.44
British Columbia	12 556	13.54	622	13.82	622	11.56	764	14.62	14 565	13.50
Territories[g]	234	0.25	11	0.23	10	0.18	10	0.19	264	0.24

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TABLE 1 (continued)
Characteristics of respondents with mood and/or anxiety disorders or no reported mood or anxiety disorder,[a] CCHS, 2019–2020

Variables	No reported disorder		Mood disorders[b]		Anxiety disorders[c]		Comorbid mood and anxiety disorders[b,c]		Total	
	n	%	n	%	n	%	n	%	n	%
Socioeconomic factors										
Household income, CAD (n = 106 620)										
< 20 000	3280	3.58	320	7.21	305	5.74	479	9.32	4384	4.11
20 000–39 999	9622	10.49	601	13.55	673	12.66	743	14.47	11 639	10.92
40 000–59 999	11 281	12.30	637	14.35	703	13.22	811	15.80	13 431	12.60
60 000–79 999	11 271	12.29	636	14.34	670	12.61	601	11.71	13 179	12.36
≥ 80 000	56 281	61.35	2243	50.55	2964	55.76	2500	48.69	63 987	60.01
Household food security status (n = 91 125)										
Food secure	71 675	91.54	3035	79.66	3914	83.85	3088	71.05	81 712	89.67
Marginally insecure	2591	3.31	213	5.60	226	4.84	230	5.29	3260	3.58
Moderately insecure	3062	3.91	325	8.52	337	7.23	538	12.37	4262	4.68
Severely insecure	973	1.24	237	6.22	191	4.09	491	11.29	1891	2.08
Health-related factors										
Perceived health (n = 107 725)										
Excellent	24 336	26.27	315	7.00	716	13.31	189	3.63	25 555	23.72
Very good	37 161	40.11	1190	26.47	1825	33.95	962	18.49	41 139	38.19
Good	23 871	25.76	1691	37.61	1931	35.91	1986	38.17	29 479	27.37
Fair	5655	6.10	948	21.09	683	12.70	1351	25.97	8638	8.02
Poor	1626	1.75	352	7.83	221	4.12	715	13.74	2914	2.71
Pain status (n = 107 570)										
No usual pain or discomfort	73 409	79.35	2513	56.16	3585	66.69	2802	53.87	82 310	76.52
Usual pain or discomfort	19 108	20.65	1962	43.84	1791	33.31	2400	46.13	25 260	23.48
Number of chronic physical conditions (n = 107 859)[h]										
0	56 801	61.24	1976	43.88	3058	56.82	2553	48.86	64 388	59.70
1	19 872	21.43	1194	26.51	1261	23.43	1429	27.34	23 755	22.02
2	9356	10.09	675	15.00	565	10.49	686	13.12	11 282	10.46
≥ 3	6719	7.24	658	14.62	498	9.25	559	10.69	8434	7.82
Unmet health care need in the past 12 months (n = 107 859)										
No	89 634	96.64	4145	92.06	5054	93.92	4451	85.17	103 285	95.76
Yes	3114	3.36	357	7.94	327	6.08	775	14.83	4574	4.24
Psychosocial factors										
Sense of community belonging (n = 103 408)										
Very strong	17 355	19.38	534	12.77	820	16.52	405	8.56	19 114	18.48
Somewhat strong	47 042	52.54	1902	45.48	2439	49.14	1913	40.43	53 296	51.54
Somewhat weak	20 005	22.34	1277	30.54	1234	24.86	1496	31.62	24 012	23.22
Very weak	5129	5.73	469	11.21	471	9.48	917	19.39	6986	6.76
Life satisfaction (n = 104 005)										
Very satisfied	39 076	43.38	788	18.75	1390	27.99	538	11.31	41 793	40.18
Satisfied	46 858	52.02	2620	62.31	3041	61.22	2762	58.06	55 281	53.15
Neither satisfied nor dissatisfied	2862	3.18	402	9.55	345	6.94	690	14.52	4299	4.13
Dissatisfied	1039	1.15	339	8.07	163	3.28	621	13.06	2162	2.08
Very dissatisfied	241	0.27	56	1.33	28	0.56	145	3.06	470	0.45

Continued on the next page

TABLE 1 (continued)
Characteristics of respondents with mood and/or anxiety disorders or no reported mood or anxiety disorder,[a] CCHS, 2019–2020

Variables	No reported disorder		Mood disorders[b]		Anxiety disorders[c]		Comorbid mood and anxiety disorders[b,c]		Total	
	n	%	n	%	n	%	n	%	n	%
Perceived life stress (n = 107 478)										
Not at all stressful	14 010	15.16	273	6.08	256	4.77	158	3.06	14 697	13.67
Not very stressful	23 916	25.87	678	15.11	905	16.85	441	8.51	25 940	24.13
A bit stressful	38 262	41.39	1939	43.23	2367	44.05	1995	38.48	44 562	41.46
Quite a bit stressful	14 443	15.62	1287	28.69	1565	29.12	1962	37.83	19 256	17.92
Extremely stressful	1806	1.95	309	6.89	280	5.21	628	12.12	3023	2.81

Abbreviations: CAD, Canadian dollars; CCHS, Canadian Community Health Survey.

[a] Survey- and bootstrap-weighted distribution of estimates of frequencies and percentages.

[b] Mood disorders included depression, bipolar disorder, mania or dysthymia.

[c] Anxiety disorders included phobia, obsessive-compulsive disorder or panic disorder.

[d] Respondents were identified as immigrants if they self-identified as permanent residents ("landed immigrants" in the 2020 CCHS) or nonpermanent residents.

[e] Respondents were identified as racialized ("visible minority" in the 2020 CCHS public-use file) if they self-identified as South Asian, Chinese, Black, Filipino, Arab, Latin American, Southeast Asian, West Asian, Korean, Japanese or another category.

[f] Respondents were identified as single if they self-identified as divorced, separated, widowed or never married.

[g] Data from Yukon, Northwest Territories and Nunavut were combined due to small counts.

[h] Based on indicators for the following diagnosed conditions: asthma, arthritis, high blood pressure, diabetes, chronic respiratory diseases, musculoskeletal disorders and/or cardiovascular disease.

Poorer perceived health showed a strong gradient that was largest for comorbid disorders (aRRR of 2.681 [95% CI: 1.944–3.696] for very good perceived health to 14.688 [9.908–21.775] for poor perceived health). Experiencing usual pain or discomfort was associated with higher risk for mood (1.392; 1.219–1.590), anxiety (1.382; 1.204–1.586) and comorbid disorders (1.364; 1.168–1.592). Risk rose with the number of coexisting chronic conditions, with three or more associated with higher risks for mood (1.542; 1.227–1.939), anxiety (1.643; 1.310–2.062) and comorbid disorders (1.937; 1.425–2.633). Having unmet health care needs was associated with comorbid disorders (2.296; 1.710–3.083) and anxiety disorders alone (1.264; 1.001–1.595), but not with mood disorders alone.

Psychosocial factors were strongly associated with the outcomes. Compared with having a very strong sense of community belonging, a very weak sense of community belonging was linked to higher risks for mood disorders alone (aRRR = 1.313; 95% CI: 1.024–1.683) and comorbid disorders (2.221; 1.703–2.895). Life satisfaction was strongly associated with mental health outcomes. Compared with respondents who were very satisfied with life, progressively lower levels of life satisfaction were associated with higher risks of mood disorders and comorbid disorders with a clear dose–response pattern. Associations with anxiety disorders were present but generally weaker and less consistent.

Perceiving life stress demonstrated a clear dose–response relationship with mental health outcomes. Increasing levels of stress were associated with progressively higher risks of anxiety disorders and comorbid disorders, with the strongest associations observed among respondents reporting extreme stress. Associations with mood disorders were weaker at lower stress levels but became more pronounced at moderate to high levels of perceived stress.

Discussion

This study provides a prepandemic profile of factors associated with mood disorders, anxiety disorders and comorbid mood and anxiety disorders among adolescents (≥ 12 years) and adults in Canada, using nationally representative data from the 2019 to 2020 CCHS. We found that 4.17% of respondents reported receiving a clinical diagnosis of a mood disorder, 4.99% of an anxiety disorder and 4.85% of comorbid disorders. While the prevalence of mood and anxiety disorders individually is broadly consistent with earlier research,[16] the similar prevalence of comorbid disorders underscores the clinical and public health importance of co-occurring mental health conditions.

Our results confirm well-established sociodemographic patterns. Females had significantly higher relative risks, compared with males, across all mental health outcomes, with the strongest association for comorbid disorders (aRRR of 2.28 vs. 1.69 for mood disorders alone and 1.96 for anxiety disorders alone). This aligns with Canadian and global evidence showing greater prevalence of mood and anxiety disorders among females.[3,21] Likely contributors include biological differences in stress regulation, greater exposure to interpersonal stressors and gendered norms around emotional expression and help-seeking. Disproportionate caregiving roles and gendered socioeconomic disadvantage may further heighten chronic stress and risk for comorbidity risk.[22] In contrast, lower reported prevalence among males may partly reflect underdiagnosis and reluctance to disclose distress due to norms around stoicism and self-reliance.[16] Together, these patterns suggest that gendered social and structural determinants intersect with biology to shape disparities in mental health.

Compared with older adults (≥ 65 years), younger adults and particularly those aged 18 to 34 years had markedly higher risks for anxiety disorders alone and comorbid disorders, with a striking nearly nine-fold increase in risk for comorbidity. These findings align with prior Canadian and international studies, and likely reflect

TABLE 2
Unadjusted univariate multinomial logistic regression associations between sociodemographic, socioeconomic, health-related and psychosocial factors and mental health outcomes[a,b] among Canadians, CCHS, 2019–2020

Variables	Mood disorders[a]			Anxiety disorders[b]			Comorbid mood and anxiety disorders[a,b]		
	RRR	95% CI	*p* value	RRR	95% CI	*p* value	RRR	95% CI	*p* value
Sociodemographic factors									
Sex (reference category: male)									
Female	1.534	1.378–1.708	< 0.001	1.835	1.641–2.053	< 0.001	1.879	1.670–2.114	< 0.001
Age, years (reference category: ≥ 65 years)									
12–17	0.324	0.232–0.451	< 0.001	2.264	1.883–2.722	< 0.001	1.626	1.267–2.085	< 0.001
18–34	0.898	0.766–1.053	0.187	1.967	1.705–2.270	< 0.001	4.085	3.539–4.715	< 0.001
35–49	1.011	0.878–1.165	0.879	1.610	1.405–1.845	< 0.001	2.637	2.271–3.061	< 0.001
50–64	1.256	1.108–1.423	< 0.001	1.357	1.179–1.562	< 0.001	2.246	1.928–2.616	< 0.001
Indigenous identity (reference category: no)									
Yes	1.961	1.586–2.425	< 0.001	1.743	1.408–2.157	< 0.001	2.994	2.428–3.692	< 0.001
Immigration status (reference category: immigrant[c])									
Canadian born	2.208	1.885–2.586	< 0.001	2.548	2.140–3.034	< 0.001	3.057	2.565–3.644	< 0.001
Racialized identity[d] (reference category: no)									
Yes	0.391	0.319–0.479	< 0.001	0.403	0.325–0.499	< 0.001	0.402	0.322–0.502	< 0.001
Marital status (reference category: married/living common law)									
Single[e]	1.578	1.418–1.756	< 0.001	1.554	1.385–1.744	< 0.001	2.510	2.251–2.799	< 0.001
Educational attainment (reference category: less than high school)									
High school graduate	1.082	0.874–1.339	0.469	0.893	0.720–1.107	0.302	1.471	1.127–1.919	0.004
Postsecondary graduate	0.888	0.743–1.062	0.194	0.939	0.794–1.111	0.465	0.998	0.779–1.277	0.986
Region of residence (reference category: Ontario)									
Newfoundland and Labrador	1.113	0.838–1.479	0.458	1.343	1.006–1.792	0.045	1.044	0.762–1.430	0.790
Prince Edward Island	1.212	0.861–1.707	0.270	1.203	0.852–1.697	0.294	1.329	0.983–1.798	0.065
Nova Scotia	1.474	1.161–1.872	0.001	1.371	1.105–1.700	0.004	1.807	1.457–2.241	< 0.001
New Brunswick	1.300	0.999–1.692	0.051	1.546	1.235–1.936	< 0.001	1.211	0.906–1.620	0.196
Quebec	0.771	0.651–0.913	0.003	1.192	1.041–1.365	0.011	0.471	0.397–0.559	< 0.001
Manitoba	1.110	0.872–1.412	0.397	0.960	0.758–1.217	0.739	0.932	0.741–1.172	0.547
Saskatchewan	1.612	1.310–1.981	< 0.001	1.058	0.785–1.427	0.709	0.936	0.715–1.226	0.631
Alberta	1.160	0.996–1.352	0.056	0.877	0.730–1.054	0.160	1.060	0.898–1.251	0.489
British Columbia	1.030	0.879–1.207	0.711	0.889	0.742–1.065	0.200	0.972	0.827–1.143	0.734
Territories[f]	0.937	0.725–1.210	0.616	0.731	0.562–0.953	0.020	0.675	0.515–0.886	0.005
Socioeconomic factors									
Household income, CAD (reference category: ≥ 80 000)									
< 20 000	2.449	2.034–2.949	< 0.001	1.766	1.440–2.166	< 0.001	3.285	2.795–3.862	< 0.001
20 000–39 999	1.568	1.353–1.817	< 0.001	1.328	1.133–1.557	< 0.001	1.738	1.487–2.031	< 0.001
40 000–59 999	1.416	1.217–1.649	< 0.001	1.183	0.999–1.400	0.052	1.619	1.370–1.914	< 0.001
60 000–79 999	1.416	1.203–1.667	< 0.001	1.130	0.959–1.331	0.145	1.201	1.011–1.427	0.037
Health-related factors									
Perceived health (reference category: excellent)									
Very good	2.478	1.997–3.074	< 0.001	1.670	1.415–1.971	< 0.001	3.340	2.522–4.424	< 0.001
Good	5.481	4.445–6.759	< 0.001	2.750	2.328–3.248	< 0.001	10.734	8.220–14.016	< 0.001
Fair	12.974	10.426–16.144	< 0.001	4.106	3.356–5.024	< 0.001	30.829	23.360–40.687	< 0.001
Poor	16.756	12.946–21.686	< 0.001	4.628	3.611–5.931	< 0.001	56.716	42.423–75.825	< 0.001
Pain status (reference category: no usual pain or discomfort)									
Usual pain or discomfort	2.999	2.698–3.333	< 0.001	1.919	1.722–2.138	< 0.001	3.290	2.954–3.665	< 0.001

Continued on the next page

TABLE 2 (continued)
Unadjusted univariate multinomial logistic regression associations between sociodemographic, socioeconomic, health-related and psychosocial factors and mental health outcomes[a,b] among Canadians, CCHS, 2019–2020

Variables	Mood disorders[a]			Anxiety disorders[b]			Comorbid mood and anxiety disorders[a,b]		
	RRR	95% CI	*p* value	RRR	95% CI	*p* value	RRR	95% CI	*p* value
Number of diagnosed chronic physical conditions[g] (reference category: 0)									
1	1.727	1.506–1.980	< 0.001	1.179	1.035–1.343	0.014	1.599	1.399–1.828	< 0.001
2	2.075	1.790–2.406	< 0.001	1.121	0.968–1.298	0.128	1.630	1.391–1.911	< 0.001
≥ 3	2.817	2.429–3.265	< 0.001	1.376	1.173–1.615	< 0.001	1.850	1.571–2.177	< 0.001
Unmet health care needs (reference category: no)									
Yes	2.481	2.005–3.071	< 0.001	1.862	1.528–2.269	< 0.001	5.013	4.174–6.021	< 0.001
Psychosocial factors									
Sense of community belonging (reference category: very strong)									
Somewhat strong	1.314	1.120–1.542	0.001	1.097	0.942–1.277	0.233	1.742	1.451–2.092	< 0.001
Somewhat weak	2.075	1.745–2.468	< 0.001	1.305	1.101–1.547	0.002	3.205	2.651–3.875	< 0.001
Very weak	2.971	2.403–3.672	< 0.001	1.941	1.549–2.432	< 0.001	7.664	6.211–9.457	< 0.001
Life satisfaction (reference category: very satisfied)									
Satisfied	2.772	2.379–3.230	< 0.001	1.824	1.618–2.057	< 0.001	4.282	3.545–5.174	< 0.001
Neither satisfied nor dissatisfied	6.959	5.623–8.612	< 0.001	3.387	2.639–4.347	< 0.001	17.530	13.942–22.041	< 0.001
Dissatisfied	16.190	12.567–20.858	< 0.001	4.411	3.286–5.920	< 0.001	43.438	33.636–56.095	< 0.001
Very dissatisfied	11.449	7.304–17.947	< 0.001	3.250	2.035–5.190	< 0.001	43.785	29.385–65.240	< 0.001
Perceived life stress (reference category: not at all stressful)									
Not very stressful	1.456	1.156–1.833	0.001	2.069	1.673–2.559	< 0.001	1.632	1.140–2.338	0.007
A bit stressful	2.603	2.105–3.220	< 0.001	3.381	2.783–4.107	< 0.001	4.611	3.380–6.290	< 0.001
Quite a bit stressful	4.578	3.682–5.692	< 0.001	5.922	4.823–7.273	< 0.001	12.011	8.753–16.481	< 0.001
Extremely stressful	8.799	6.534–11.848	< 0.001	8.477	6.383–11.257	< 0.001	30.773	21.651–43.737	< 0.001

Abbreviations: RRR, relative risk ratio; CAD, Canadian dollars; CCHS, Canadian Community Health Survey; CI, confidence interval.

[a] Mood disorders included depression, bipolar disorder, mania or dysthymia.

[b] Anxiety disorders included phobia, obsessive-compulsive disorder or panic disorder.

[c] Respondents were identified as immigrants if they self-identified as permanent residents ("landed immigrants" in the 2020 CCHS) or nonpermanent residents.

[d] Respondents were identified as racialized ("visible minority" in the CCHS public-use file) if they self-identified as South Asian, Chinese, Black, Filipino, Arab, Latin American, Southeast Asian, West Asian, Korean, Japanese or another category.

[e] Respondents were identified as single if they self-identified as divorced, separated, widowed or never married.

[f] Values for Yukon, Northwest Territories and Nunavut were combined due to small counts.

[g] Based on indicators for the following diagnosed conditions: asthma, arthritis, high blood pressure, diabetes, chronic respiratory diseases, musculoskeletal disorders and/or cardiovascular disease.

age-related differences in stress exposure, socioeconomic pressures, coping resources and help-seeking.[18,19] The findings also highlight the need for age-specific, low-barrier mental health supports for youth and young adults (e.g. campus-based services, youth-appropriate virtual care, brief counselling).

Individuals who identified as Indigenous had higher risk for comorbid mental health disorders (aRRR = 1.41). This is consistent with previous research findings[34] and likely reflects the enduring impacts of colonialism, intergenerational trauma, systemic inequities and underlying social determinants of health such as poverty, housing insecurity and limited access to culturally safe care.[35] However, the CCHS excludes people living on reserves, in Indigenous settlements and in many remote communities as well as in institutions,[31] which likely means our results underestimate the true burden of mental health disorders among Indigenous people. Because population surveys cannot fully capture the historical and structural determinants of Indigenous mental health, national surveillance and service planning should be conducted, in partnership with Indigenous organizations, in ways that respect Indigenous data sovereignty and support culturally grounded, community-led care.

Canadian-born respondents had higher risks across all mental health outcomes than immigrants. While this pattern is often described as consistent with the "healthy immigrant effect,"[36-38] its applicability to mental health outcomes warrants careful interpretation. The lower prevalence observed among immigrants may reflect underutilization of mental health services, stigma related to help-seeking and barriers to accessing care rather than true differences in underlying mental health burden.[39-41] Moreover, mental health risks vary substantially across immigrant groups, with refugees and individuals with forced migration experiences potentially experiencing greater risk than suggested by aggregated immigrant categories.[42,43]

TABLE 3
Adjusted multinomial logistic regression[a] associations between sociodemographic, socioeconomic, health-related and psychosocial factors and mental health outcomes[b,c] among Canadians, CCHS, 2019–2020

Variables	Mood disorders[b]			Anxiety disorders[c]			Comorbid mood and anxiety disorders[b,c]		
	aRRR	95% CI	*p* value	aRRR	95% CI	*p* value	aRRR	95% CI	*p* value
Sociodemographic factors									
Sex (reference category: male)									
Female	1.688	1.487–1.916	< 0.001	1.956	1.712–2.234	< 0.001	2.284	1.951–2.673	< 0.001
Age, years (reference category: ≥ 65 years)									
12–17[d]	–	–	–	–	–	–	–	–	–
18–34	1.586	1.269–1.982	< 0.001	3.036	2.441–3.776	< 0.001	9.311	7.134–12.153	< 0.001
35–49	1.653	1.349–2.027	< 0.001	2.350	1.923–2.872	< 0.001	5.319	4.157–6.804	< 0.001
50–64	1.612	1.371–1.895	< 0.001	1.457	1.228–1.730	< 0.001	3.013	2.454–3.700	< 0.001
Indigenous identity (reference category: no)									
Yes	1.154	0.856–1.538	0.331	1.181	0.880–1.585	0.267	1.410	1.048–1.896	0.023
Immigration status (reference category: immigrant[e])									
Canadian born	1.723	1.414–2.099	< 0.001	1.701	1.355–2.136	< 0.001	1.984	1.544–2.551	< 0.001
Racialized identity[f] (reference category: no)									
Yes	0.525	0.410–0.671	< 0.001	0.478	0.354–0.645	< 0.001	0.423	0.308–0.581	< 0.001
Marital status (reference category: married/living common law)									
Single[g]	1.313	1.139–1.513	< 0.001	1.156	1.004–1.331	0.044	1.415	1.230–1.628	< 0.001
Educational attainment (reference category: less than high school)									
High school graduate	1.207	0.944–1.542	0.133	0.874	0.681–1.121	0.288	1.394	1.049–1.853	0.022
Postsecondary graduate	1.473	1.179–1.841	0.001	1.062	0.858–1.315	0.581	1.456	1.108–1.913	0.007
Region of residence (reference category: Ontario)									
Newfoundland and Labrador	1.039	0.737–1.463	0.829	1.325	0.913–1.923	0.139	1.040	0.673–1.608	0.859
Prince Edward Island	1.140	0.778–1.672	0.502	1.019	0.638–1.626	0.938	1.225	0.818–1.834	0.325
Nova Scotia	1.451	1.102–1.909	0.008	1.305	1.001–1.700	0.049	1.547	1.139–2.102	0.005
New Brunswick	0.998	0.712–1.399	0.989	1.263	0.947–1.686	0.112	1.015	0.654–1.575	0.948
Quebec	0.799	0.660–0.968	0.022	1.133	0.957–1.340	0.146	0.462	0.368–0.581	< 0.001
Manitoba	1.130	0.864–1.476	0.372	0.914	0.681–1.227	0.551	0.736	0.554–0.978	0.034
Saskatchewan	1.591	1.228–2.062	< 0.001	1.064	0.751–1.508	0.727	1.016	0.716–1.443	0.928
Alberta	1.241	1.036–1.486	0.019	0.875	0.707–1.082	0.217	1.016	0.815–1.267	0.885
British Columbia	1.046	0.863–1.269	0.646	0.993	0.799–1.234	0.950	0.912	0.734–1.133	0.404
Territories[h]	–	–	–	–	–	–	–	–	–
Socioeconomic factors									
Household income, CAD (reference category: ≥ 80 000)									
< 20 000	1.659	1.306–2.106	< 0.001	1.571	1.176–2.098	0.002	1.872	1.479–2.369	< 0.001
20 000–39 999	1.197	0.974–1.471	0.087	1.176	0.953–1.452	0.131	1.262	1.005–1.583	0.045
40 000–59 999	1.250	1.036–1.509	0.020	1.114	0.917–1.352	0.276	1.359	1.086–1.700	0.007
60 000–79 999	1.283	1.062–1.550	0.010	1.245	1.022–1.517	0.029	1.173	0.943–1.459	0.152
Health-related factors									
Perceived health (reference category: excellent)									
Very good	1.783	1.398–2.274	< 0.001	1.550	1.270–1.892	< 0.001	2.681	1.944–3.696	< 0.001
Good	3.177	2.481–4.069	< 0.001	2.358	1.912–2.910	< 0.001	7.038	5.142–9.632	< 0.001
Fair	4.832	3.605–6.477	< 0.001	3.182	2.410–4.203	< 0.001	12.874	9.058–18.297	< 0.001
Poor	4.422	3.082–6.345	< 0.001	2.632	1.883–3.679	< 0.001	14.688	9.908–21.775	< 0.001

Continued on the next page

TABLE 3 (continued)
Adjusted multinomial logistic regression[a] associations between sociodemographic, socioeconomic, health-related and psychosocial factors and mental health outcomes[b,c] among Canadians, CCHS, 2019–2020

Variables	Mood disorders[b]			Anxiety disorders[c]			Comorbid mood and anxiety disorders[b,c]		
	aRRR	95% CI	*p* value	aRRR	95% CI	*p* value	aRRR	95% CI	*p* value
Pain status (reference category: no usual pain or discomfort)									
Usual pain or discomfort	1.392	1.219–1.590	< 0.001	1.382	1.204–1.586	< 0.001	1.364	1.168–1.592	< 0.001
Number of diagnosed chronic physical conditions[i] (reference category: 0)									
1	1.290	1.086–1.532	0.004	1.320	1.117–1.560	0.001	1.417	1.159–1.731	0.001
2	1.336	1.094–1.632	0.005	1.412	1.143–1.745	0.001	1.707	1.295–2.251	< 0.001
≥ 3	1.542	1.227–1.939	< 0.001	1.643	1.310–2.062	< 0.001	1.937	1.425–2.633	< 0.001
Unmet health care need (reference category: no)									
Yes	1.268	0.991–1.622	0.059	1.264	1.001–1.595	0.049	2.296	1.710–3.083	< 0.001
Psychosocial factors									
Sense of community belonging (reference category: very strong)									
Somewhat strong	0.984	0.823–1.178	0.861	0.852	0.714–1.017	0.076	1.182	0.940–1.487	0.153
Somewhat weak	1.241	1.013–1.520	0.037	0.877	0.715–1.075	0.206	1.563	1.229–1.988	< 0.001
Very weak	1.313	1.024–1.683	0.032	1.178	0.902–1.539	0.229	2.221	1.703–2.895	< 0.001
Life satisfaction (reference category: very satisfied)									
Satisfied	1.655	1.386–1.977	< 0.001	1.248	1.074–1.450	0.004	1.879	1.502–2.350	< 0.001
Neither satisfied nor dissatisfied	2.280	1.752–2.968	< 0.001	1.658	1.207–2.279	0.002	3.874	2.844–5.275	< 0.001
Dissatisfied	3.926	2.889–5.337	< 0.001	1.644	1.112–2.430	0.013	5.157	3.648–7.289	< 0.001
Very dissatisfied	2.906	1.638–5.156	< 0.001	0.797	0.452–1.404	0.432	4.819	2.821–8.232	< 0.001
Perceived life stress (reference category: not at all stressful)									
Not very stressful	1.184	0.904–1.551	0.221	1.803	1.385–2.348	< 0.001	1.144	0.724–1.807	0.564
A bit stressful	1.770	1.376–2.276	< 0.001	2.446	1.902–3.145	< 0.001	2.205	1.467–3.313	< 0.001
Quite a bit stressful	2.340	1.789–3.061	< 0.001	3.620	2.769–4.733	< 0.001	3.447	2.272–5.229	< 0.001
Extremely stressful	2.856	1.981–4.116	< 0.001	4.228	2.896–6.172	< 0.001	3.927	2.390–6.453	< 0.001

Abbreviations: aRRR, adjusted relative risk ratio; CAD, Canadian dollars; CCHS, Canadian Community Health Survey; CI, confidence Interval.

[a] aRRRs and 95% CIs from survey- and bootstrap-weighted multinomial logistic regression analyses.

[b] Mood disorders included depression, bipolar disorder, mania or dysthymia.

[c] Anxiety disorders included phobia, obsessive-compulsive disorder or panic disorder.

[d] aRRRs for the 12–17-year age group are not reported because collinearity with marital status was perfect as all respondents were single, which prevented unique parameter estimation.

[e] Respondents who self-identified as permanent residents (referred to as "landed immigrants" in the 2020 CCHS) or nonpermanent residents.

[f] Respondents were identified as racialized ("visible minority" in the CCHS public-use file) if they self-identified as South Asian, Chinese, Black, Filipino, Arab, Latin American, Southeast Asian, West Asian, Korean, Japanese or another category.

[g] Respondents were identified as single if they self-identified as divorced, separated, widowed or never married.

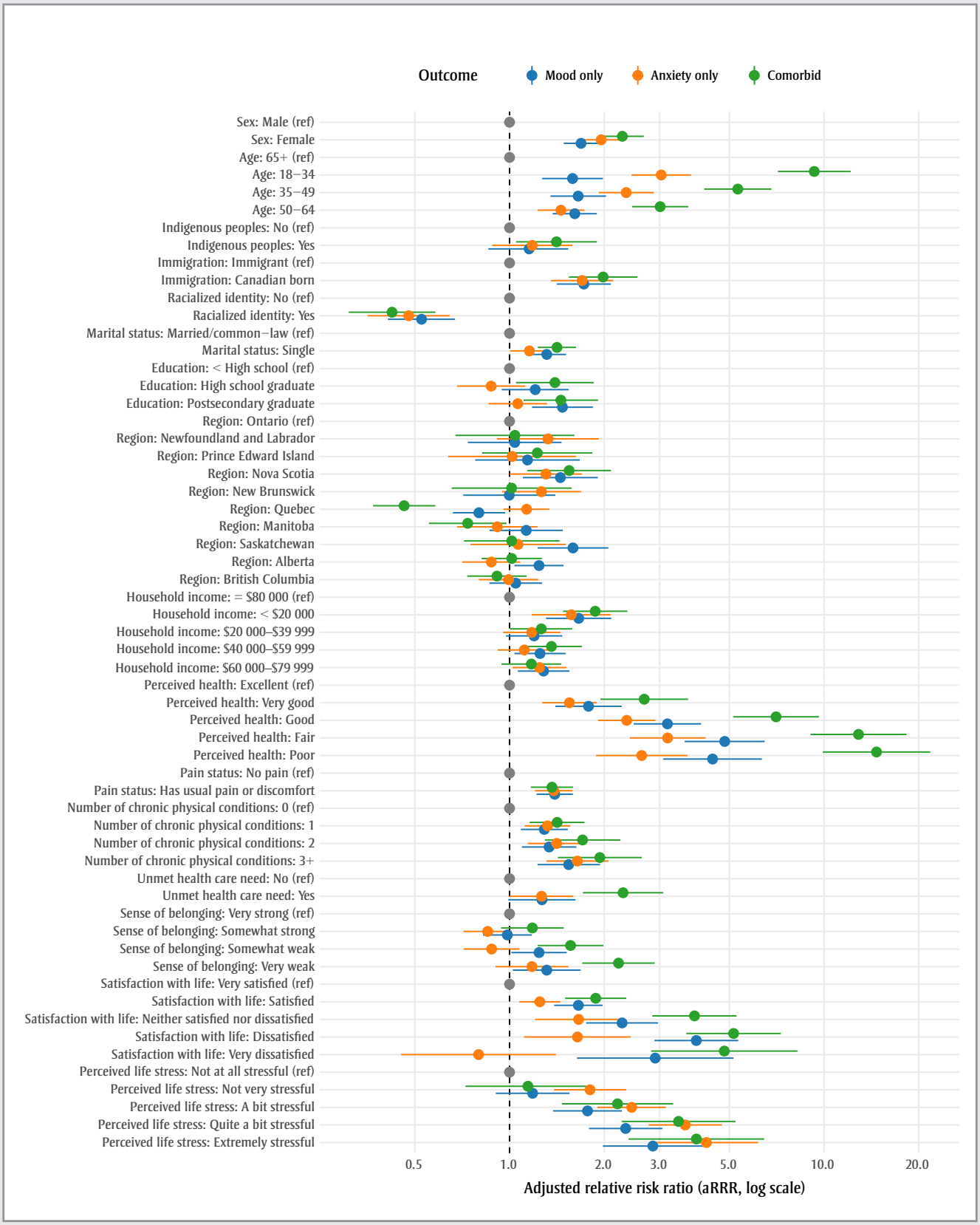
[h] aRRRs for Yukon, Northwest Territories and Nunavut combined are suppressed due to very small cell counts (mood disorders, n = 11; anxiety disorders, n = 10; comorbid disorders, n = 10) and likely instability; descriptive estimates are shown in Table 1.

[i] Based on indicators for the following diagnosed chronic conditions: asthma, arthritis, high blood pressure, diabetes, chronic respiratory diseases, musculoskeletal disorders and/or cardiovascular disease.

Racialized respondents had lower relative risks for mood disorders, anxiety disorders and comorbid conditions (aRRRs = 0.423–0.525). While this may reflect protective cultural or familial support networks that buffer psychological distress, it too should be interpreted with caution. Lower reported prevalence among racialized populations may also arise from underdiagnosis and underreporting linked to stigma, limited access to culturally safe services and barriers to mental health assessment.[44,45] The CCHS public-use file collapses different racialized identities into a binary "visible minority" indicator, which obscures heterogeneity and likely masks disparities between specific racialized groups.[46] These findings reinforce the need for disaggregated analyses by race, ethnicity and immigration status and for culturally responsive measurement.

Education showed a more complex relationship. A completed postsecondary education was associated with increased risks for mood disorders and comorbid conditions, but not with anxiety disorders. This is not entirely consistent with earlier work that suggested a straightforward protective effect of education on mental health,[11] but it does align with Finnish and Canadian studies that have found no consistent protection of higher education against anxiety

FIGURE 1
Adjusted relative risk ratios for mood, anxiety and comorbid disorders among Canadians, CCHS, 2019–2020



Abbreviations: CCHS, Canadian Community Health Survey; ref., reference.

Note: Dots indicate value on the adjusted relative risk ratio axis. The bars on either side of each dot represent the associated 95% confidence interval.

disorders.[19,47] One plausible explanation is that individuals with higher educational attainment may have greater mental health literacy, better access to primary care and more opportunities to receive and report a formal diagnosis of depression or a mood disorder. Conversely, work–family strain, job insecurity within professionalized labour markets and chronic work stress may contribute to mood symptoms despite higher educational attainment.

We observed differences between the provinces: compared with Ontario, Saskatchewan had the highest adjusted risk for mood disorders and Nova Scotia for comorbid conditions, while Quebec showed lower risks across most outcomes, consistent with previous research.[3,17] These patterns likely reflect unmeasured contextual factors—primary-care attachment and service organization (e.g. availability of stepped care, waiting times, rural access), social policy environments (income, housing, employment supports) and help-seeking or diagnostic practices (literacy, stigma, screening, billing/coding). Such factors may be especially relevant for comorbidity, which often requires more coordinated care pathways.

Lower household income was positively associated with all mental health outcomes even after adjustment, consistent with evidence linking socioeconomic disadvantage to depression and anxiety.[48-51] Our results underscore the continued importance of socioeconomic factors in mental health disparities and suggest that income remains a relevant consideration for targeted prevention and intervention strategies.

Finally, several health-related and psychosocial factors—poor perceived health and experiencing chronic pain, multimorbidity, unmet health care needs, dissatisfaction with life and higher stress—were strongly associated with all outcomes. Poor perceived health had the strongest association with comorbid disorders, suggesting heavier overall symptom burden and lower perceived capacity for self-management. Unmet health care needs may reflect structural and stigma-related barriers to timely mental health care.[24,52,53]

Having a weaker sense of community belonging was associated with higher risks for mood disorder and comorbidity, consistent with prior work linking low sense of community belonging to poorer mental health and higher risk for depression.[54,55] Rather than an individual trait, having a weaker sense of community belonging can indicate structural disconnection driven by poverty, exclusion and discrimination that undermines social cohesion and resilience. Large-scale CCHS analyses have also shown an inverse relationship between life satisfaction and mental illness, independent of income, health or gender.[28,29]

Taken together, these patterns are consistent with the social determinants of health and the socioecological frameworks[56,57] in which community belonging, stress and life satisfaction reflect upstream social and environmental contexts that shape exposure to—and coping with—psychological distress. We therefore interpret these psychosocial measures as markers and potential mediators of accumulated disadvantage, not merely individual attributes. While avoiding causal claims in this cross-sectional design, this framing helps explain why associations are strongest for comorbidity and suggests that linking social supports (e.g. income assistance, housing, community-connection programs such as social-prescribing initiatives) with clinical care may be especially relevant for people with multiple co-occurring needs.

Strengths and limitations

This study uses the large, nationally representative CCHS to examine population-level associations between sociodemographic, socioeconomic, psychosocial and health-related factors and mood and anxiety disorders among people living in Canada. Although the data were collected before the COVID-19 pandemic and may not reflect current mental health trends, it provides a useful snapshot of prepandemic mental health that can serve as a point of comparison for future studies. By distinguishing mood and anxiety disorders and comorbid outcomes and applying survey and bootstrap weights, this analysis offers a nuanced understanding of shared and distinct correlates.

Several limitations should be noted. The CCHS likely underestimates the true burden of mood and anxiety disorders because it relies on self-reported professionally diagnosed conditions and excludes undiagnosed or undisclosed cases. Its cross-sectional design precludes causal inference. The survey also excludes people living on reserves, in remote regions and in institutional settings, potentially resulting in underrepresentation of population groups facing structural inequities. In addition, the public-use file collapses diverse racialized identities into a binary "visible minority" variable, masking heterogeneity across groups. Important factors such as family history were unavailable.

Finally, several covariates (e.g. perceived health, multimorbidity, stress, life satisfaction) may act as mediators rather than independent predictors; adjusted estimates should therefore be interpreted as conditional associations. Future longitudinal and linkage studies could validate self-reports, assess temporality and better capture the mental health needs of excluded and marginalized populations.

Conclusion

This study identifies shared and distinct associations with mood disorders, anxiety disorders and their comorbidity in Canada. Higher relative risk was observed among younger adults, females and those with lower income, poorer perceived health, multimorbidity, unmet health care needs and adverse psychosocial profiles (dissatisfaction with life, weak sense of community belonging, higher stress). Individuals with comorbid mood and anxiety conditions exhibited the greatest overall burden across clinical and social indicators. While not causal, these patterns can inform service planning: age-tailored, low-barrier supports for youth and young adults; culturally grounded, community-led approaches for Indigenous people; and care models that link social supports (e.g. income, housing, community-connection programs) with clinical services for people reporting unmet needs or social isolation. Coordinated, team-based and culturally safe care (e.g. collaborative or stepped care) in primary and community settings may be particularly relevant for those with co-occurring conditions. Ensuring timely, equitable and culturally safe access to care remains a central priority.

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Conflicts of interest

The authors declare no conflicts of interest.

Authors' contributions and statement

FH: Conceptualization, methodology, data curation, formal analysis, writing—original draft; writing—review and editing. CF: Conceptualization, methodology, data curation, formal analysis, visualization, funding acquisition, project administration, supervision, validation, writing—review and editing.

The authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

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Corrigendum – Child maltreatment in Canada: prevalence and gender differences among youth

Britt McKinnon, PhD (1); Harriet L. MacMillan, MD (2); Ashley Vandermorris, MD (3,4); Katholiki Georgiades, PhD (2,5); Emma Nolan, PhD (6); Christina Catley, PhD (7); Isabelle Lévesque, MSc (7); Lil Tonmyr, PhD (1)

This corrigendum is being published to correct a co-author's erroneous degree in the following article:

McKinnon B, MacMillan HL, Vandermorris A, Georgiades K, Nolan E, Catley C, Lévesque I, Tonmyr L. Child maltreatment in Canada: prevalence and gender differences among youth. Health Promot Chronic Dis Prev Can. 2026;46(2):61-6. https://doi.org/10.24095/hpcdp.46.2.02

Before correction

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