BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-070509
Article Type:	Original research
Date Submitted by the Author:	25-Nov-2022

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Keywords:	EPIDEMIOLOGY, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PAIN MANAGEMENT, Sexual and gender disorders < PSYCHIATRY, STATISTICS & RESEARCH METHODS

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TITLE PAGE

Sex and gender differences in health care utilization trajectories: A cohort study among Quebec workers living with chronic pain

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Keywords: sex, gender, chronic pain, health care, trajectories, group-based trajectory modelling

Word count: 3,123
Number of tables: 2
Number of figures: 4

ABSTRACT

Objectives: Chronic pain is a poorly recognized and frequently inadequately treated condition affecting 1 in 5 adults. Reflecting on sociodemographic disparities as barriers to chronic pain (CP) care in Canada was recently established as a federal priority. The objective of this study was to assess sex and gender differences in health care utilization trajectories among workers living with CP. **Design:** Retrospective cohort study. **Participants:** This study was conducted using the TorSaDE Cohort which links the 2007-2016 Canadian Community Health Surveys and Quebec administrative databases (longitudinal claims). Among 2,955 workers living with CP, the annual number of health care contacts was computed during the three years after survey completion. **Outcome:** Group-based trajectory modelling (GBTM) was used to identify subgroups of individuals with similar patterns of health care utilization over time (health care utilization trajectories). **Results:** Across the study population, three distinct three-year health care utilization trajectories were found: (1) low health care users (59.9%), (2) moderate health care users (33.6%), and (3) heavy health care users (6.4%). Sex and gender differences were found in the number of distinct trajectories and the stability of the number of health care contacts over time. Multivariable analysis revealed that independent of other sociodemographic characteristics and severity of health condition, sex—but not gender—was associated with the heavy health care utilization longitudinal trajectory (with females showing a greater likelihood; OR: 2.6, 95%CI: 1.6-4.1). **Conclusions:** Our results underline the importance of assessing sex-based disparities in help-seeking behaviours, access to health care, and resource utilization among persons living with CP.

Strengths and limitations of the study

- Health care trajectories were modelled using group-based trajectory modelling, an objective and person-centred statistical approach.
- Use of an exhaustive database harnessing the strengths of longitudinal claim data linked to patient-reported outcomes
- The analysis was conducted in a community sample and included people with little or no contact with the health care system, which increases the external validity of the results.
- A gender measure was only available among participants having worked in the past year.
- Medical claims do not allow reliable identification of CP-related health care contacts/visit. All-cause health care visits were thus studied.

INTRODUCTION

Defined as persistent or recurrent pain lasting over three months (1), chronic pain (CP) affects 23% of females and 16% of males in Canada (2), seriously impacting physical functioning, emotional well-being and quality of life (3-8). It also constitutes a significant economic burden for patients, the health care system and third-party payers (9-11). In Canada, direct health care costs and loss of productivity due to CP amount to $38.3-40.4 billion per year (12). This number was estimated to reach $560-635 billion in the United States, exceeding the societal cost of heart disease, diabetes or cancer (13). Despite decades of research on CP and its treatment, the management of this condition remains suboptimal. Indeed, CP is characterized as poorly recognized, underdiagnosed, and inadequately treated (12, 14-17). CP should be managed in the primary care setting (family physicians, pharmacists, nurses) and more complex cases referred to multidisciplinary pain clinics in the secondary and tertiary care sectors before being redirected to community-based services. Unfortunately, the current situation does not reflect such trajectories. In the universal health care coverage context of Canada for example, major shortcomings persist and render the health care system inefficient, such as numerous gaps in primary care CP management (14), too many patients ending up in the emergency room (a setting that is not conducive to the management of CP) (18, 19), ill-equipped health care professionals (14), insufficient access to pain clinics due to a lack of resources, long waiting lists or the absence of such clinics in certain regions (20), and the absence of a measurement culture that makes it difficult to quantify the impact of our interventions (need for outcome measures and descriptors that are standardized from one care setting to another (21)).

Implementing favorable health care trajectories for CP, from primary care to multidisciplinary specialized care teams, and reversing sociodemographic disparities as barriers to CP care are priorities emanating from consultations conducted among patients and stakeholders (12).

One may wonder if women, men and gender-diverse people living with CP share similar health care utilization. Sex can be defined as a set of biological attributes associated with physical and physiological features (22). It has intrigued pain researchers for decades; differences between males and females are found in pain sensitivity, CP prevalence, medication use, response to treatment, drug side effects, pain beliefs, and attitudes toward people living with CP (16, 23-34). Conversely, gender refers to socially constructed roles, behaviours, expressions and identities (22). Although equally important, it is a complex and challenging construct to measure that is often overlooked (35). Without proper measurement and consideration of gender, it is unclear the extent to which sex differences are explained by biological factors or indirect measurement of social factors.

While sex differences have been found in health care utilization among people living with CP (36, 37), few has considered gender in their analysis (38) or explored how sex and gender intersect with regard to health care utilization. Furthermore, to our knowledge, none has delved into the related patterns of health care utilization over time (trajectories). A better understanding of the determinants of health care utilization has the potential to guide the prevention of adverse trajectories and reduction of pain inequities. This study thus aimed to examine sex and gender differences in health care utilization trajectories.

METHODS

Data source

This retrospective cohort study was conducted using data from the TorSaDE Cohort (39). This cohort of 102,148 participants links five cycles of Statistics Canada's Canadian Community Health Survey (CCHS; 2007-2008, 2009-2010, 2011-2012, 2013-2014 and 2015-2016 cross-sectional questionnaires) and Quebec administrative databases (1996 to 2016 longitudinal health insurance claims). ***Canadian Community Health Survey.*** Statistics Canada's CCHS is designed to collect health data on a representative sample Canadians aged 12 years and older (probability sampling) (40). Not included are on-reserve Indigenous people, full-time members of the Canadian Armed Forces, institutionalized individuals, or persons living in the Quebec regions of Nunavik and Terres-Cries-de-la-Baie-James (altogether <3% of Canadians). Standardized questionnaires were used and data quality was maximized through a variety of methods, including rigorous interviewer training and various control measures (40). Response rates are high (69.8-78.9%, depending on cycles (41)) and the test-retest reliability of responses to several questions has been demonstrated (42). As part of the CCHS, participants give informed consent to Statistics Canada allowing the provinces to link their responses to provincial administrative databases. ***Quebec administrative databases.*** The Régie de l'assurance maladie du Québec (RAMQ) administers the provincial universal health insurance (43), which covers the cost of medical visits, emergency department visits, hospitalizations and medical procedures for all Quebec residents (44). The TorSaDE Cohort, whose implementation is detailed elsewhere (39), is unique in Canada and contains a rich set of sociodemographic variables not included in administrative databases when used alone for health care service research.

Access and ethics. De-identified TorSaDE Cohort data was accessed through the *Institut de la statistique du Québec* (ISQ) secure virtual server (data holder). Ethical approval was obtained from the *Commission d'accès à l'information du Québec* (#1013990) and relevant university Research Ethics Boards (Université du Québec en Abitibi-Témiscamingue: # 2018-02 – Lacasse, A.; Centre hospitalier universitaire de Sherbrooke (CHUS): #2017-1504). ***Patient and public involvement***. In this study, a person with lived experience of CP (NM) was involved in the grant application, formulation of research objectives, and interpretation of results.

Selection criteria and study population

The TorSaDE Cohort includes 102,148 participants who completed 103,241 entries (participants could take part in more than one CCHS cycle). As shown in **Figure 1**, our study sample, of 2,955 individuals, was created using four criteria: (**1**) For participants with more than one CCHS entry, only the most recent entry was retained. (**2**) Participants reporting CP (having answered "No" to the CCHS question "*Are you usually free of pain or discomfort?*"). While this definition may differ from commonly used definitions of chronicity based on the duration of symptoms (1, 45-47), it has been used in many CP epidemiology studies (2, 8, 48-52) and provides prevalence estimates comparable to studies using more traditional definitions (53). (**3**) Participants with complete longitudinal health insurance information for three years following CCHS completion (since longitudinal administrative data are available in the TorSaDE Cohort up until 2016, participants of the 2015-2016 CCHS cycle were not included). And (**4**) Participants for whom a composite gender index (54) was available. In the TorSaDE Cohort, a gender measure (see Study variables section) is only available among participants having worked in the past year (all types of occupations taken together) and for whom work variables were measured by Statistics Canada (participants aged 18 to 50 years). For this reason, the present study is centred on workers only.

Study variables

Health care utilization trajectories. Using administrative data, all hospitalizations, physician visits, and emergency department visits were considered. The number of health care contacts per participant per year was modelled into three-year health care utilization trajectories using group-based trajectory modelling (GBTM), a statistical approach to grouping participants with similar patterns of outcomes over time (55-59) (see full description in Supplementary material). Trajectory group membership was then used as a categorical dependent variable.

Sex and gender. Sex and gender were the independent variables of interest. In the 2007-2016 CCHS questionnaires, sex was measured as a self-reported dichotomous variable (male vs. female). Gender was not directly available in the CCHS questionnaire, but measured using a composite index previously developed by our group using gender-related CCHS variables, namely the GENDER Index (54). Higher scores on the 0-100 index represent more feminine characteristics. Face and construct validity of the GENDER Index scores were demonstrated in the TorSaDE Cohort population (54). The index was deemed multidimensional and includes variables related to various gender constructs such as gender identity (how individuals see themselves—e.g., man, woman, non-binary, two-spirited), gender roles (behavioural norms applied to males and females that influence everyday actions, expectations and experiences), gender relationships (how individuals interact with and are treated by others based on their ascribed gender) and institutionalized gender (distribution of power between men and women in societal institutions) (60). As underlined, work-related variables appeared to be paramount in the development of our gender measure (conceptually [(60, 61)] and based on the iterative statistical analysis [(54)]). Thus, the gender index could only be calculated among 18 to 50-year-old participants who reported having worked in the past year in the CCHS and for whom work variables were measured by Statistics Canada (**Figure 1**).

Covariables. CCHS data enabled consideration of the following self-reported variables: socioeconomic factors, pain intensity (mild/moderate/severe), pain interference (none/a few/some/most activities prevented), self-reported back pain (except fibromyalgia and arthritis), self-reported arthritis (except fibromyalgia), perceived general health (excellent/very good/good/fair/poor), alcohol consumption in the past year, smoking, physical activity (regular/occasional, rare), lifestyle (active/moderately active/inactive, according to Statistics Canada's index of physical activity), and reporting having a regular physician. Further, the following was derived from administrative data: public precription drug insurance status at time of CCHS completion (about 45% of the Quebec population is covered: people who are not eligible for private drug insurance with their employer or their spouse's employer, who are ≥65 years old, receiving last-resort financial assistance (44)), combined Charlson comorbidity index and Elixhauser comorbidity index (62) calculated in the year before CCHS completion (accounting for various non-pain comorbidities that can show sex-differences), and use of a pain clinic (medical claims associated with a pain clinic establishment code [4X1] or professional activities billed for services rendered in a pain clinic [anesthesia services coded 41055, 41056, 41057, 41058 and 41059]).

Statistical analysis

A sex- and gender-based analysis was conducted (63-65), including stratified statistics, statistical significance of sex, gender and their interaction term in multivariable models, and reporting of negative findings (statistically nonsignificant results). First, the characteristics of the whole study population were summarized using descriptive statistics. As mentioned earlier, GBTM was applied to model three-year health care utilization trajectories and classify participants into trajectory groups (Supplementary material). This analysis was conducted for the whole study sample, and then repeated among the following strata to assess sex and gender differences in the number and patterns of health care utilization trajectories: males, females, and three strata formed using the GENDER Index tertiles (0-100 values were ordered and the distribution was separated into three equal parts/groups to reflect masculine, androgynous or undifferentiated, and feminine gender). A multivariable logistic regression model was then used across the study sample to assess the association between sex, gender (independent variables) and dichotomized trajectory group membership (dependent variable), while accounting for covariables. Intersectional factors and potential confounders to be considered in the model were selected a priori based on intersectionality-based research (65, 66) and Andersen's (1995) model (67), which is widely used in health care utilization studies (68). All variables considered are detailed in **Table 1**. In the regression model, trajectory group membership was dichotomized to predict participants with the heaviest health care utilization over time (the health care utilization trajectory the most likely to be unfavourable (69)). Multicollinearity was tested according to variance inflation factors (70) and no multiple imputation was applied as missing data proportion was low across variables of interest (<3.8%). Statistical interaction between sex and gender was tested, and all analyses were conducted using SAS® (version 9.4, Cary, NC, USA).

RESULTS

The analysis was conducted among 2,955 workers living with CP (**Figure 1**), whose characteristics are shown in **Table 1**. Mean age was 37.3 ± 9.0 years old (range: 18-50) and 56.1% were female. In total, GBTM led to the testing of 29 models with differences in the number of health care utilization trajectories (between 1 and 4) and trajectory shape (linear or linear and quadratic components). Model fit indices for each model tested are shown in Supplementary material. The best fit for the data, guaranteeing a minimum of 5% of participants belonging to the smallest trajectory was a three-trajectory model (**Figure 2**): **(1)** low health care users (trajectory #1: 59.9% of the sample; the mean number of health care contacts varied from 2.1 ± 2.1 to 2.3 ± 2.2 per year), **(2)** heavy health care users (trajectory #2: 6.4% of the sample; 19.0 ± 10.8 to 20.6 ± 12.6 contacts per year), and **(3)** moderate health care users (trajectory #3: 33.6% of the sample; 7.9 ± 4.7 to 8.4 ± 5.0 contacts per year). According to the graph (**Figure 2**), health care utilization (number of health care contacts per year) appeared stable across the three-year time window.

Table 1. Study population characteristics.

Characteristics * (n = 2 955)	**No. (%) of participants ****
Sociodemographic profile	
Age (years) – mean ± SD	37.31 ± 9.02
Sex	
Females	1,659 (56.14)
Males	1,296 (43.86)
Gender Index (0-100) – mean ± SD	0.50 ± 0.26
Masculine (tertile #1 scores 0.01-0.42)	984 (33.30%)
Androgynous or undifferentiated (tertile #2 scores 0.42-0.64)	986 (33.47%)
Feminine (tertile #3 scores 0.64-0.99)	985 (33.33%)
White self-identified race	
Yes	2,705 (91.54)
Indigenous self-identification	
Yes	67 (2.36)
Country of birth	
Canada	2,734 (92.52)
Other	221 (7.48)
Education level	
No secondary diploma	270 (9.16)
Secondary diploma	322 (10.92)
College diploma/Registered apprenticeship or other trades certificate or diploma	1,618 (54.88)
University education diploma	738 (25.03)
Marital status	
In a relationship	1,655 (56.35)
Not in a relationship	1,290 (43.65)
Household income (Can$)	
< 20,000	160 (5.41)
20,000 -39,999	582 (19.70)
40,000 – 59,999	633 (21.42)
60,000 -79,999	551 (18.65)
≥ 80,000	1,029 (34.82)
Region of residence	
Remote	657 (22.23)
Non-remote	2,298 (77.77)
Geographic area	
Urban	2,136 (72.28)
Rural	819 (27.72)
Public drug insurance status	
Covered	753 (25.48)
Not covered	2,202 (74.52)
Pain symptoms	
Pain intensity	
Mild	964 (32.74)

Moderate	1,568	(53.26)
Severe	412	(13.99)
Pain interference (activities prevented)		
None	1,257	(42.61)
A few	1,183	(40.10)
Some	348	(11.80)
Most	162	(5.49)
Self-reported back pain (except fibromyalgia and arthritis)		
Yes	1,261	(42.79)
Self-reported arthritis (except fibromyalgia)		
Yes	414	(14.06)
General health and lifestyle profile		
Combined comorbidity index of Charlson and Elixhauser – mean ± SD	0.12	±0.68
Perceived general health		
Excellent or very good	1,291	(43.72)
Good	1,245	(42.16)
Fair or bad	417	(14.12)
Alcohol consumption in the past 12 months		
Regular	2,280	(77.26)
Occasional	400	(13.55)
Has not drunk	271	(9.18)
Smoking		
Regular	762	(25.79)
Occasional	190	(6.43)
Never	2,003	(67.78)
Physical activity		
Regular	1,822	(61.66)
Occasional	596	(20.17)
Rare	537	(18.17)
Lifestyle		
Active	583	(19.73)
Moderately active	737	(24.94)
Inactive	1,635	(55.33)
Health care		
Use of a pain clinic		
Yes	162	(5.49)
Having a regular physician		
Yes	2,215	(74.98)

Table footnotes:

* Proportion of missing data across presented variable ranged between 0 and 3.76%. Listwise deletion was thus applied for the subsequent phases of the analysis.

** Unless stated otherwise.

SD: Standard deviation

When GBTM was repeated among sex (males and females) and gender (GENDER Index tertiles) strata (see Supplementary material for model fit indices), a three-trajectory model best fit the data for males, and a four-trajectory model best fitted the data for females (**Figure 3**). The first three health care utilization trajectories (low, moderate, and substantial health care users) were characterized by stable number of health care contacts over time and were similar between males and females. However, a fourth group of females (5.4%) displayed a decreasing curve of heavy health care use. Also, the number and pattern of health care utilization trajectories varied across gender strata (**Figure 4**), with feminine persons showing once again a decreasing curve of heavy health care use.

Table 2 shows the results of the multivariable logistic regression model used to assess the association between sex, gender and a heavy health care trajectory while adjusting for sociodemographic status, pain characteristics and health profile. Sex—but not gender—was associated with a heavy health care trajectory (females having a greater likelihood than males; OR: 2.6, 95%CI: 1.6-4.1). The same result was reached whether gender was used as a continuous or categorical variable (groups formed by tertiles). No statistical interaction was found between sex and gender. Other factors associated with a heavy health care utilization trajectory in the multivariable model were greater pain intensity, interference, and comorbidity, poorer perceived general health, use of a pain clinic and having a regular physician.

Table 2. Multivariable logistic regression model used to identify participants' sociodemographic and clinical characteristics associated with the unfavorable health care trajectory

Participant characteristics	Adjusted OR	95% Confidence interval		P-value
Sociodemographic profile				
Age (years)	1.006	0.986	1.026	0.5383
Sex (females vs. males)	**2.588**	**1.626**	**4.117**	**<.0001**
Gender index (0-100)	1.959	0.838	4.579	0.1206
White self-identified race (no vs. yes)	1.445	0.502	4.158	0.4946
Indigenous self-identification (no vs. yes)	0.942	0.237	3.745	0.9323
Country of birth (other vs. Canada)	0.765	0.255	2.293	0.6323
Education level (vs. no secondary education diploma)				
Secondary education diploma	0.793	0.355	1.774	0.5724
Post-secondary education diploma	1.002	0.531	1.889	0.9960
University education diploma	1.112	0.543	2.279	0.7712
Marital status (not in a relationship vs. in a relationship)	0.726	0.487	1.081	0.1149
Household income ($) (vs. < 20,000)				
20,000 -39,999	0.729	0.343	1.547	0.4097
40,000 – 59,999	0.850	0.392	1.843	0.6806
60,000 -79,999	0.885	0.394	1.987	0.7673
≥ 80,000	0.694	0.305	1.579	0.3840
Region of residence (non-remote region vs. remote region)	1.463	0.954	2.244	0.0809
Geographic area (rural vs. urban)	0.760	0.507	1.139	0.1841
Public drug insurance status (covered vs. not covered)	1.117	0.731	1.705	0.6095
Pain symptoms				
Pain intensity (vs. mild)				
Moderate	1.393	0.886	2.189	0.1514
Severe	**1.812**	**1.028**	**3.195**	**0.0399**
Pain interference (vs. none)				
Some	1.388	0.904	2.131	0.1342
Several	**2.243**	**1.311**	**3.837**	**0.0032**

Most	**2.351**	**1.184**	**4.670**	**0.0146**
Back pain (no vs. yes)	1.261	0.894	1.779	0.1870
Arthritis (no vs. yes)	0.908	0.596	1.383	0.6526
General health profile				
Combined comorbidity index of Charlson and Elixhauser	**1.681**	**1.424**	**1.986**	**<.0001**
Perceived general health (vs. excellent or very good)				
Good	**1.609**	**1.062**	**2.440**	**0.0250**
Fair or bad	**3.326**	**2.016**	**5.488**	**<.0001**
Alcohol consumption in the past 12 months (vs. regular)				
Occasional	1.146	0.733	1.792	0.5504
Has not drunk	1.021	0.578	1.803	0.9439
Smoking (vs. regular)				
Occasional	0.902	0.387	2.100	0.8101
Never	1.354	0.896	2.045	0.1498
Frequency of physical activities (vs. regular)				
Occasional	1.009	0.587	1.736	0.9741
Rare	0.754	0.435	1.309	0.3160
Index of physical activities (vs. active)				
Moderately active	0.990	0.592	1.657	0.9704
Inactive	0.813	0.467	1.413	0.4625
Health care				
Use of a pain clinic (yes vs. no)	**2.286**	**1.337**	**3.909**	**0.0025**
Having a regular physician (yes vs. no)	**1.862**	**1.111**	**3.123**	**0.0184**

Table footnotes: Bold text = Statistically significant associations

DISCUSSION

This study aimed to examine sex and gender differences in health care utilization trajectories given the growing recognition of the importance of examining these differences when studying the experience of pain (28, 33, 35) and health outcomes in general (71-73). Sex and gender differences were found in the number and shape of health care utilization trajectories. Females had a greater likelihood of falling into the heavy health care utilization trajectory independent of social factors measured by the GENDER Index, pain severity, and non-pain comorbidities.

To our knowledge, not one previous study has focused on sex- and gender-based differences in health care utilization longitudinal trajectories among people living with CP. An earlier Canadian study by Antaky et al. (36) failed to find a multivariable association between sex and heavy health care use among CP patients (defined as individuals in the highest one-year direct health care costs quartile). However, their definition of heavy health care, statistical approach, and time window were different, and they did not consider gender. Having adjusted for many covariables, our results are likely to reflect true sex-based differences. As there are no tenable access barriers to health care driven exclusively by biological sex, differences in health care utilization trajectories between the males and females of our study may be explained by intersecting behavioural and social factors not captured by the GENDER Index or covariables that could be related to health care utilization (e.g., help-seeking tendencies,(74) health literacy (75)).

Future directions

Although the non-pain-related medical literature abounds with findings demonstrating the tendency of females to have more health service contacts (74), our study is novel as it represents a first step in demystifying distinct subgroups of health care users among females and males living with CP. Further studies should examine the reasons for those sex differences (e.g., qualitative studies allowing an in-depth understanding of the behaviours and experiences specific to people living with CP). Understanding the presence of disparities vs inequities may also be relevant. Disparities are not undesirable as such, unless they result in unfairness and injustice. On the other side, inequities are undesirable and should be subject to moral criticism as they imply unfairness and injustice [(76, 77)]. One may wonder, for example, if males receive similar medical follow-up and prescription opportunities as females do to manage their pain. All in all, our results provide valuable information to identify, early on, patients who are more likely to experience heavy health care utilization—i.e., females—and adapt health care services accordingly (e.g., assess if heavy health care use is useful and necessary).

Strengths and limitations

The TorSaDE Cohort, a unique database harnessing the strengths of longitudinal claim data from Canadian universal health care coverage linked to patient-reported outcomes, allowed to increase the generalizability of our results to various persons living with CP in Canada and possibly in countries with a similar gender norms and health care system. In fact, the validity of administrative databases used alone for the identification of persons living with CP is questionable [(78, 79)]. Although our data did not allow us to apply the most widely accepted definition of CP (persistent or recurrent pain lasting over three months (1)), identifying CP cases using CCHS data allowed us to work with a community sample and include people with little or no contact with the health care system. As participants were not selected based on administrative data, the index date (defined as CCHS completion) was not related to a significant event in the care trajectory of CP patients (e.g., first diagnosis). Consequently, trajectories modelled in this study represent a random picture of a part of the life course of participants, and patterns of health care utilization were quite stable over time. A limitation of our study is that we had to study all-cause health care visits (as medical claims do not allow reliable identification of CP-related health care contacts/visits) (78, 79). Nevertheless, this allows the patient journey to be viewed as a whole, which could also be seen as a strength. Another limitation is that the GENDER Index was only available to workers (54) limiting our capacity to study older adults who are more likely to have CP. However, the multivariable analysis allowed the consideration of various socioeconomic and health impairment profiles (e.g., participants reporting severe pain). Globally, the strengths of using the TorSaDe Cohort clearly outweigh the disadvantages since, to our knowledge at the time of this study, no pain-specific Canadian data source outside tertiary care settings links self-reported data from thousands of patients to longitudinal administrative databases (the only way to study bio-psycho-social determinants of health care trajectories).

Conclusion

Our results underline the importance of deepening our understanding of sex-based disparities and inequities in terms of help-seeking, access to health care and resource utilization among persons living with CP. Studies exploring the experience and perception of patients would be a good follow-up to this study in order to identify priorities to reduce the burden of pain and pain inequities in Canada.

ACKNOWLEDGMENTS

We would like to thank members of the TorSaDE Cohort Working Group for exchange and methodological sharing activities. We thank Mélissa Gosselin and Adriana Angarita-Fonseca who helped with the literature review. We would also like to thank Emily-Jayn Rubec, who provided linguistic revision services for this paper.

AUTHORS CONTRIBUTIONS

Each author listed in the manuscript has participated actively and sufficiently in this study to fulfill all authorship criteria of the International Committee of Medical Journal Editors (ICMJE). AL, MGP, MC, OMS JK and NM conceptualized the project and secured funding. AL led the study, wrote the statistical analysis plan and drafted the manuscript. HLNN conducted the statistical analysis and assisted in drafting the manuscript. NM, BV, and MZ contributed to the interpretation of data. All authors revised the manuscript critically, gave final approval of the version to be published, and agreed to act as guarantors of the work.

FUNDING STATEMENT

This work was supported by the Canadian Institutes of Health Research (CIHR) (Personalized Health Catalyst Grants - Development of predictive analytic models: #PCG155479) and the Fondation de l'Université du Québec en Abitibi-Témiscamingue (FUQAT; no funding #). The implementation of the TorSaDE Cohort was funded by the Quebec SUPPORT Unit (Support for People and Patient-Oriented Research and Trials; no funding #), an initiative funded by the CIHR, the Ministry of Health and Social Services of Québec, and the Fonds de recherche du Québec – Santé (FRQS). During this study, MGP and AL were respectively Junior 1 and Junior 2 research scholars from the FRQS. JK is supported by a CIHR Research Chair in health psychology. This research received no specific grant from the commercial sector.

COMPETING INTERESTS STATEMENT

The authors declare no conflicts of interest and no financial interests related to this study.

ETHICS APPROVAL STATEMENT

De-identified TorSaDE Cohort data was accessed through the *Institut de la statistique du Québec* (ISQ) secure virtual server (data holder). Ethical approval was obtained from the *Commission d'accès à l'information du Québec* (#1013990) and relevant university Research Ethics Boards (Université du Québec en Abitibi-Témiscamingue: # 2018-02 – Lacasse, A.; Centre hospitalier universitaire de Sherbrooke (CHUS): #2017-1504).

DATA SHARING

TorSaDE Cohort data links Statistics Canada's Canadian Community Health Survey (CCHS) data and Quebec Health Ministry data that are not publicly available. Access must be granted by the Institut de la statistique du Québec (ISQ) (data holder) and the Commission d'accès à l'information du Québec. Programming codes can be obtained directly from the corresponding author.

FIGURE LEGENDS

Figure 1. Study population selection.

Figure 2. Health care utilization trajectories in the whole study sample.

Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

Figure 3. Health care utilization trajectories in males (left) and females (right).

Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

Figure 4. Health care utilization trajectories in first (left), second (center) and third (right) tertiles of gender index.

Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

REFERENCES

1. Treede RD, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, et al. Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). Pain. 2019;160(1):19-27.

2. Reitsma M, Tranmer JE, Buchanan DM, VanDenKerkhof EG. The epidemiology of chronic pain in Canadian men and women between 1994 and 2007: longitudinal results of the National Population Health Survey. Pain Res Manag. 2012;17(3):166-72.

3. Ashburn MA, Staats PS. Management of chronic pain. Lancet. 1999;353(9167):1865-9.

4. Ohayon MM, Schatzberg AF. Using chronic pain to predict depressive morbidity in the general population. Arch Gen Psychiatry. 2003;60(1):39-47.

5. Gureje O, Von Korff M, Simon GE, Gater R. Persistent pain and well-being: a World Health Organization Study in Primary Care. JAMA. 1998;280(2):147-51.

6. Smith BH, Elliott AM, Chambers WA, Smith WC, Hannaford PC, Penny K. The impact of chronic pain in the community. Fam Pract. 2001;18(3):292-9.

7. Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. EurJ Pain. 2006;10(4):287-333.

8. Hogan ME, Taddio A, Katz J, Shah V, Krahn M. Health utilities in people with chronic pain using a population-level survey and linked health care administrative data. Pain. 2017;158(3):408-16.

9. Kronborg C, Handberg G, Axelsen F. Health care costs, work productivity and activity impairment in non-malignant chronic pain patients. The European journal of health economics : HEPAC : health economics in prevention and care. 2009;10(1):5-13.

10. Guerriere DN, Choiniere M, Dion D, Peng P, Stafford-Coyte E, Zagorski B, et al. The Canadian STOP-PAIN project - Part 2: What is the cost of pain for patients on waitlists of multidisciplinary pain treatment facilities? Can J Anaesth. 2010;57(6):549-58.

11. Lalonde L, Choiniere M, Martin E, Berbiche D, Perreault S, Lussier D. Costs of moderate to severe chronic pain in primary care patients - a study of the ACCORD Program. Journal of pain research. 2014;7:389-403.

12. Campbell M, Hudspith M, Choinière M, El-Gabalawy H, Laliberté J, Sangster M, et al. Working together to better understand, prevent and, manage chronic pain: What We Heard. Ottawa: Report by the Canadian Pain Task Force – Health Canada; 2020.

13. Gaskin DJ, Richard P. The economic costs of pain in the United States. J Pain. 2012;13(8):715-24.

14. Lalonde L, Choiniere M, Martin E, Levesque L, Hudon E, Belanger D, et al. Priority interventions to improve the management of chronic non-cancer pain in primary care: a participatory research of the ACCORD program. Journal of pain research. 2015;8:203-15.

15. Kress HG, Aldington D, Alon E, Coaccioli S, Collett B, Coluzzi F, et al. A holistic approach to chronic pain management that involves all stakeholders: change is needed. Curr Med Res Opin. 2015;31(9):1743-54.

16. Lacasse A, Choiniere M, Connelly J-A. Knowledge, beliefs, and attitudes of the Quebec population toward chronic pain: Where are we now? Canadian Journal of Pain. 2017;1(1):151-60.

17. Campbell M, Hudspith M, Anderson M, Choinière M, El-Gabalawy H, Laliberté J, et al. Chronic Pain in Canada: Laying a Foundation for Action. Ottawa: Report by the Canadian Pain Task Force – Health Canada; 2019.

18. Poulin PA, Nelli J, Tremblay S, Small R, Caluyong MB, Freeman J, et al. Chronic Pain in the Emergency Department: A Pilot Mixed-Methods Cross-Sectional Study Examining Patient Characteristics and Reasons for Presentations. Pain Res Manag. 2016;2016:3092391.

19. Dépelteau A, Racine-Hemmings F, Lagueux É, Hudon C. Chronic pain and frequent use of emergency department: A systematic review. Am J Emerg Med. 2020;38(2):358-63.

20. Choinière M, Peng P, Gilron I, Buckley N, Williamson O, Janelle-Montcalm A, et al. Accessing care in multidisciplinary pain treatment facilities continues to be a challenge in Canada. Reg Anesth Pain Med. 2020;45(12):943-8.

21. Campbell M, Hudspith M, Choinière M, El-Gabalawy H, Laliberté J, Sangster M, et al. An Action Plan for Pain in Canada. Ottawa: Report by the Canadian Pain Task Force – Health Canada; 2021.

22. CIHR. How to integrate sex and gender into research Ottawa: Institute of Gender and Health, Canadian Institutes of Health Research; 2018 [Available from: http://www.cihr-irsc.gc.ca/e/50836.html.

23. Racine M, Tousignant-Laflamme Y, Kloda LA, Dion D, Dupuis G, Choiniere M. A systematic literature review of 10 years of research on sex/gender and experimental pain perception - part 1: are there really differences between women and men? Pain. 2012;153(3):602-18.

24. Bartley EJ, Fillingim RB. Sex differences in pain: a brief review of clinical and experimental findings. Br J Anaesth. 2013;111(1):52-8.

25. Fillingim RB, Gear RW. Sex differences in opioid analgesia: clinical and experimental findings. Eur J Pain. 2004;8(5):413-25.

26. Leresche L. Defining gender disparities in pain management. Clin Orthop Relat Res. 2011;469(7):1871-7.

27. Paller CJ, Campbell CM, Edwards RR, Dobs AS. Sex-based differences in pain perception and treatment. Pain Med. 2009;10(2):289-99.

28. Pieretti S, Di Giannuario A, Di Giovannandrea R, Marzoli F, Piccaro G, Minosi P, et al. Gender differences in pain and its relief. Annali dell'Istituto superiore di sanita. 2016;52(2):184-9.

29. Smitherman TA, Ward TN. Psychosocial factors of relevance to sex and gender studies in headache. Headache. 2011;51(6):923-31.

30. Hurley RW, Adams MC. Sex, gender, and pain: an overview of a complex field. Anesth Analg. 2008;107(1):309-17.

31. Samulowitz A, Gremyr I, Eriksson E, Hensing G. "Brave Men" and "Emotional Women": A Theory-Guided Literature Review on Gender Bias in Health Care and Gendered Norms towards Patients with Chronic Pain. Pain Res Manag. 2018;2018:6358624.

32. Richardson J, Holdcroft A. Gender Differences and Pain Medication. Women's Health. 2009;5(1):79-88.

33. Fillingim RB, King CD, Ribeiro-Dasilva MC, Rahim-Williams B, Riley JL, 3rd. Sex, gender, and pain: a review of recent clinical and experimental findings. J Pain. 2009;10(5):447-85.

34. Nguena Nguefack HL, Gabrielle Pagé M, Guénette L, Blais L, Diallo M, Godbout-Parent M, et al. Gender Differences in Medication Adverse Effects Experienced by People Living With Chronic Pain. Front Pain Res (Lausanne). 2022;3:830153.

35. Boerner KE, Chambers CT, Gahagan J, Keogh E, Fillingim RB, Mogil JS. Conceptual complexity of gender and its relevance to pain. Pain. 2018;159(11):2137-41.

36. Antaky E, Lalonde L, Schnitzer ME, Martin E, Berbiche J, Perreault S, et al. Identifying heavy health care users among primary care patients with chronic non-cancer pain. Canadian Journal of Pain. 2017;1(1):22-36.

37. Sagy I, Friger M, Sagy TP, Rudich Z. [Gender-based differences in the management of low back pain]. Harefuah. 2014;153(7):380-4, 434.

38. LaGrange SJ. Gender influences on help seeking among men and women with chronic pain [PhD thesis]: Indiana University; 2014.

39. Vanasse A, Chiu YM, Courteau J, Dorais M, Bartlett G, Zawaly K, et al. Cohort profile: the care trajectories—enriched data (TorSaDE) cohort. International journal of epidemiology. 2021;50(4):1066-h.

40. Statistics Canada. Canadian Community Health Survey - Annual Component (CCHS) - Detailed information for 2012. Ottawa: Statistics Canada; 2012 [Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=135927.

41. Sanmartin C, Decady Y, Trudeau R, Dasylva A, Tjepkema M, Fines P, et al. Linking the Canadian Community Health Survey and the Canadian Mortality Database: An enhanced data source for the study of mortality. Health Rep. 2016;27(12):10-8.

42. Raina P, Bonnett B, Waltner-Toews D, Woodward C, Abernathy T. How reliable are selected scales from population-based health surveys? An analysis among seniors. Can J Public Health. 1999;90(1):60-4.

43. Régie de l'assurance maladie du Québec. La Régie de l'assurance maladie du Québec 2017 [Available from: http://www.ramq.gouv.qc.ca/fr/regie/Pages/mission.aspx.

44. Régie de l'assurance maladie du Québec. Rapport annuel de gestion 2017-2018 Québec, Qc: Régie de l'assurance maladie du Québec, Gouvernement du Québec; 2018

[Available from: http://www.ramq.gouv.qc.ca/SiteCollectionDocuments/citoyens/fr/rapports/rappann1718.pdf.

45. Bouhassira D, Lanteri-Minet M, Attal N, Laurent B, Touboul C. Prevalence of chronic pain with neuropathic characteristics in the general population. Pain. 2008;136(3):380-7.

46. Boulanger A, Clark AJ, Squire P, Cui E, Horbay GL. Chronic pain in Canada: have we improved our management of chronic noncancer pain? Pain Res Manag. 2007;12(1):39-47.

47. Moulin DE, Clark AJ, Speechley M, Morley-Forster PK. Chronic pain in Canada--prevalence, treatment, impact and the role of opioid analgesia. Pain Res Manag. 2002;7(4):179-84.

48. Ramage-Morin PL, Gilmour H. Chronic pain at ages 12 to 44. Health Rep. 2010;21(4):53-61.

49. Reitsma ML, Tranmer JE, Buchanan DM, Vandenkerkhof EG. The prevalence of chronic pain and pain-related interference in the Canadian population from 1994 to 2008. Chronic diseases and injuries in Canada. 2011;31(4):157-64.

50. Gilmour H. Chronic pain, activity restriction and flourishing mental health. Health Rep. 2015;26(1):15-22.

51. Ramage-Morin PL. Chronic pain in Canadian seniors. Health Rep. 2008;19(1):37-52.

52. Hogan ME, Taddio A, Katz J, Shah V, Krahn M. Incremental health care costs for chronic pain in Ontario, Canada: a population-based matched cohort study of adolescents and adults using administrative data. Pain. 2016;157(8):1626-33.

53. Moore RA, Derry S, Taylor RS, Straube S, Phillips CJ. The costs and consequences of adequately managed chronic non-cancer pain and chronic neuropathic pain. Pain Pract. 2014;14(1):79-94.

54. Lacasse A, Pagé MG, Choinière M, Dorais M, Vissandjée B, Nguefack HLN, et al. Conducting gender-based analysis of existing databases when self-reported gender data are unavailable: the GENDER Index in a working population. Can J Public Health. 2020;111(2):155-68.

55. Jones BL, Nagin DS. Advances in Group-Based Trajectory Modeling and an SAS Procedure for Estimating Them. Sociological Methods & Research. 2007;35(4):542-71.

56. Nagin DS, Odgers C. Group-Based Trajectory Modeling in Clinical Research. Annual review of clinical psychology. 2010;6:109-38.

57. Jones BL, Nagin DS, Roeder K. A SAS Procedure Based on Mixture Models for Estimating Developmental Trajectories. Sociological Methods&Reserch. 2001;29(3):374-93.

58. Nagin DS. Analyzing Developmental Trajectories: A Semiparametric, Group-Based Approach. Psychological Methods. 1999;4(2):139-57.

59. Nguena Nguefack HL, Pagé MG, Katz J, Choinière M, Vanasse A, Dorais M, et al. Trajectory modelling techniques useful to epidemiological research: a comparative narrative review of approaches. Clinical epidemiology. 2020;12:1205.

60. Johnson JL, Greaves L, Repta R. Better science with sex and gender: Facilitating the use of a sex and gender-based analysis in health research. International journal for equity in health. 2009;8(14):1-11.

61. Bekker MHJ. Investigating gender within health research is more than sex disaggregation of data: A Multi-Facet Gender and Health Model. Psychology, Health & Medicine. 2003;8(2):231-43.

62. Simard M, Sirois C, Candas B. Validation of the Combined Comorbidity Index of Charlson and Elixhauser to Predict 30-Day Mortality Across ICD-9 and ICD-10. Med Care. 2018;56(5):441-7.

63. Heidari S, Babor TF, De Castro P, Tort S, Curno M. Sex and Gender Equity in Research: rationale for the SAGER guidelines and recommended use. Res Integr Peer Rev. 2016;1:2.

64. Canadian Institutes of Health Research. Online Training Modules: Integrating Sex & Gender in Health Research - Sex and Gender in the Analysis of Data from Human Participants Ottawa: Canadian Institutes of Health Research (CIHR); 2017 [Available from: http://www.cihr-irsc.gc.ca/e/49347.html.

65. Mena E, Bolte G, Bolte G, Mena E, Rommel A, Saß A-C, et al. Intersectionality-based quantitative health research and sex/gender sensitivity: a scoping review. International journal for equity in health. 2019;18(1):199.

66. Bauer G. Meet the Methods Series: Quantitative intersectional study design and primary data collection, Issue 3 Part 1. Canadian Institutes of Health Research; 2021.

67. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? Journal of health and social behavior. 1995;36(1):1-10.

68. Babitsch B, Gohl D, von Lengerke T. Re-revisiting Andersen's Behavioral Model of Health Services Use: a systematic review of studies from 1998-2011. Psycho-social medicine. 2012;9:Doc11.

69. Nguena Nguefack HL, Pagé MG, Choinière M, Vanasse A, Deslauriers S, Angarita-Fonseca A, et al. Distinct care trajectories among persons living with arthritic conditions: A two-year state sequence analysis. Frontiers in Pain Research. 2022;3.

70. Vatcheva KP, Lee M, McCormick JB, Rahbar MH. Multicollinearity in Regression Analyses Conducted in Epidemiologic Studies. Epidemiology (Sunnyvale). 2016;6(2):227.

71. Pilote L, Humphries KH. Incorporating sex and gender in cardiovascular research: the time has come. Can J Cardiol. 2014;30(7):699-702.

72. Tannenbaum C, Ellis RP, Eyssel F, Zou J, Schiebinger L. Sex and gender analysis improves science and engineering. Nature. 2019;575(7781):137-46.

73. Tannenbaum C, Clow B, Haworth-Brockman M, Voss P. Sex and gender considerations in Canadian clinical practice guidelines: a systematic review. CMAJ Open. 2017;5(1):E66.

74. Thompson AE, Anisimowicz Y, Miedema B, Hogg W, Wodchis WP, Aubrey-Bassler K. The influence of gender and other patient characteristics on health care-seeking behaviour: a QUALICOPC study. BMC family practice. 2016;17(1):38.

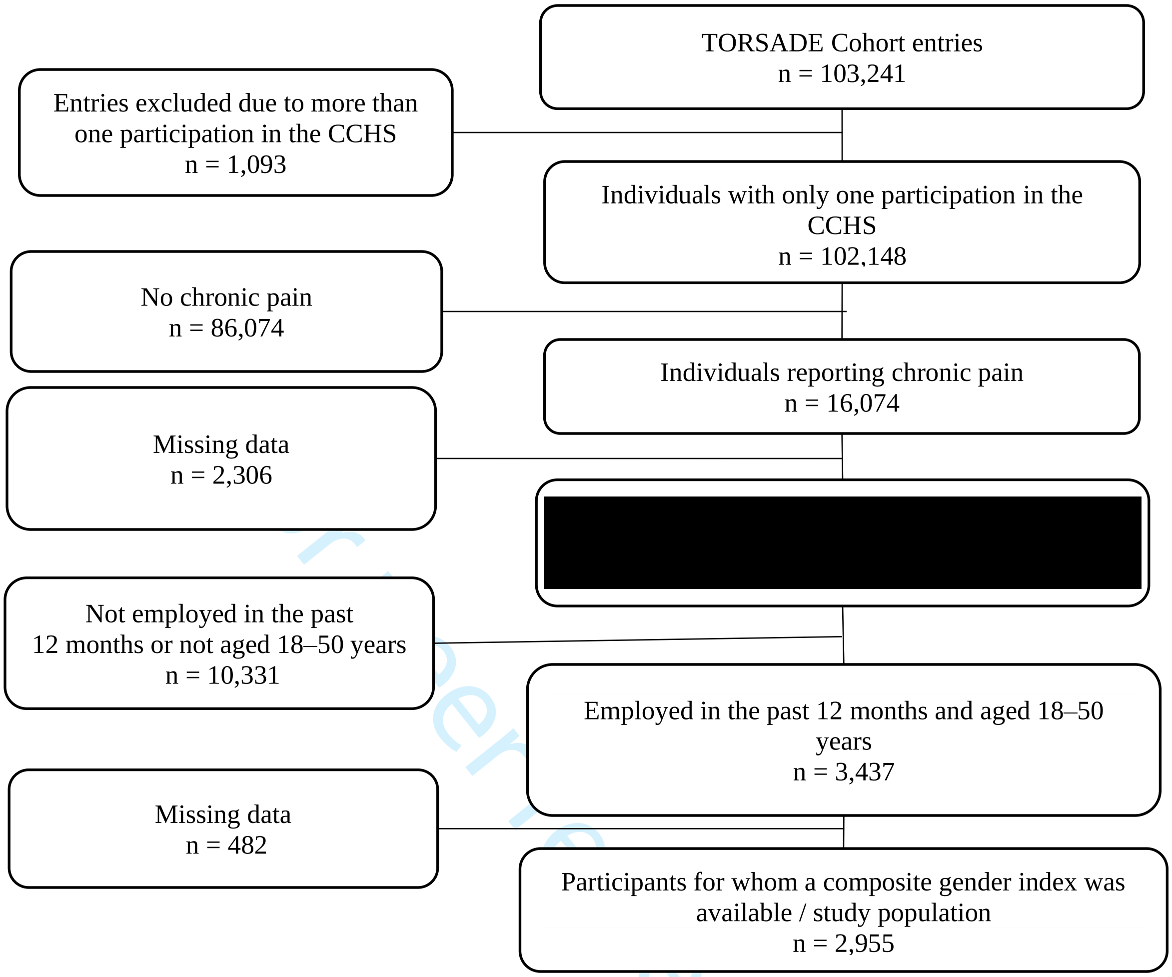
75. Rasu RS, Bawa WA, Suminski R, Snella K, Warady B. Health Literacy Impact on National Healthcare Utilization and Expenditure. Int J Health Policy Manag. 2015;4(11):747-55.

76. Meghani SH, Gallagher RM. Disparity vs Inequity: Toward Reconceptualization of Pain Treatment Disparities. Pain Medicine. 2008;9(5):613-23.

77. Arcaya MC, Arcaya AL, Subramanian SV. Inequalities in health: definitions, concepts, and theories. Global health action. 2015;8(1):27106.

78. Lacasse A, Cauvier Charest E, Dault R, Cloutier A-M, Choinière M, Blais L, et al. Validity of Algorithms for Identification of Individuals Suffering from Chronic Noncancer Pain in Administrative Databases: A Systematic Review. Pain Medicine. 2020;21(9):1825-39.

79. Lacasse A, Ware MA, Dorais M, Lanctot H, Choiniere M. Is the Quebec provincial administrative database a valid source for research on chronic non-cancer pain? Pharmacoepidemiol Drug Saf. 2015;24(9):980-90.


TORSADE Cohort entries
n = 103,241
Entries excluded due to more than one participation in the CCHS
n = 1,093
Individuals with only one participation in the CCHS
n = 102,148
No chronic pain
n = 86,074
Individuals reporting chronic pain
n = 16,074
Missing data
n = 2,306
[redacted]
Not employed in the past 12 months or not aged 18–50 years
n = 10,331
Employed in the past 12 months and aged 18–50 years
n = 3,437
Missing data
n = 482
Participants for whom a composite gender index was available / study population
n = 2,955

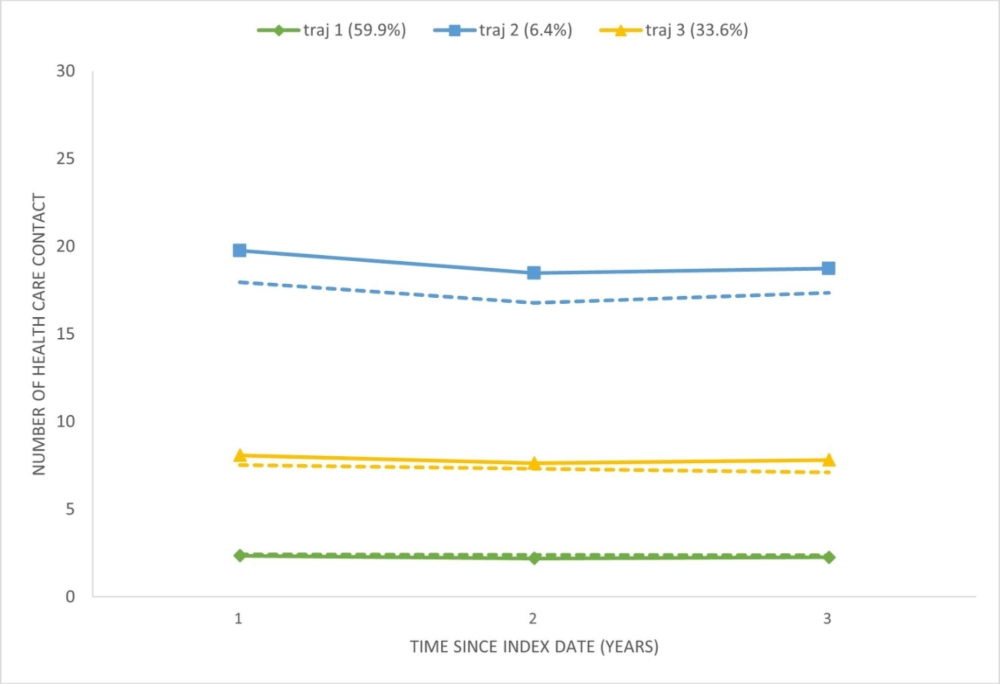


Figure 2. Health care utilization trajectories in the whole study sample.
Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

168x115mm (300 x 300 DPI)

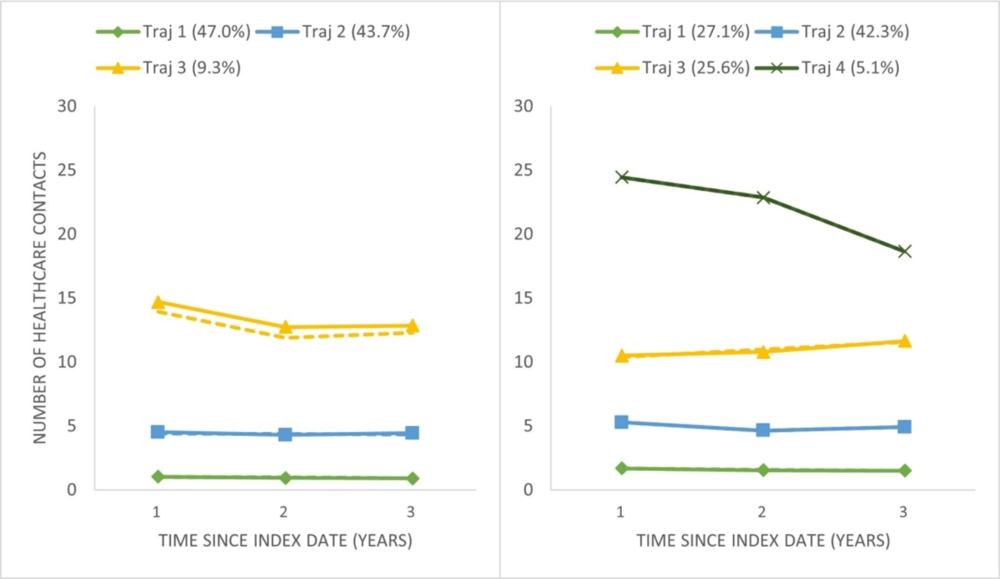


Figure 3. Health care utilization trajectories in males (left) and females (right).
Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

164x95mm (300 x 300 DPI)

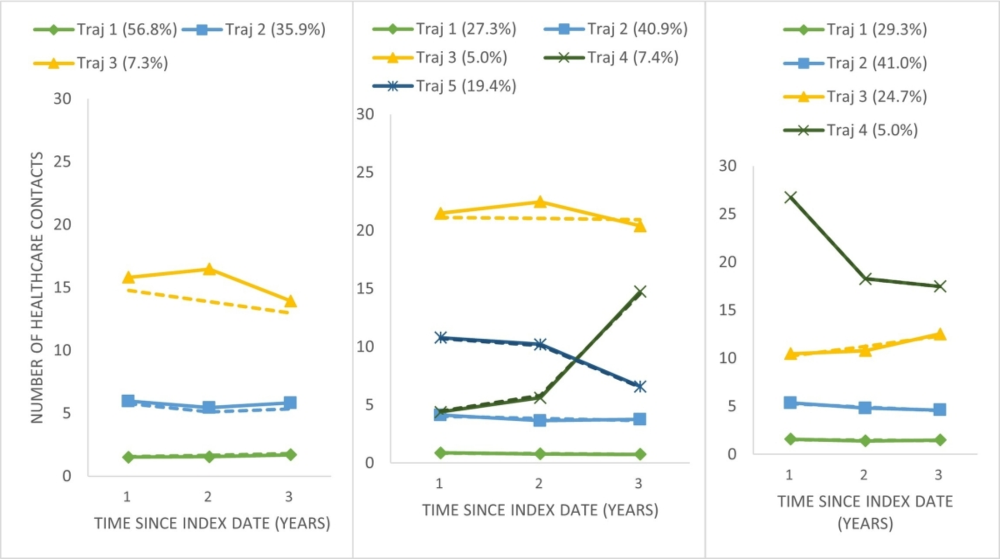


Figure 4. Health care utilization trajectories in first (left), second (center) and third (right) tertiles of gender index.
Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

176x98mm (300 x 300 DPI)

SUPPLEMENTARY MATERIAL

Trajectory modelling approach

The goal was to model the number of health care contacts per participant per year, and to group participants showing similar patterns of health care visits over time to better capture the intra- and inter-individual heterogeneity of health care utilization.

1. Choosing of a trajectory modelling approach

Considering the health care utilization data used in this study were count data, particularly zero-inflated Poisson (ZIP) data, a group-based trajectory modelling (GBTM) approach (Jones & Nagin, 2007; Jones et al., 2001; Nagin, 1999; Nagin & Odgers, 2010; Nguena Nguefack et al., 2020) was chosen over latent transition analysis (LTA) which mainly handles categorical data, or growth mixture modelling (GMM) which is more suitable for continuous data (Lanza & Cooper, 2016; Muthén, 2004). GBTM is a finite mixture modelling that involves a procedure that gathers individuals into meaningful subgroups that show statistically similar trajectories. Thus, it allows for the possibility of distinct sub-groups within a population and it allows the trajectories to emerge from the data itself (Collins et al., 2014; Jiang, 2015). This offers an alternative to the limitations of using assignment rules based on inherently subjective categorization criteria. The model determines the form and number of groups that best fit the data, and it provides a metric for evaluating the precision of group assignments (Nagin, 1999). GBTM predicts the trajectory of each group and the form of each trajectory, estimates the probability for each individual of group membership (posterior probability), and assigns them to the group for which they have the highest probability to belong (Jones et al., 2001; Nagin, 1999). The SAS® Proc Traj (version 9.4, Cary, NC, USA) was used to perform GBTM. This procedure can be downloaded for free from B. Jones' website (https://www.andrew.cmu.edu/user/bjones/). The full description of the different steps to perform GBTM, as well as the other trajectory modelling approaches can be found elsewhere (Nguena Nguefack et al., 2020).

2. Data preparation

For each participant, the number of health care contacts per year was calculated using administrative data. To work around the convergence problems induced by outliers, the number of health care contacts was set at 50 for any value greater than 50 (applied only for four individuals). The number of health care contacts at three time points (1, 2 and 3 years after completion of CCHS questionnaire) were used to estimate health care trajectories.

3. Choosing the right number of trajectories

Once the GBTM program was applied, the Bayesian information criterion (BIC) was used to select the optimal model (1, 2, 3, 4 or more trajectory groups and different curve possibilities) (Nagin & Odgers, 2010; Schwarz, 1978). The BIC is a measure of the fit of the model that is calculated based on the likelihood of the model and the number of estimated parameters. It favours models that are more parsimonious as compared to the Akaike information criterion (AIC). The model with the lower value (absolute value) of BIC is preferred. The optimal number of trajectories was also chosen to have adequate numbers of participants in each group (at least 5%) (Nagin & Odgers, 2010). The following pages shows the model fit indices used to select the optimal models for the whole study sample and for the various subgroups defined by sex and the GENDER Index tertiles.

4. Trajectories' interpretation

Once the optimal number of trajectories was identified, graphs of observed vs. estimated number of healthcare contacts over time were created and qualitative/clinical descriptors were chosen to describe each trajectory.

Model fit indices tables

Table legend:

[1] 1 = linear (straight line); 2 = linear + quadratic (u-shaped curve/parabola) components

[2] AIC : Akaike information criterion

[3] BIC : Bayesian information criterion

[*] One or more groups in the model had less than 5% of participants

Bold text: Model which best fits the data and respected all criteria (lowest BIC absolute value among trajectory groups that respected the 5% criteria)

Model fit indices for the number of health care utilization trajectories in the whole study sample

Number of trajectories	Trajectory shape [1]	AIC [2] (n=2955)	BIC [3] (n=2955)
1	1	-34331.89	-34343.87
1	2	-34325.65	-34340.63
2	11	-27348.28	-27369.24
2	12	-27345.23	-27369.20
2	21	-27343.57	-27367.53
2	22	-27341.49	-27368.45
3	111	-25943.74	-25973.70
3	112	-25939.86	-25972.81
3	**121**	**-25907.72**	**-25940.67**
3	211	-25943.17	-25976.12
3	122	-25935.23	-25971.17
3	212	-25939.40	-25975.35
3	221	-25937.51	-25973.45
3	222	-25935.29	-25974.23
4	1111*	-25055.74	-25094.68
4	1112*	-25056.73	-25098.67
4	1121*	-25048.88	-25090.82
4	1211*	-25050.08	-25092.02
4	2111*	-25054.82	-25096.76
4	1212*	-25051.08	-25096.01

4	1221*	-25045.90	-25090.83
4	2121*	-25048.00	-25092.93
4	2112*	-25055.81	-25100.75
4	2211*	-25049.80	-25094.74
4	1222*	-25046.59	-25094.52
4	2122*	- 25048.58	-25096.51
4	2212*	-25050.80	-25098.73
4	2221*	- 25045.51	-25093.44
4	2222*	-25046.21	-25097.13

Model fit indices for the number of health care utilization trajectories in males

Number of trajectories	Trajectory shape [1]	AIC [2] (n=1296)	BIC [3] (n=1296)
1	2	-12506.94	-12519.86
2	11	-10297.80	-10315.89
2	12	-10294.35	-10315.01
2	21	-10298.36	-10319.03
2	22	-10295.09	-10318.34
3	111	-9750.51	-9776.35
3	**112**	**-9747.67**	**-9776.09**
3	121	-9749.53	-9777.95
3	211	-9751.31	-9779.72
3	122	-9747.72	-9778.72
3	212	-9748.44	-9779.44
3	221	-9750.42	-9781.42
3	222	-9748.56	-9782.15
4	2211*	-9425.41	-9464.17
4	1222*	-9421.26	-9462.59
4	2122*	-9420.97	-9462.30
4	2212*	-9425.63	-9466.97
4	2221*	-9421.04	-9462.38
4	2222*	-9421.86	-9465.78
5	22222*	-9283.21	-9337.46

Model fit indices for the number of health care utilization trajectories in females

Number of trajectories	Trajectory shape [1]	AIC [2] (n=1659)	BIC [3] (n=1659)
1	2	-22287.79	-22293.20
2	11	-16914.21	-16927.74
2	12	-16914.87	-16931.11
2	21	-16914.87	-16931.11
2	22	-16907.86	-16926.81
3	111	-15867.18	-15888.84
3	**112**	-15867.87	-15892.23
3	121	-15865.80	-15890.16
3	211	-15864.21	-15888.58

3	122	-15866.73	-15893.80
3	212	-15866.73	-15893.80
3	221	-15863.69	-15890.76
3	222	-15864.60	-15894.38
4	1111	-15422.88	-15452.66
4	1112*	-15421.61	-15454.09
4	1121*	-15420.75	-15453.23
4	1211	-15440.30	-15472.79
4	2111	-15445.74	-15478.23
4	2211	-15417.90	-15453.09
4	2121	-15489.51	-15524.70
4	1221	-15417.48	-15452.67
4	**1212**	**-15416.10**	**-15451.29**
4	1222*	-15415.55	-15453.44
4	2122*	-15417.76	-15455.65
4	2212*	-15417.76	-15455.65
4	2221	-15417.92	-15455.82
4	2222*	-15415.93	-15456.54

Model fit indices for the number of health care utilization trajectories in GENDER Index tertile #1

Number of trajectories	**Trajectory shape ^{1}**	**AIC^2 (n=984)**	**BIC ^{3} (n=984)**
1	2	-10083.57	-10095.80
2	11	-8300.65	-8317.77
2	12	-8301.25	-8320.81
2	21	-8301.58	-8321.15
2	22	-8302.20	-8324.22
3	111	-7938.86	-7963.32
3	112	-7939.18	-7966.08
3	**121**	**-7936.17**	**-7963.07**
3	211	-7938.86	-7965.77
3	122	-7934.77	-7964.12
3	212	-7939.20	-7968.55
3	221	-7936.74	-7966.09
3	222	-7935.63	-7967.42
4	1111*	-7703.13	-7734.93
4	2111*	-7702.98	-7737.22
4	1211*	-7703.37	-7737.61
4	1121*	-7703.82	-7738.06
4	1112*	-7704.12	-7738.36
4	2211*	-7703.38	-7740.07
4	2121*	-7703.66	-7740.35
4	1212*	-7704.36	-7741.04
4	1221*	-7704.19	-7740.88
4	1222*	-7705.19	-7744.32

4	2122*	-7704.66	-7743.79
4	2212*	-7704.37	-7743.50
4	2221*	-7704.19	-7743.32
4	2222*	-7705.18	-7746.76

Model fit indices for the number of health care utilization trajectories in GENDER Index tertile #2

Number of trajectories	Trajectory shape [1]	AIC [2] (n=986)	BIC [3] (n=986)
1	2	-11545.63	-11557.87
2	11	-9206.04	-9223.16
2	12	-9201.35	-9220.93
2	21	-9201.35	-9220.93
2	22	-9198.26	-9220.28
3	111	-8617.12	-8641.59
3	112	-8618.10	-8645.01
3	121	-8618.11	-8645.02
3	211	-8617.81	-8644.73
3	122	-8619.09	-8648.45
3	212	-8618.79	-8648.15
3	221	-8618.81	-8648.17
3	222	-8619.79	-8651.60
4	1111	-8325.28	-8357.09
4	2111	-8326.02	-8360.28
4	1211	-8318.29	-8352.54
4	1121	-8323.46	-8357.72
4	1112	-8325.34	-8359.60
4	2211	-8319.21	-8355.92
4	2121	-8324.16	-8360.86
4	2112	-8326.09	-8362.79
4	1221	-8312.73	-8349.43
4	1212	-8318.35	-8355.05
4	1122	-8324.26	-8360.96
4	1222	-8313.65	-8352.80
4	2122	-8324.96	-8364.11
4	2212	-8319.28	-8358.42
4	2221	-8313.66	-8352.81
4	2222	-8314.59	-8356.18
5	11111*	-8154.15	-8195.75
5	11222	-8139.19	-8185.68
5	12212	-8151.35	-8197.84
5	12221*	-8136.98	-8183.47
5	21221*	-8143.25	-8189.74
5	22121*	-8143.25	-8189.74
5	22211*	-8323.21	-8369.70
5	21122	-8141.07	-8187.56

5	22112	-8153.23	-8199.72
5	22111*	-8155.14	-8199.19
5	21211*	-8330.02	-8374.06
5	21121*	-8146.94	-8190.98
5	21112*	-8155.00	-8199.05
5	12112	-8152.39	-8196.43
5	11212*	-8152.64	-8196.68
5	**11122**	**-8140.22**	**-8184.26**
5	12211*	-8322.29	-8366.33
5	11221*	-8142.29	-8186.34
5	21111*	-8156.61	-8198.21
5	12111*	-8154.21	-8195.80
5	11211*	-8329.28	-8370.88
5	11121*	-8146.08	-8187.68
5	11112*	-8154.15	-8195.75
5	12222	-8136.02	-8184.96
5	21222	-8140.04	-8188.98
5	22122*	-8142.45	-8191.39
5	22212	-8152.27	-8201.21
5	22221*	-8137.94	-8186.88
5	22222	-8136.98	-8188.36

Model fit indices for the number of health care utilization trajectories in GENDER Index tertile #3

Number of trajectories	**Trajectory shape [1]**	**AIC [2] (n=985)**	**BIC [3] (n=985)**
1	2	-13215.39	-13222.73
2	11	-9830.89	-9843.13
2	12	-9817.74	-9832.41
2	21	-9831.27	-9845.95
2	22	-9818.50	-9835.63
3	111	-9269.62	-9289.19
3	112	-9261.57	-9283.59
3	121	-9264.52	-9286.54
3	211	-9270.19	-9292.21
3	122	-9258.96	-9283.42
3	212	-9262.08	-9286.55
3	221	-9265.52	-9289.98
3	222	-9259.93	-9286.84
4	1111*	-8981.82	-9008.73
4	2111*	-8981.22	-9010.58
4	1211*	-8981.22	-9010.58
4	1121*	-8968.20	-8997.56
4	**1112**	**-8980.34**	**-9009.69**
4	2211*	-8981.73	-9013.53
4	2121*	-8967.54	-8999.34

4	2112*	-8969.19	-9000.99
4	1221*	-8969.13	-9000.93
4	1212*	-8980.36	-9012.16
4	1122*	-8969.19	-9000.99
4	1222*	-8970.12	-9004.36
4	2122*	-8968.53	-9002.78
4	2212*	-8980.24	-9014.49
4	2221*	-8968.54	-9002.79
4	2222*	-8969.53	-9006.22

Supplementary material references

Collins, J. E., Katz, J. N., Dervan, E. E., & Losina, E. (2014). Trajectories and Risk Profiles of Pain in Persons with Radiographic, Symptomatic Knee Osteoarthritis: Data from the Osteoarthritis Initiative. *Osteoarthritis Cartilage, 22*(5), 622–630. https://doi.org/doi:10.1016/j.joca.2014.03.009.

Jiang, J. (2015). *Group-based trajectory modeling for longitudinal data of healthcare financial charges in patients with inflammatory bowel disease* University of Pittsburgh]. Graduate School of Public Health. http://d-scholarship.pitt.edu/25293/1/JJIANG_MS_ETD_061715V6-1.pdf

Jones, B. L., & Nagin, D. S. (2007). Advances in Group-Based Trajectory Modeling and an SAS Procedure for Estimating Them. *Sociological Methods & Research, 35*(4), 542-571. https://doi.org/10.1177/0049124106292364

Jones, B. L., Nagin, D. S., & Roeder, K. (2001). A SAS Procedure Based on Mixture Models for Estimating Developmental Trajectories. *Sociological Methods&Reserch, 29*(3), 374-393.

Lanza, S. T., & Cooper, B. R. (2016). Latent Class Analysis for Developmental Research. *The Society for Research in Child Development, 10*(1), 59–64. https://doi.org/10.1111/cdep.12163

Muthén, B. (2004). Latent variable analysis: Growth mixture modeling and related techniques for longitudinal data. In D. Kaplan (Ed.), *Handbook of quantitative methodology for the social sciences* (pp. 345-368). CA: Sage. https://doi.org/http://dx.doi.org/10.4135/9781412986311.n19

Nagin, D. S. (1999). Analyzing Developmental Trajectories: A Semiparametric, Group-Based Approach. *Psychological Methods, 4*(2), 139-157.

Nagin, D. S., & Odgers, C. (2010, 4 January 2010). Group-Based Trajectory Modeling in Clinical Research. *Annu Rev Clin Psychol, 6*, 109-138. https://doi.org/10.1146/annurev.clinpsy.121208.131413

Nguena Nguefack, H. L., Pagé, M. G., Katz, J., Choinière, M., Vanasse, A., Dorais, M., Samb, O. M., & Lacasse, A. (2020). Trajectory modelling techniques useful to epidemiological research: a comparative narrative review of approaches. *Clin Epidemiol*, *12*, 1205.

Schwarz, G. (1978). Estimating the Dimension of a Model. *The annals of statistics*, *6*(2), 461-464.

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study’s design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	#3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	#4	Present key elements of study design early in the paper	7
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up.	8
Eligibility criteria	#6b	For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-11
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than	9-11

		one group. Give information separately for for exposed and unexposed groups if applicable.	
Bias	#9	Describe any efforts to address potential sources of bias	11, 15-16
Study size	#10	Explain how the study size was arrived at	8
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	11-12
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	
11-12			
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	11-12
Statistical methods	#12c	Explain how missing data were addressed	12
Statistical methods	#12d	If applicable, explain how loss to follow-up was addressed	NA
Statistical methods	#12e	Describe any sensitivity analyses	
NA			

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	12, Fig 1
Participants	#13b	Give reasons for non-participation at each stage	NA
Participants	#13c	Consider use of a flow diagram	
Fig 1			
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	12, Table 1
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	
Table 1 footnote			
Descriptive data	#14c	Summarise follow-up time (eg, average and total amount)	
NA			
Outcome data	#15	Report numbers of outcome events or summary measures over time. Give information separately for exposed and unexposed groups if applicable.	
13-17			

Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13-17, Table 2
Main results	#16b	Report category boundaries when continuous variables were categorized	Tables 1-2
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
NA			
Other analyses	#17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	15
Discussion			
Key results	#18	Summarise key results with reference to study objectives	18
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	19-20
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	18-21
Generalisability	#21	Discuss the generalisability (external validity) of the study results	19-20
Other Information			

Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

Notes:

- 14a: Table 1
- 14b: Table 1 footnote
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BMJ Open

Sex and gender differences in health care utilization trajectories: A cohort study among Quebec workers living with chronic pain

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-070509.R1
Article Type:	Original research
Date Submitted by the Author:	03-Jul-2023
Complete List of Authors:	Lacasse, Anaïs; Université du Québec en Abitibi-Témiscamingue, Department of Health Sciences Nguena Nguefack, Hermine Lore; Université du Québec en Abitibi-Témiscamingue, Department of Health Sciences Page, G; Centre Hospitalier de l'Universite de Montreal, Centre de recherche; Université de Montréal, Department of Anesthesiology and Pain Medicine Choinière, Manon; Centre Hospitalier de l'Universite de Montreal, Centre de recherche; Université de Montréal, Department of Anesthesiology and Pain Medicine Samb, Oumar ; Université du Québec en Abitibi-Témiscamingue, Department of Health Sciences Katz, Joel; York University, Department of Psychology Ménard, Nancy; Université du Québec en Abitibi-Témiscamingue, Chronic Pain Epidemiology Laboratory Vissandjée, Bilkis; Université de Montréal, Faculty of Nursing; Université de Montréal, Public Health Research Institute Zerriouh, Meriem; Université du Québec en Abitibi-Témiscamingue, Department of Health Sciences on behalf of the TorSaDE Cohort Working , .; Université du Québec en Abitibi-Témiscamingue
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Epidemiology, Health services research
Keywords:	EPIDEMIOLOGY, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PAIN MANAGEMENT, Sexual and gender disorders < PSYCHIATRY, STATISTICS & RESEARCH METHODS

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TITLE PAGE

Sex and gender differences in health care utilization trajectories: A cohort study among Quebec workers living with chronic pain

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Keywords: sex, gender, chronic pain, health care, trajectories, group-based trajectory modelling

Word count: 3,524
Number of tables: 1
Number of figures: 4

ABSTRACT

Objectives: Chronic pain is a poorly recognized and frequently inadequately treated condition affecting 1 in 5 adults. Reflecting on sociodemographic disparities as barriers to chronic pain (CP) care in Canada was recently established as a federal priority. The objective of this study was to assess sex and gender differences in health care utilization trajectories among workers living with CP. **Design:** Retrospective cohort study. **Participants:** This study was conducted using the TorSaDE Cohort which links the 2007-2016 Canadian Community Health Surveys and Quebec administrative databases (longitudinal claims). Among 2,955 workers living with CP, the annual number of health care contacts was computed during the three years after survey completion. **Outcome:** Group-based trajectory modelling (GBTM) was used to identify subgroups of individuals with similar patterns of health care utilization over time (health care utilization trajectories). **Results:** Across the study population, three distinct three-year health care utilization trajectories were found: (1) low health care users (59.9%), (2) moderate health care users (33.6%), and (3) heavy health care users (6.4%). Sex and gender differences were found in the number of distinct trajectories and the stability of the number of health care contacts over time. Multivariable analysis revealed that independent of other sociodemographic characteristics and severity of health condition, sex—but not gender—was associated with the heavy health care utilization longitudinal trajectory (with females showing a greater likelihood; OR: 2.6, 95%CI: 1.6-4.1). **Conclusions:** Our results underline the importance of assessing sex-based disparities in help-seeking behaviours, access to health care, and resource utilization among persons living with CP.

Strengths and limitations of the study

- Health care trajectories were modelled using group-based trajectory modelling, an objective and person-centred statistical approach.
- Use of an exhaustive database harnessing the strengths of longitudinal claim data linked to patient-reported outcomes
- The analysis was conducted in a community sample and included people with little or no contact with the health care system, which increases the external validity of the results.
- A gender measure was only available among participants having worked in the past year.
- Medical claims do not allow reliable identification of CP-related health care contacts/visit. All-cause health care visits were thus studied.

INTRODUCTION

Defined as persistent or recurrent pain lasting over three months (1), chronic pain (CP) affects 23% of females and 16% of males in Canada (2), seriously impacting physical functioning, emotional well-being and quality of life (3-8). It also constitutes a significant economic burden for patients, the health care system and third-party payers (9-11). In Canada, direct health care costs and loss of productivity due to CP amount to $38.3-40.4 billion per year (12). This number was estimated to reach $560-635 billion in the United States, exceeding the societal cost of heart disease, diabetes or cancer (13). Despite decades of research on CP and its treatment, the management of this condition remains suboptimal. Indeed, CP is characterized as poorly recognized, underdiagnosed, and inadequately treated (12, 14-17). CP should be managed in the primary care setting (family physicians, pharmacists, nurses) and more complex cases referred to multidisciplinary pain clinics in the secondary and tertiary care sectors before being redirected to community-based services. Unfortunately, the current situation does not reflect such trajectories. In the universal health care coverage context of Canada for example, major shortcomings persist and render the health care system inefficient, such as numerous gaps in primary care CP management (14), too many patients ending up in the emergency room (a setting that is not conducive to the management of CP) (18, 19), ill-equipped health care professionals (14), insufficient access to pain clinics due to a lack of resources, long waiting lists or the absence of such clinics in certain regions (20), and the absence of a measurement culture that makes it difficult to quantify the impact of our interventions (need for outcome measures and descriptors that are standardized from one care setting to another (21)).

Implementing favorable health care trajectories for CP, from primary care to multidisciplinary specialized care teams, and reversing sociodemographic disparities as barriers to CP care are priorities emanating from consultations conducted among patients and stakeholders (12).

One may wonder if women, men and gender-diverse people living with CP share similar health care utilization. Sex can be defined as a set of biological attributes associated with physical and physiological features (22). It has intrigued pain researchers for decades; differences between males and females are found in pain sensitivity, CP prevalence, medication use, response to treatment, drug side effects, pain beliefs, and attitudes toward people living with CP (16, 23-34). Conversely, gender refers to socially constructed roles, behaviours, expressions and identities (22). Although equally important, it is a complex and challenging construct to measure that is often overlooked (35). Without proper measurement and consideration of gender, it is unclear the extent to which sex differences are explained by biological factors or indirect measurement of social factors.

While sex differences have been found in health care utilization among people living with CP (36, 37), few has considered gender in their analysis (38) or explored how sex and gender intersect with regard to health care utilization. Furthermore, to our knowledge, none has delved into the related patterns of health care utilization over time (trajectories). A better understanding of the determinants of health care utilization has the potential to guide the prevention of adverse trajectories and reduction of pain inequities. This study thus aimed to examine sex and gender differences in health care utilization trajectories.

METHODS

Data source

This retrospective cohort study was conducted using data from the TorSaDE Cohort (39). This cohort of 102,148 participants links five cycles of Statistics Canada's Canadian Community Health Survey (CCHS; 2007-2008, 2009-2010, 2011-2012, 2013-2014 and 2015-2016 cross-sectional questionnaires) and Quebec administrative databases (1996 to 2016 longitudinal health insurance claims). ***Canadian Community Health Survey.*** Statistics Canada's CCHS is designed to collect health data on a representative sample of Canadians aged 12 years and older (probability sampling) (40). Not included are on-reserve Indigenous people, full-time members of the Canadian Armed Forces, institutionalized individuals, or persons living in the Quebec regions of Nunavik and Terres-Cries-de-la-Baie-James (altogether <3% of Canadians). Standardized questionnaires are used and data quality is maximized through a variety of methods, including rigorous interviewer training and various control measures (40). Response rates are high (69.8-78.9%, depending on cycles (41)) and the test-retest reliability of responses to several questions has been demonstrated (42). As part of the CCHS, participants give informed consent to Statistics Canada allowing the provinces to link their responses to provincial administrative databases. ***Quebec administrative databases.*** The Régie de l'assurance maladie du Québec (RAMQ) administers the provincial universal health insurance (43), which covers the cost of medical visits, emergency department visits, hospitalizations and medical procedures for all Quebec residents (44). The TorSaDE Cohort, whose implementation is detailed elsewhere (39), is unique in Canada and contains a rich set of sociodemographic variables not included in administrative databases when used alone for health care service research.

Access and ethics. De-identified TorSaDE Cohort data was accessed through the *Institut de la statistique du Québec* (ISQ) secure virtual server (data holder). Ethical approval was obtained from the *Commission d'accès à l'information du Québec* (#1013990) and relevant university Research Ethics Boards (Université du Québec en Abitibi-Témiscamingue: # 2018-02 – Lacasse, A.; Centre hospitalier universitaire de Sherbrooke (CHUS): #2017-1504). ***Patient and public involvement***. In this study, a person with lived experience of CP (NM) was involved in the grant application, formulation of research objectives, and interpretation of results.

Selection criteria and study population

The TorSaDE Cohort includes 102,148 participants who completed 103,241 entries (participants could take part in more than one CCHS cycle). As shown in **Figure 1**, our study sample, of 2,955 individuals, was created using four criteria: (**1**) For participants with more than one CCHS entry, only the most recent entry was retained. (**2**) Participants reporting CP (having answered "No" to the CCHS question "*Are you usually free of pain or discomfort?*"). While this definition may differ from commonly used definitions of chronicity based on the duration of symptoms (1, 45-47), it has been used in many CP epidemiology studies (2, 8, 48-52) and provides prevalence estimates comparable to studies using more traditional definitions (53). (**3**) Participants with complete longitudinal health insurance information for three years following CCHS completion (since longitudinal administrative data are available in the TorSaDE Cohort up until 2016, participants of the 2015-2016 CCHS cycle were not included). And (**4**) Participants for whom a composite gender index (54) was available. In the TorSaDE Cohort, a gender measure (see Study variables section) is only available among participants having worked in the past year (all types of occupations taken together) and for whom work variables were measured by Statistics Canada (participants aged 18 to 50 years). For this reason, the present study is centred on workers only.

Study variables

Health care utilization trajectories. Using administrative data, all hospitalizations, physician visits, and emergency department visits were considered. The number of health care contacts per participant per year was modelled into three-year health care utilization trajectories using group-based trajectory modelling (GBTM), a statistical approach to grouping participants with similar patterns of outcomes over time (55-59) (see full description in Supplemental Content #1). Trajectory group membership was then used as a categorical dependent variable.

Sex and gender. Sex and gender were the independent variables of interest. In the 2007-2016 CCHS cross-sectional questionnaires, sex was measured as a self-reported dichotomous variable (male vs. female). Gender was not directly available in the CCHS questionnaire, but measured using a composite index previously developed by our group using gender-related CCHS variables, namely the GENDER Index (54). Higher scores on the 0-100 index represent more feminine characteristics. Face and construct validity of the GENDER Index scores were demonstrated in the TorSaDE Cohort population (54). When looking at the distribution of GENDER Index scores in males and females in the TorSaDE Cohort, sex and GENDER Index scores appeared related but partly independent (e.g., incomplete histogram overlap, variability of gender scores within each sex group) (54). The index was deemed multidimensional and includes variables related to various gender constructs such as gender identity (how individuals see themselves—e.g., man, woman, non-binary, two-spirited), gender roles (behavioural norms applied to males and females that influence everyday actions, expectations and experiences), gender relationships (how individuals interact with and are treated by others based on their ascribed gender) and institutionalized gender (distribution of power between men and women in societal institutions) (60). As underlined, work-related variables appeared to be paramount in the development of our gender measure (conceptually [(60, 61)] and based on the iterative statistical analysis [(54)]). Thus, the gender index could only be calculated among 18 to 50-year-old participants who reported having worked in the past year in the CCHS and for whom work variables were measured by Statistics Canada (**Figure 1**).

Covariables. CCHS data enabled consideration of the following self-reported variables: socioeconomic factors, pain intensity (mild/moderate/severe), pain interference (none/a few/some/most activities prevented), self-reported back pain (except fibromyalgia and arthritis), self-reported arthritis (except fibromyalgia), perceived general health (excellent/very good/good/fair/poor), alcohol consumption in the past year, smoking, physical activity (regular/occasional, rare), lifestyle (active/moderately active/inactive, according to Statistics Canada's index of physical activity), and reporting having a regular physician. Further, the following was derived from administrative data: public prescription drug insurance status at time of CCHS completion (about 45% of the Quebec population is covered: people who are not eligible for private drug insurance with their employer or their spouse's employer, who are ≥65 years old, or who receive last-resort financial assistance (44)), combined Charlson comorbidity index and Elixhauser comorbidity index (62) calculated in the year before CCHS completion (accounting for various non-pain comorbidities that can show sex-differences), and use of a pain clinic (medical claims associated with a pain clinic establishment code [4X1] or professional activities billed for services rendered in a pain clinic [anesthesia services coded 41055, 41056, 41057, 41058 and 41059]).

Statistical analysis

A sex- and gender-based analysis was conducted (63-65), including stratified statistics, statistical significance of sex, gender and their interaction term in multivariable models, and reporting of negative findings (statistically nonsignificant results). First, the characteristics of the whole study population were summarized using descriptive statistics. As mentioned earlier, GBTM was applied to model three-year health care utilization trajectories and classify participants into trajectory groups (Supplemental Content #1). This analysis was conducted for the whole study sample, and then repeated among the following strata to assess sex and gender differences in the number and patterns of health care utilization trajectories: males, females, and three strata formed using the GENDER Index tertiles (0-100 values were ordered and the distribution was separated into three equal parts/groups to reflect masculine, androgynous or undifferentiated, and feminine gender). A multivariable logistic regression model was then used across the study sample to assess the association between sex, gender (independent variables) and dichotomized trajectory group membership (dependent variable), while accounting for covariables. Intersectional factors and potential confounders to be considered in the model were selected a priori based on intersectionality-based research (65, 66) and Andersen's (1995) model (67), which is widely used in health care utilization studies (68). All variables considered are detailed in **Table 1**. In the regression model, trajectory group membership was dichotomized to predict participants with the heaviest health care utilization over time (the health care utilization trajectory the most likely to be unfavourable (69)). Multicollinearity was tested according to variance inflation factors (70) and no multiple imputation was applied as missing data proportion was low across variables of interest (<3.8%). Statistical interaction between sex and gender was tested, and all analyses were conducted using SAS® (version 9.4, Cary, NC, USA).

RESULTS

The analysis was conducted among 2,955 workers living with CP (**Figure 1**), whose characteristics are shown in **Table 1**. Mean age was 37.3 ± 9.0 years old (range: 18-50) and 56.1% were female. In total, GBTM led to the testing of 29 models with differences in the number of health care utilization trajectories (between 1 and 4) and trajectory shape (linear or linear and quadratic components). Model fit indices for each model tested are shown in Supplemental Content #1. The best fit for the data, guaranteeing a minimum of 5% of participants belonging to the smallest trajectory was a three-trajectory model (**Figure 2**): **(1)** low health care users (trajectory #1: 59.9% of the sample; the mean number of health care contacts varied from 2.1 ± 2.1 to 2.3 ± 2.2 per year), **(2)** heavy health care users (trajectory #2: 6.4% of the sample; 19.0 ± 10.8 to 20.6 ± 12.6 contacts per year), and **(3)** moderate health care users (trajectory #3: 33.6% of the sample; 7.9 ± 4.7 to 8.4 ± 5.0 contacts per year). According to the graph (**Figure 2**), health care utilization (number of health care contacts per year) appeared stable across the three-year time window.

Table 1. Study population characteristics.

Characteristics * (n = 2 955)	**No. (%) of participants ****	
Sociodemographic profile		
Age (years) – mean ± SD	37.31 ± 9.02	
Sex		
Females	1,659 (56.14)	
Males	1,296 (43.86)	
Gender Index (0-100) – mean ± SD	0.50 ± 0.26	
Masculine (tertile #1 scores 0.01-0.42)	984 (33.30%)	
Androgynous or undifferentiated (tertile #2 scores 0.42-0.64)	986 (33.47%)	
Feminine (tertile #3 scores 0.64-0.99)	985 (33.33%)	
White self-identified race		
Yes	2,705 (91.54)	
Indigenous self-identification		
Yes	67 (2.36)	
Country of birth		
Canada	2,734 (92.52)	
Other	221 (7.48)	
Education level		
No secondary diploma	270 (9.16)	
Secondary diploma	322 (10.92)	
College diploma/Registered apprenticeship or other trades certificate or diploma	1,618 (54.88)	
University education diploma	738 (25.03)	
Marital status		
In a relationship	1,655 (56.35)	
Not in a relationship	1,290 (43.65)	
Household income (Can$)		
< 20,000	160 (5.41)	
20,000 -39,999	582 (19.70)	
40,000 – 59,999	633 (21.42)	
60,000 -79,999	551 (18.65)	
≥ 80,000	1,029 (34.82)	
Region of residence		
Remote	657 (22.23)	

Non-remote	2,298 (77.77)	
Geographic area		
Urban	2,136 (72.28)	
Rural	819 (27.72)	
Public drug insurance status		
Covered	753 (25.48)	
Not covered	2,202 (74.52)	
Pain symptoms		
Pain intensity		
Mild	964 (32.74)	
Moderate	1,568 (53.26)	
Severe	412 (13.99)	
Pain interference (activities prevented)		
None	1,257 (42.61)	
A few	1,183 (40.10)	
Some	348 (11.80)	
Most	162 (5.49)	
Self-reported back pain (except fibromyalgia and arthritis)		
Yes	1,261 (42.79)	
Self-reported arthritis (except fibromyalgia)		
Yes	414 (14.06)	
General health and lifestyle profile		
Combined comorbidity index of Charlson and Elixhauser – mean ± SD	0.12 ±0.68	
Perceived general health		
Excellent or very good	1,291 (43.72)	
Good	1,245 (42.16)	
Fair or bad	417 (14.12)	
Alcohol consumption in the past 12 months		
Regular	2,280 (77.26)	
Occasional	400 (13.55)	
Has not drunk	271 (9.18)	
Smoking		
Regular	762 (25.79)	
Occasional	190 (6.43)	
Never	2,003 (67.78)	
Physical activity		
Regular	1,822 (61.66)	
Occasional	596 (20.17)	
Rare	537 (18.17)	
Lifestyle		
Active	583 (19.73)	
Moderately active	737 (24.94)	

Inactive	1,635 (55.33)	
Health care		
Use of a pain clinic Yes	162 (5.49)	
Having a regular physician Yes	2,215 (74.98)	

Table footnotes:
* Proportion of missing data across presented variable ranged between 0 and 3.76%. Listwise deletion was thus applied for the subsequent phases of the analysis.
** Unless stated otherwise.
SD: Standard deviation

When GBTM was repeated among sex (males and females) and gender (GENDER Index tertiles) strata (see Supplemental Content #1 for model fit indices), a three-trajectory model best fit the data for males, and a four-trajectory model best fitted the data for females (shown respectively in the left and right panels of **Figure 3**). The first three health care utilization trajectories (low, moderate, and substantial health care users) were characterized by stable number of health care contacts over time and were similar between males and females. However, a fourth group of females (5.4%) displayed a decreasing curve of heavy health care use. Also, the number and pattern of health care utilization trajectories varied across gender strata (**Figure 4**), with feminine persons showing a decreasing curve of heavy health care use.

The complete results of the multivariable logistic regression model used to assess the association between sex, gender and a heavy health care trajectory while adjusting for sociodemographic status, pain characteristics and health profile are presented in Supplemental Content #2. Sex—but not gender—was associated with a heavy health care trajectory (females having a greater likelihood than males; OR: 2.6, 95%CI: 1.6-4.1). The same result was reached whether gender was used as a continuous or categorical variable (groups formed by tertiles). No statistical interaction was found between sex and gender. Other factors associated with a heavy health care utilization trajectory in the multivariable model were greater pain intensity, interference, and comorbidity, poorer perceived general health, use of a pain clinic and having a regular physician.

DISCUSSION

This study aimed to examine sex and gender differences in health care utilization trajectories given the growing recognition of the importance of examining these differences when studying the experience of pain (28, 33, 35) and health outcomes in general (71-73). Sex and gender differences were found in the number and shape of health care utilization trajectories. Females had a greater likelihood of falling into the heavy health care utilization trajectory independent of social factors measured by the GENDER Index, pain severity, and non-pain comorbidities.

To our knowledge, not one previous study has focused on sex- and gender-based differences in health care utilization longitudinal trajectories among people living with CP. An earlier Canadian study by Antaky et al. (36) failed to find a multivariable association between sex and heavy health care use among CP patients (defined as individuals in the highest one-year direct health care costs quartile). However, their definition of heavy health care, statistical approach, and time window were different, and they did not consider gender. Having adjusted for many covariables, our results are likely to reflect true sex-based differences. As there are no tenable access barriers to health care driven exclusively by biological sex, differences in health care utilization trajectories between the males and females of our study may be explained by intersecting behavioural and social factors not captured by the GENDER Index or covariables that could be related to health care utilization (e.g., help-seeking tendencies,(74) health literacy (75)).

Implications for Knowledge Users

For clinicians. It will be important for clinicians to be aware of their clientele who are heavy healthcare users. Be vigilant about the presence of sex disparities vs. inequities is relevant. Disparities are not undesirable as such, unless they result in unfairness and injustice. On the other side, inequities are undesirable and should be subject to moral criticism as they imply unfairness and injustice [(76, 77)]. One may wonder, for example, if males receive similar medical follow-up and prescription opportunities as females do to manage their pain. Our results provide valuable information to identify, early on, patients who are more likely to experience heavy health care utilization—i.e., females—and adapt health care services accordingly (e.g., assess if heavy health care use is useful and necessary). ***For patients.*** It will be important to raise awareness among persons living with chronic pain, especially women, regarding the trends found in this study. Partnership with patients and the public could help explore the causes and potential solutions. ***For policymakers***. We would suggest all federal and provincial survey and patient registry developers to plan the measurement of sex at birth, gender identity (which was not available in our data), in addition to gender-related variables (e.g., responsibility for caring for children, occupation, number of hours of work). The inclusion of such measures would allow for more relevant, equitable, diversified, and inclusive future research. ***For***

researchers. Our results underline the importance of considering both sex and gender in CP healthcare utilization research. This approach allows for a better understanding of whether differences are explained by biological factors or indirect measurement of social factors, and consequently helps identify modifiable risk factors for unfavourable outcomes. Although the non-pain-related medical literature abounds with findings demonstrating the tendency of females to have more health service contacts (74), our study is novel as it represents a first step in demystifying distinct subgroups of health care users among females and males living with CP. Future studies should build upon our work and enhance and diversify the operationalization of healthcare utilization and care trajectories. For example, they could focus on a specific type of visits (e.g., emergency department visits), examine transitions between different care sectors (primary, secondary, tertiary), or analyze sequences of care events over time (e.g., sequence analysis (59)). Further studies should also examine the reasons for sex differences (e.g., qualitative studies allowing an in-depth understanding of the behaviours and experiences specific to people living with CP).

Strengths and Limitations

Selection bias and external validity. The TorSaDE Cohort, a unique database harnessing the strengths of longitudinal claim data from Canadian universal health care coverage linked to cross-sectional patient-reported outcomes, allowed to increase the generalizability of our results to various persons living with CP in Canada and possibly in countries with a similar gender norms and health care system. In fact, probability sampling and diversity of profiles are strengths of the CCHS. Also, CCHS allowed to work with a community sample and include people with little or no contact with the health care system, as compared to studies using administrative databases alone, using medical charts, or involving clinic-based recruitment). A limitation is, however, that the GENDER Index was only available to workers (54) limiting our capacity to study older adults who are more likely to have CP. Still, various socioeconomic and health impairment profiles (e.g., participants reporting severe pain) could be taken into account in the multivariable analysis.

Information bias. Available data did not allow us to apply the new accepted definition of CP (persistent or recurrent pain lasting over three months (1)). However, our CCHS-based CP definition has been used in many epidemiology studies (2, 8, 48-52) and provides prevalence estimates comparable to studies using more traditional definitions (53). In our study, the index date (defined as CCHS date of completion) was not related to a significant event in the care trajectory of CP patients (e.g., first diagnosis). Consequently, trajectories modelled in this study represent a random picture of a part of the life course of participants, and patterns of health care utilization were quite stable over time. A limitation of our study is also that we had to study all-cause health care visits (as medical claims do not allow reliable identification of CP-related health care contacts/visits) (78, 79). Nevertheless, this allows the patient journey to be viewed as a whole, which could also be seen as a strength. Next relevant aspect, gender was assessed using the GENDER Index, which was computed using cross-sectional CCHS variables. Although some Canadians may have participated multiple times in the CCHS, our sample was limited to only one CCHS participation (Figure 1), and we could not accommodate change in gender over time in the analysis. Overall, the strengths of using the TorSaDe Cohort clearly outweigh the disadvantages since, to our knowledge at the time of this study, no pain-specific Canadian data source outside tertiary care settings links self-reported data from thousands of patients to longitudinal administrative databases (the only way to study bio-psycho-social determinants of health care trajectories). ***Confounding.*** The use of multivariable analysis in a large sample of participants and the availability of many potential confounders chosen according to recognized models (65-68) allowed us to control confounding.

Conclusion

Our results underline the importance of deepening our understanding of sex-based disparities and inequities in terms of help-seeking, access to health care and resource utilization among persons living with CP. Studies exploring the experience and perception of patients would be a good follow-up to this study in order to identify priorities to reduce the burden of pain and pain inequities in Canada.

ACKNOWLEDGMENTS

We would like to thank members of the TorSaDE Cohort Working Group for exchange and methodological sharing activities. We thank Mélissa Gosselin and Adriana Angarita-Fonseca who helped with the literature review. We would also like to thank Emily-Jayn Rubec, who provided linguistic revision services for this paper.

AUTHORS CONTRIBUTIONS

Each author listed in the manuscript has participated actively and sufficiently in this study to fulfill all authorship criteria of the International Committee of Medical Journal Editors (ICMJE). AL, MGP, MC, OMS JK and NM conceptualized the project and secured funding. AL led the study, wrote the statistical analysis plan and drafted the manuscript. HLNN conducted the statistical analysis and assisted in drafting the manuscript. NM, BV, and MZ contributed to the interpretation of data. All authors revised the manuscript critically, gave final approval of the version to be published, and agreed to act as guarantors of the work.

FUNDING STATEMENT

This work was supported by the Canadian Institutes of Health Research (CIHR) (Personalized Health Catalyst Grants - Development of predictive analytic models: #PCG155479) and the Fondation de l'Université du Québec en Abitibi-Témiscamingue (FUQAT; no funding #). The implementation of the TorSaDE Cohort was funded by the Quebec SUPPORT Unit (Support for People and Patient-Oriented Research and Trials; no funding #), an initiative funded by the CIHR, the Ministry of Health and Social Services of Québec, and the Fonds de recherche du Québec – Santé (FRQS). During this study, MGP and AL were respectively Junior 1 and Junior 2 research scholars from the FRQS. JK is supported by a CIHR Research Chair in health psychology. This research received no specific grant from the commercial sector.

COMPETING INTERESTS STATEMENT

The authors declare no conflicts of interest and no financial interests related to this study.

ETHICS APPROVAL STATEMENT

De-identified TorSaDE Cohort data was accessed through the *Institut de la statistique du Québec* (ISQ) secure virtual server (data holder). Ethical approval was obtained from the *Commission d'accès à l'information du Québec* (#1013990) and relevant university Research Ethics Boards (Université du Québec en Abitibi-Témiscamingue: # 2018-02 – Lacasse, A.; Centre hospitalier universitaire de Sherbrooke (CHUS): #2017-1504).

DATA SHARING

TorSaDE Cohort data links Statistics Canada's Canadian Community Health Survey (CCHS) data and Quebec Health Ministry data that are not publicly available. Access must be granted by the Institut de la statistique du Québec (ISQ) (data holder) and the Commission d'accès à l'information du Québec. Programming codes can be obtained directly from the corresponding author.

FIGURE LEGENDS

Figure 1. Study population selection.

Figure 2. Health care utilization trajectories in the whole study sample.

Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

Figure 3. Health care utilization trajectories in males (left) and females (right).

Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

Figure 4. Health care utilization trajectories in first (left), second (center) and third (right) tertiles of gender index.

Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

REFERENCES

1. Treede RD, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, et al. Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). Pain. 2019;160(1):19-27.

2. Reitsma M, Tranmer JE, Buchanan DM, VanDenKerkhof EG. The epidemiology of chronic pain in Canadian men and women between 1994 and 2007: longitudinal results of the National Population Health Survey. Pain Res Manag. 2012;17(3):166-72.

3. Ashburn MA, Staats PS. Management of chronic pain. Lancet. 1999;353(9167):1865-9.

4. Ohayon MM, Schatzberg AF. Using chronic pain to predict depressive morbidity in the general population. Arch Gen Psychiatry. 2003;60(1):39-47.

5. Gureje O, Von Korff M, Simon GE, Gater R. Persistent pain and well-being: a World Health Organization Study in Primary Care. JAMA. 1998;280(2):147-51.

6. Smith BH, Elliott AM, Chambers WA, Smith WC, Hannaford PC, Penny K. The impact of chronic pain in the community. Fam Pract. 2001;18(3):292-9.

7. Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. EurJ Pain. 2006;10(4):287-333.

8. Hogan ME, Taddio A, Katz J, Shah V, Krahn M. Health utilities in people with chronic pain using a population-level survey and linked health care administrative data. Pain. 2017;158(3):408-16.

9. Kronborg C, Handberg G, Axelsen F. Health care costs, work productivity and activity impairment in non-malignant chronic pain patients. The European journal of health economics : HEPAC : health economics in prevention and care. 2009;10(1):5-13.

10. Guerriere DN, Choiniere M, Dion D, Peng P, Stafford-Coyte E, Zagorski B, et al. The Canadian STOP-PAIN project - Part 2: What is the cost of pain for patients on waitlists of multidisciplinary pain treatment facilities? Can J Anaesth. 2010;57(6):549-58.

11. Lalonde L, Choiniere M, Martin E, Berbiche D, Perreault S, Lussier D. Costs of moderate to severe chronic pain in primary care patients - a study of the ACCORD Program. Journal of pain research. 2014;7:389-403.

12. Campbell M, Hudspith M, Choinière M, El-Gabalawy H, Laliberté J, Sangster M, et al. Working together to better understand, prevent and, manage chronic pain: What We Heard. Ottawa: Report by the Canadian Pain Task Force – Health Canada; 2020.

13. Gaskin DJ, Richard P. The economic costs of pain in the United States. J Pain. 2012;13(8):715-24.

14. Lalonde L, Choiniere M, Martin E, Levesque L, Hudon E, Belanger D, et al. Priority interventions to improve the management of chronic non-cancer pain in primary care: a participatory research of the ACCORD program. Journal of pain research. 2015;8:203-15.

15. Kress HG, Aldington D, Alon E, Coaccioli S, Collett B, Coluzzi F, et al. A holistic approach to chronic pain management that involves all stakeholders: change is needed. Curr Med Res Opin. 2015;31(9):1743-54.

16. Lacasse A, Choiniere M, Connelly J-A. Knowledge, beliefs, and attitudes of the Quebec population toward chronic pain: Where are we now? Canadian Journal of Pain. 2017;1(1):151-60.

17. Campbell M, Hudspith M, Anderson M, Choinière M, El-Gabalawy H, Laliberté J, et al. Chronic Pain in Canada: Laying a Foundation for Action. Ottawa: Report by the Canadian Pain Task Force – Health Canada; 2019.

18. Poulin PA, Nelli J, Tremblay S, Small R, Caluyong MB, Freeman J, et al. Chronic Pain in the Emergency Department: A Pilot Mixed-Methods Cross-Sectional Study Examining Patient Characteristics and Reasons for Presentations. Pain Res Manag. 2016;2016:3092391.

19. Dépelteau A, Racine-Hemmings F, Lagueux É, Hudon C. Chronic pain and frequent use of emergency department: A systematic review. Am J Emerg Med. 2020;38(2):358-63.

20. Choinière M, Peng P, Gilron I, Buckley N, Williamson O, Janelle-Montcalm A, et al. Accessing care in multidisciplinary pain treatment facilities continues to be a challenge in Canada. Reg Anesth Pain Med. 2020;45(12):943-8.

21. Campbell M, Hudspith M, Choinière M, El-Gabalawy H, Laliberté J, Sangster M, et al. An Action Plan for Pain in Canada. Ottawa: Report by the Canadian Pain Task Force – Health Canada; 2021.

22. CIHR. How to integrate sex and gender into research Ottawa: Institute of Gender and Health, Canadian Institutes of Health Research; 2018 [Available from: http://www.cihr-irsc.gc.ca/e/50836.html.

23. Racine M, Tousignant-Laflamme Y, Kloda LA, Dion D, Dupuis G, Choiniere M. A systematic literature review of 10 years of research on sex/gender and experimental pain perception - part 1: are there really differences between women and men? Pain. 2012;153(3):602-18.

24. Bartley EJ, Fillingim RB. Sex differences in pain: a brief review of clinical and experimental findings. Br J Anaesth. 2013;111(1):52-8.

25. Fillingim RB, Gear RW. Sex differences in opioid analgesia: clinical and experimental findings. Eur J Pain. 2004;8(5):413-25.

26. Leresche L. Defining gender disparities in pain management. Clin Orthop Relat Res. 2011;469(7):1871-7.

27. Paller CJ, Campbell CM, Edwards RR, Dobs AS. Sex-based differences in pain perception and treatment. Pain Med. 2009;10(2):289-99.

28. Pieretti S, Di Giannuario A, Di Giovannandrea R, Marzoli F, Piccaro G, Minosi P, et al. Gender differences in pain and its relief. Annali dell'Istituto superiore di sanita. 2016;52(2):184-9.

29. Smitherman TA, Ward TN. Psychosocial factors of relevance to sex and gender studies in headache. Headache. 2011;51(6):923-31.

30. Hurley RW, Adams MC. Sex, gender, and pain: an overview of a complex field. Anesth Analg. 2008;107(1):309-17.

31. Samulowitz A, Gremyr I, Eriksson E, Hensing G. "Brave Men" and "Emotional Women": A Theory-Guided Literature Review on Gender Bias in Health Care and Gendered Norms towards Patients with Chronic Pain. Pain Res Manag. 2018;2018:6358624.

32. Richardson J, Holdcroft A. Gender Differences and Pain Medication. Women's Health. 2009;5(1):79-88.

33. Fillingim RB, King CD, Ribeiro-Dasilva MC, Rahim-Williams B, Riley JL, 3rd. Sex, gender, and pain: a review of recent clinical and experimental findings. J Pain. 2009;10(5):447-85.

34. Nguena Nguefack HL, Gabrielle Pagé M, Guénette L, Blais L, Diallo M, Godbout-Parent M, et al. Gender Differences in Medication Adverse Effects Experienced by People Living With Chronic Pain. Front Pain Res (Lausanne). 2022;3:830153.

35. Boerner KE, Chambers CT, Gahagan J, Keogh E, Fillingim RB, Mogil JS. Conceptual complexity of gender and its relevance to pain. Pain. 2018;159(11):2137-41.

36. Antaky E, Lalonde L, Schnitzer ME, Martin E, Berbiche J, Perreault S, et al. Identifying heavy health care users among primary care patients with chronic non-cancer pain. Canadian Journal of Pain. 2017;1(1):22-36.

37. Sagy I, Friger M, Sagy TP, Rudich Z. [Gender-based differences in the management of low back pain]. Harefuah. 2014;153(7):380-4, 434.

38. LaGrange SJ. Gender influences on help seeking among men and women with chronic pain [PhD thesis]: Indiana University; 2014.

39. Vanasse A, Chiu YM, Courteau J, Dorais M, Bartlett G, Zawaly K, et al. Cohort profile: the care trajectories—enriched data (TorSaDE) cohort. International journal of epidemiology. 2021;50(4):1066-h.

40. Statistics Canada. Canadian Community Health Survey - Annual Component (CCHS) - Detailed information for 2012. Ottawa: Statistics Canada; 2012 [Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=135927.

41. Sanmartin C, Decady Y, Trudeau R, Dasylva A, Tjepkema M, Fines P, et al. Linking the Canadian Community Health Survey and the Canadian Mortality Database: An enhanced data source for the study of mortality. Health Rep. 2016;27(12):10-8.

42. Raina P, Bonnett B, Waltner-Toews D, Woodward C, Abernathy T. How reliable are selected scales from population-based health surveys? An analysis among seniors. Can J Public Health. 1999;90(1):60-4.

43. Régie de l'assurance maladie du Québec. La Régie de l'assurance maladie du Québec 2017 [Available from: http://www.ramq.gouv.qc.ca/fr/regie/Pages/mission.aspx.

44. Régie de l'assurance maladie du Québec. Rapport annuel de gestion 2017-2018 Québec, Qc: Régie de l'assurance maladie du Québec, Gouvernement du Québec; 2018

[Available from: http://www.ramq.gouv.qc.ca/SiteCollectionDocuments/citoyens/fr/rapports/rappann1718.pdf.

45. Bouhassira D, Lanteri-Minet M, Attal N, Laurent B, Touboul C. Prevalence of chronic pain with neuropathic characteristics in the general population. Pain. 2008;136(3):380-7.

46. Boulanger A, Clark AJ, Squire P, Cui E, Horbay GL. Chronic pain in Canada: have we improved our management of chronic noncancer pain? Pain Res Manag. 2007;12(1):39-47.

47. Moulin DE, Clark AJ, Speechley M, Morley-Forster PK. Chronic pain in Canada--prevalence, treatment, impact and the role of opioid analgesia. Pain Res Manag. 2002;7(4):179-84.

48. Ramage-Morin PL, Gilmour H. Chronic pain at ages 12 to 44. Health Rep. 2010;21(4):53-61.

49. Reitsma ML, Tranmer JE, Buchanan DM, Vandenkerkhof EG. The prevalence of chronic pain and pain-related interference in the Canadian population from 1994 to 2008. Chronic diseases and injuries in Canada. 2011;31(4):157-64.

50. Gilmour H. Chronic pain, activity restriction and flourishing mental health. Health Rep. 2015;26(1):15-22.

51. Ramage-Morin PL. Chronic pain in Canadian seniors. Health Rep. 2008;19(1):37-52.

52. Hogan ME, Taddio A, Katz J, Shah V, Krahn M. Incremental health care costs for chronic pain in Ontario, Canada: a population-based matched cohort study of adolescents and adults using administrative data. Pain. 2016;157(8):1626-33.

53. Moore RA, Derry S, Taylor RS, Straube S, Phillips CJ. The costs and consequences of adequately managed chronic non-cancer pain and chronic neuropathic pain. Pain Pract. 2014;14(1):79-94.

54. Lacasse A, Pagé MG, Choinière M, Dorais M, Vissandjée B, Nguefack HLN, et al. Conducting gender-based analysis of existing databases when self-reported gender data are unavailable: the GENDER Index in a working population. Can J Public Health. 2020;111(2):155-68.

55. Jones BL, Nagin DS. Advances in Group-Based Trajectory Modeling and an SAS Procedure for Estimating Them. Sociological Methods & Research. 2007;35(4):542-71.

56. Nagin DS, Odgers C. Group-Based Trajectory Modeling in Clinical Research. Annual review of clinical psychology. 2010;6:109-38.

57. Jones BL, Nagin DS, Roeder K. A SAS Procedure Based on Mixture Models for Estimating Developmental Trajectories. Sociological Methods&Reserch. 2001;29(3):374-93.

58. Nagin DS. Analyzing Developmental Trajectories: A Semiparametric, Group-Based Approach. Psychological Methods. 1999;4(2):139-57.

59. Nguena Nguefack HL, Pagé MG, Katz J, Choinière M, Vanasse A, Dorais M, et al. Trajectory modelling techniques useful to epidemiological research: a comparative narrative review of approaches. Clinical epidemiology. 2020;12:1205.

60. Johnson JL, Greaves L, Repta R. Better science with sex and gender: Facilitating the use of a sex and gender-based analysis in health research. International journal for equity in health. 2009;8(14):1-11.

61. Bekker MHJ. Investigating gender within health research is more than sex disaggregation of data: A Multi-Facet Gender and Health Model. Psychology, Health & Medicine. 2003;8(2):231-43.

62. Simard M, Sirois C, Candas B. Validation of the Combined Comorbidity Index of Charlson and Elixhauser to Predict 30-Day Mortality Across ICD-9 and ICD-10. Med Care. 2018;56(5):441-7.

63. Heidari S, Babor TF, De Castro P, Tort S, Curno M. Sex and Gender Equity in Research: rationale for the SAGER guidelines and recommended use. Res Integr Peer Rev. 2016;1:2.

64. Canadian Institutes of Health Research. Online Training Modules: Integrating Sex & Gender in Health Research - Sex and Gender in the Analysis of Data from Human Participants Ottawa: Canadian Institutes of Health Research (CIHR); 2017 [Available from: http://www.cihr-irsc.gc.ca/e/49347.html.

65. Mena E, Bolte G, Bolte G, Mena E, Rommel A, Saß A-C, et al. Intersectionality-based quantitative health research and sex/gender sensitivity: a scoping review. International journal for equity in health. 2019;18(1):199.

66. Bauer G. Meet the Methods Series: Quantitative intersectional study design and primary data collection, Issue 3 Part 1. Canadian Institutes of Health Research; 2021.

67. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? Journal of health and social behavior. 1995;36(1):1-10.

68. Babitsch B, Gohl D, von Lengerke T. Re-revisiting Andersen's Behavioral Model of Health Services Use: a systematic review of studies from 1998-2011. Psycho-social medicine. 2012;9:Doc11.

69. Nguena Nguefack HL, Pagé MG, Choinière M, Vanasse A, Deslauriers S, Angarita-Fonseca A, et al. Distinct care trajectories among persons living with arthritic conditions: A two-year state sequence analysis. Frontiers in Pain Research. 2022;3.

70. Vatcheva KP, Lee M, McCormick JB, Rahbar MH. Multicollinearity in Regression Analyses Conducted in Epidemiologic Studies. Epidemiology (Sunnyvale). 2016;6(2):227.

71. Pilote L, Humphries KH. Incorporating sex and gender in cardiovascular research: the time has come. Can J Cardiol. 2014;30(7):699-702.

72. Tannenbaum C, Ellis RP, Eyssel F, Zou J, Schiebinger L. Sex and gender analysis improves science and engineering. Nature. 2019;575(7781):137-46.

73. Tannenbaum C, Clow B, Haworth-Brockman M, Voss P. Sex and gender considerations in Canadian clinical practice guidelines: a systematic review. CMAJ Open. 2017;5(1):E66.

74. Thompson AE, Anisimowicz Y, Miedema B, Hogg W, Wodchis WP, Aubrey-Bassler K. The influence of gender and other patient characteristics on health care-seeking behaviour: a QUALICOPC study. BMC family practice. 2016;17(1):38.

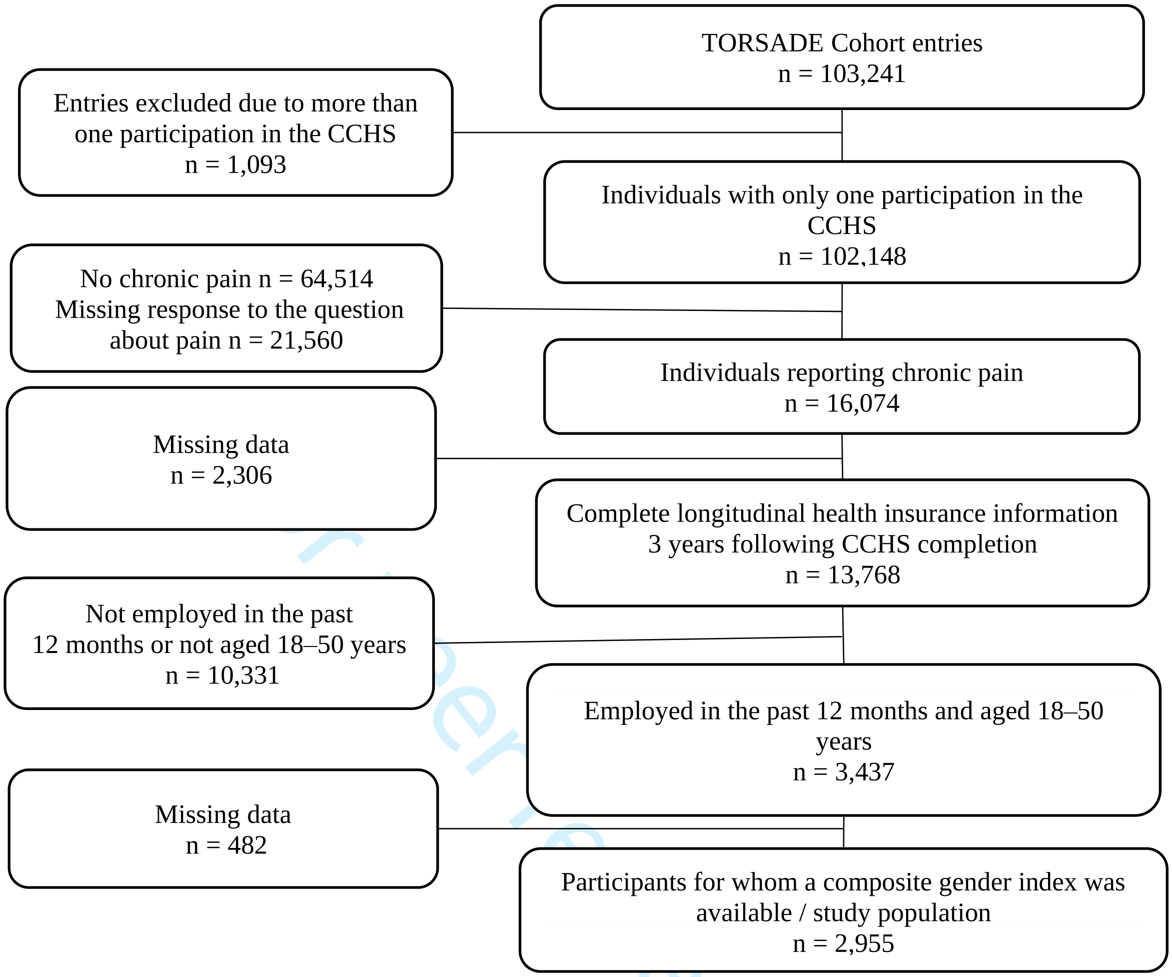
75. Rasu RS, Bawa WA, Suminski R, Snella K, Warady B. Health Literacy Impact on National Healthcare Utilization and Expenditure. Int J Health Policy Manag. 2015;4(11):747-55.

76. Meghani SH, Gallagher RM. Disparity vs Inequity: Toward Reconceptualization of Pain Treatment Disparities. Pain Medicine. 2008;9(5):613-23.

77. Arcaya MC, Arcaya AL, Subramanian SV. Inequalities in health: definitions, concepts, and theories. Global health action. 2015;8(1):27106.

78. Lacasse A, Cauvier Charest E, Dault R, Cloutier A-M, Choinière M, Blais L, et al. Validity of Algorithms for Identification of Individuals Suffering from Chronic Noncancer Pain in Administrative Databases: A Systematic Review. Pain Medicine. 2020;21(9):1825-39.

79. Lacasse A, Ware MA, Dorais M, Lanctot H, Choiniere M. Is the Quebec provincial administrative database a valid source for research on chronic non-cancer pain? Pharmacoepidemiol Drug Saf. 2015;24(9):980-90.


TORSADE Cohort entries
n = 103,241
Entries excluded due to more than one participation in the CCHS
n = 1,093
Individuals with only one participation in the CCHS
n = 102,148
No chronic pain n = 64,514
Missing response to the question about pain n = 21,560
Individuals reporting chronic pain
n = 16,074
Missing data
n = 2,306
Complete longitudinal health insurance information 3 years following CCHS completion
n = 13,768
Not employed in the past 12 months or not aged 18–50 years
n = 10,331
Employed in the past 12 months and aged 18–50 years
n = 3,437
Missing data
n = 482
Participants for whom a composite gender index was available / study population
n = 2,955

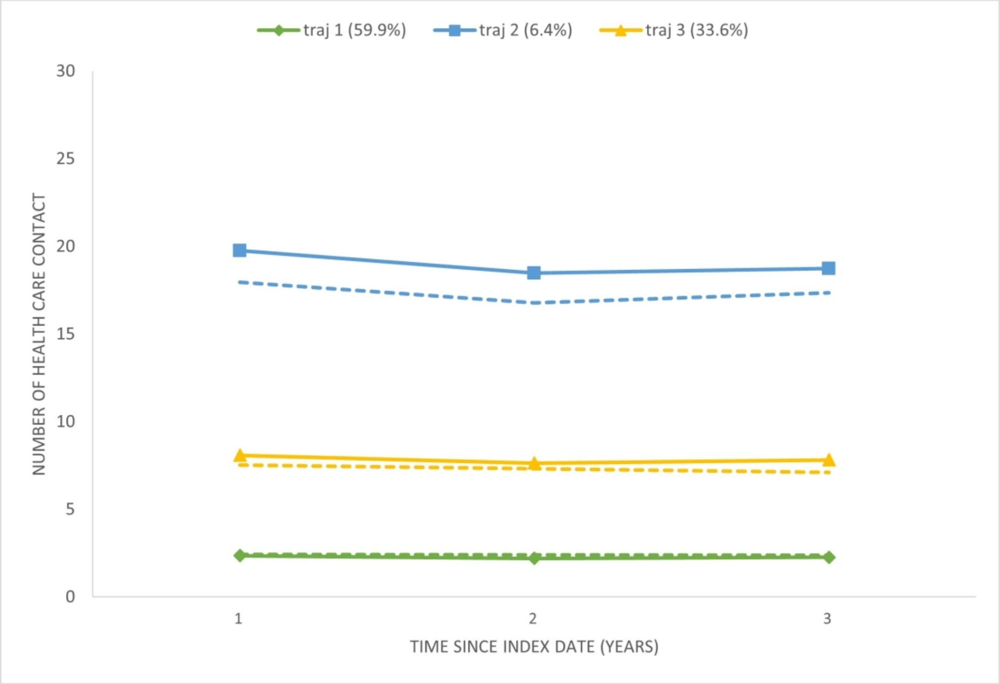


Figure 2. Health care utilization trajectories in the whole study sample.
Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

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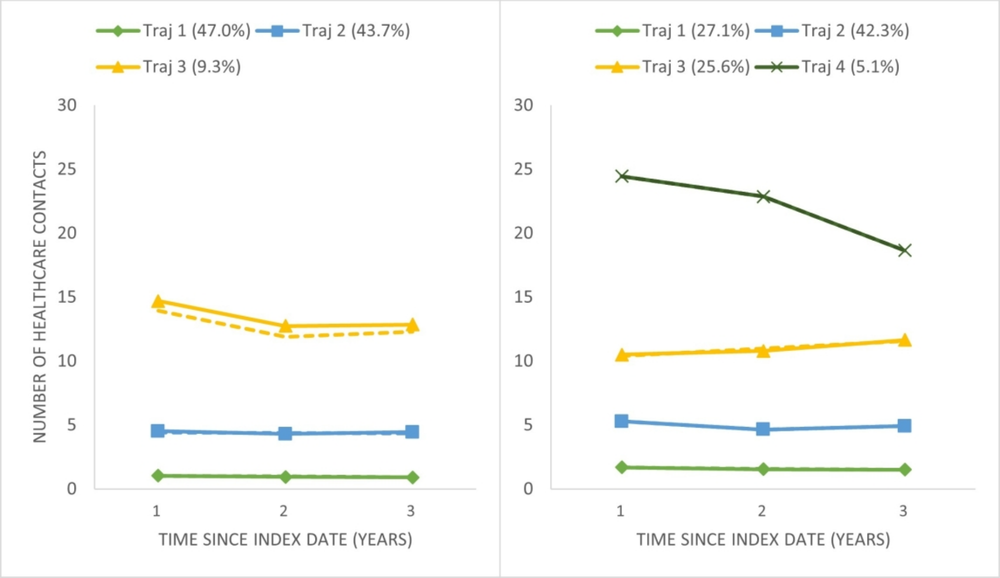

Figure 3. Health care utilization trajectories in males (left) and females (right).
Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

164x95mm (330 x 330 DPI)

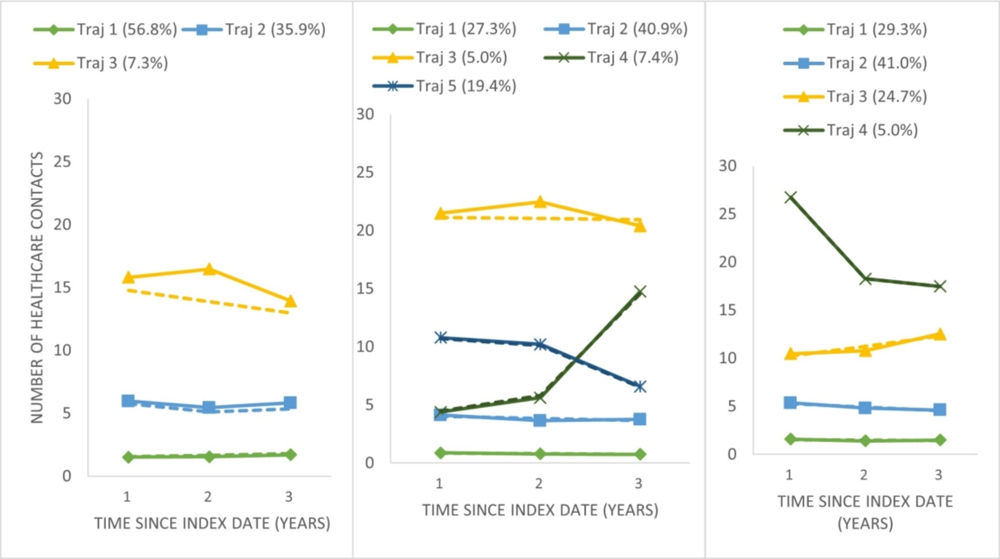

Figure 4. Health care utilization trajectories in first (left), second (center) and third (right) tertiles of gender index.
Plain line: observed mean number of healthcare contacts. Interrupted line: estimated number of healthcare contacts by the GBTM.

177x99mm (330 x 330 DPI)

Supplementary material #1
Model fit indices tables

Table legend:

[1] 1 = linear (straight line); 2 = linear + quadratic (u-shaped curve/parabola) components

[2] AIC : Akaike information criterion

[3] BIC : Bayesian information criterion

[*] One or more groups in the model had less than 5% of participants

Bold text: Model which best fits the data and respected all criteria (lowest BIC absolute value among trajectory groups that respected the 5% criteria)

Model fit indices for the number of health care utilization trajectories in the whole study sample

Number of trajectories	Trajectory shape [1]	AIC [2] (n=2955)	BIC [3] (n=2955)
1	1	-34331.89	-34343.87
1	2	-34325.65	-34340.63
2	11	-27348.28	-27369.24
2	12	-27345.23	-27369.20
2	21	-27343.57	-27367.53
2	22	-27341.49	-27368.45
3	111	-25943.74	-25973.70
3	112	-25939.86	-25972.81
3	**121**	**-25907.72**	**-25940.67**
3	211	-25943.17	-25976.12
3	122	-25935.23	-25971.17
3	212	-25939.40	-25975.35
3	221	-25937.51	-25973.45
3	222	-25935.29	-25974.23
4	1111*	-25055.74	-25094.68
4	1112*	-25056.73	-25098.67
4	1121*	-25048.88	-25090.82
4	1211*	-25050.08	-25092.02
4	2111*	-25054.82	-25096.76
4	1212*	-25051.08	-25096.01
4	1221*	-25045.90	-25090.83
4	2121*	-25048.00	-25092.93
4	2112*	-25055.81	-25100.75
4	2211*	-25049.80	-25094.74
4	1222*	-25046.59	-25094.52
4	2122*	- 25048.58	-25096.51
4	2212*	-25050.80	-25098.73
4	2221*	- 25045.51	-25093.44
4	2222*	-25046.21	-25097.13

Model fit indices for the number of health care utilization trajectories in males

Number of trajectories	Trajectory shape [1]	AIC [2] (n=1296)	BIC [3] (n=1296)
1	2	-12506.94	-12519.86
2	11	-10297.80	-10315.89
2	12	-10294.35	-10315.01
2	21	-10298.36	-10319.03
2	22	-10295.09	-10318.34
3	111	-9750.51	-9776.35
3	**112**	**-9747.67**	**-9776.09**
3	121	-9749.53	-9777.95
3	211	-9751.31	-9779.72
3	122	-9747.72	-9778.72
3	212	-9748.44	-9779.44
3	221	-9750.42	-9781.42
3	222	-9748.56	-9782.15
4	2211*	-9425.41	-9464.17
4	1222*	-9421.26	-9462.59
4	2122*	-9420.97	-9462.30
4	2212*	-9425.63	-9466.97
4	2221*	-9421.04	-9462.38
4	2222*	-9421.86	-9465.78
5	22222*	-9283.21	-9337.46

Model fit indices for the number of health care utilization trajectories in females

Number of trajectories	Trajectory shape [1]	AIC [2] (n=1659)	BIC [3] (n=1659)
1	2	-22287.79	-22293.20
2	11	-16914.21	-16927.74
2	12	-16914.87	-16931.11
2	21	-16914.87	-16931.11
2	22	-16907.86	-16926.81
3	111	-15867.18	-15888.84
3	**112**	-15867.87	-15892.23
3	121	-15865.80	-15890.16
3	211	-15864.21	-15888.58
3	122	-15866.73	-15893.80
3	212	-15866.73	-15893.80
3	221	-15863.69	-15890.76
3	222	-15864.60	-15894.38
4	1111	-15422.88	-15452.66
4	1112*	-15421.61	-15454.09
4	1121*	-15420.75	-15453.23
4	1211	-15440.30	-15472.79
4	2111	-15445.74	-15478.23
4	2211	-15417.90	-15453.09
4	2121	-15489.51	-15524.70
4	1221	-15417.48	-15452.67
4	**1212**	**-15416.10**	**-15451.29**
4	1222*	-15415.55	-15453.44
4	2122*	-15417.76	-15455.65
4	2212*	-15417.76	-15455.65
4	2221	-15417.92	-15455.82
4	2222*	-15415.93	-15456.54

Model fit indices for the number of health care utilization trajectories in GENDER Index tertile #1

Number of trajectories	Trajectory shape[1]	AIC[2] (n=984)	BIC[3] (n=984)
1	2	-10083.57	-10095.80
2	11	-8300.65	-8317.77
2	12	-8301.25	-8320.81
2	21	-8301.58	-8321.15
2	22	-8302.20	-8324.22
3	111	-7938.86	-7963.32
3	112	-7939.18	-7966.08
3	**121**	**-7936.17**	**-7963.07**
3	211	-7938.86	-7965.77
3	122	-7934.77	-7964.12
3	212	-7939.20	-7968.55
3	221	-7936.74	-7966.09
3	222	-7935.63	-7967.42
4	1111*	-7703.13	-7734.93
4	2111*	-7702.98	-7737.22
4	1211*	-7703.37	-7737.61
4	1121*	-7703.82	-7738.06
4	1112*	-7704.12	-7738.36
4	2211*	-7703.38	-7740.07
4	2121*	-7703.66	-7740.35
4	1212*	-7704.36	-7741.04
4	1221*	-7704.19	-7740.88
4	1222*	-7705.19	-7744.32
4	2122*	-7704.66	-7743.79
4	2212*	-7704.37	-7743.50
4	2221*	-7704.19	-7743.32
4	2222*	-7705.18	-7746.76

Model fit indices for the number of health care utilization trajectories in GENDER Index tertile #2

Number of trajectories	Trajectory shape[1]	AIC[2] (n=986)	BIC[3] (n=986)
1	2	-11545.63	-11557.87
2	11	-9206.04	-9223.16
2	12	-9201.35	-9220.93
2	21	-9201.35	-9220.93
2	22	-9198.26	-9220.28
3	111	-8617.12	-8641.59
3	112	-8618.10	-8645.01
3	121	-8618.11	-8645.02
3	211	-8617.81	-8644.73
3	122	-8619.09	-8648.45
3	212	-8618.79	-8648.15
3	221	-8618.81	-8648.17
3	222	-8619.79	-8651.60
4	1111	-8325.28	-8357.09
4	2111	-8326.02	-8360.28
4	1211	-8318.29	-8352.54
4	1121	-8323.46	-8357.72
4	1112	-8325.34	-8359.60
4	2211	-8319.21	-8355.92
4	2121	-8324.16	-8360.86
4	2112	-8326.09	-8362.79
4	1221	-8312.73	-8349.43

4	1212	-8318.35	-8355.05
4	1122	-8324.26	-8360.96
4	1222	-8313.65	-8352.80
4	2122	-8324.96	-8364.11
4	2212	-8319.28	-8358.42
4	2221	-8313.66	-8352.81
4	2222	-8314.59	-8356.18
5	11111*	-8154.15	-8195.75
5	11222	-8139.19	-8185.68
5	12212	-8151.35	-8197.84
5	12221*	-8136.98	-8183.47
5	21221*	-8143.25	-8189.74
5	22121*	-8143.25	-8189.74
5	22211*	-8323.21	-8369.70
5	21122	-8141.07	-8187.56
5	22112	-8153.23	-8199.72
5	22111*	-8155.14	-8199.19
5	21211*	-8330.02	-8374.06
5	21121*	-8146.94	-8190.98
5	21112*	-8155.00	-8199.05
5	12112	-8152.39	-8196.43
5	11212*	-8152.64	-8196.68
5	**11122**	**-8140.22**	**-8184.26**
5	12211*	-8322.29	-8366.33
5	11221*	-8142.29	-8186.34
5	21111*	-8156.61	-8198.21
5	12111*	-8154.21	-8195.80
5	11211*	-8329.28	-8370.88
5	11121*	-8146.08	-8187.68
5	11112*	-8154.15	-8195.75
5	12222	-8136.02	-8184.96
5	21222	-8140.04	-8188.98
5	22122*	-8142.45	-8191.39
5	22212	-8152.27	-8201.21
5	22221*	-8137.94	-8186.88
5	22222	-8136.98	-8188.36

Model fit indices for the number of health care utilization trajectories in GENDER Index tertile #3

Number of trajectories	Trajectory shape [1]	AIC [2] (n=985)	BIC [3] (n=985)
1	2	-13215.39	-13222.73
2	11	-9830.89	-9843.13
2	12	-9817.74	-9832.41
2	21	-9831.27	-9845.95
2	22	-9818.50	-9835.63
3	111	-9269.62	-9289.19
3	112	-9261.57	-9283.59
3	121	-9264.52	-9286.54
3	211	-9270.19	-9292.21
3	122	-9258.96	-9283.42
3	212	-9262.08	-9286.55
3	221	-9265.52	-9289.98
3	222	-9259.93	-9286.84
4	1111*	-8981.82	-9008.73
4	2111*	-8981.22	-9010.58
4	1211*	-8981.22	-9010.58

4	1121*	-8968.20	-8997.56
4	**1112**	**-8980.34**	**-9009.69**
4	2211*	-8981.73	-9013.53
4	2121*	-8967.54	-8999.34
4	2112*	-8969.19	-9000.99
4	1221*	-8969.13	-9000.93
4	1212*	-8980.36	-9012.16
4	1122*	-8969.19	-9000.99
4	1222*	-8970.12	-9004.36
4	2122*	-8968.53	-9002.78
4	2212*	-8980.24	-9014.49
4	2221*	-8968.54	-9002.79
4	2222*	-8969.53	-9006.22

Supplementary material #2

Multivariable logistic regression model used to identify participants' sociodemographic and clinical characteristics associated with the unfavorable health care trajectory

Participant characteristics	Adjusted OR	95% Confidence interval		P-value
Sociodemographic profile				
Age (years)	1.006	0.986	1.026	0.5383
Sex (females vs. males)	**2.588**	**1.626**	**4.117**	**<.0001**
Gender index (0-100)	1.959	0.838	4.579	0.1206
White self-identified race (no vs. yes)	1.445	0.502	4.158	0.4946
Indigenous self-identification (no vs. yes)	0.942	0.237	3.745	0.9323
Country of birth (other vs. Canada)	0.765	0.255	2.293	0.6323
Education level (vs. no secondary education diploma)				
Secondary education diploma	0.793	0.355	1.774	0.5724
Post-secondary education diploma	1.002	0.531	1.889	0.9960
University education diploma	1.112	0.543	2.279	0.7712
Marital status (not in a relationship vs. in a relationship)	0.726	0.487	1.081	0.1149
Household income ($) (vs. < 20,000)				
20,000 -39,999	0.729	0.343	1.547	0.4097
40,000 – 59,999	0.850	0.392	1.843	0.6806
60,000 -79,999	0.885	0.394	1.987	0.7673
≥ 80,000	0.694	0.305	1.579	0.3840
Region of residence (non-remote region vs. remote region)	1.463	0.954	2.244	0.0809
Geographic area (rural vs. urban)	0.760	0.507	1.139	0.1841
Public drug insurance status (covered vs. not covered)	1.117	0.731	1.705	0.6095
Pain symptoms				
Pain intensity (vs. mild)				
Moderate	1.393	0.886	2.189	0.1514
Severe	**1.812**	**1.028**	**3.195**	**0.0399**
Pain interference (vs. none)				
Some	1.388	0.904	2.131	0.1342
Several	**2.243**	**1.311**	**3.837**	**0.0032**
Most	**2.351**	**1.184**	**4.670**	**0.0146**

Back pain (no vs. yes)	1.261	0.894	1.779	0.1870
Arthritis (no vs. yes)	0.908	0.596	1.383	0.6526
General health profile				
Combined comorbidity index of Charlson and Elixhauser	**1.681**	**1.424**	**1.986**	**<.0001**
Perceived general health (vs. excellent or very good)				
Good	**1.609**	**1.062**	**2.440**	**0.0250**
Fair or bad	**3.326**	**2.016**	**5.488**	**<.0001**
Alcohol consumption in the past 12 months (vs. regular)				
Occasional	1.146	0.733	1.792	0.5504
Has not drunk	1.021	0.578	1.803	0.9439
Smoking (vs. regular)				
Occasional	0.902	0.387	2.100	0.8101
Never	1.354	0.896	2.045	0.1498
Frequency of physical activities (vs. regular)				
Occasional	1.009	0.587	1.736	0.9741
Rare	0.754	0.435	1.309	0.3160
Index of physical activities (vs. active)				
Moderately active	0.990	0.592	1.657	0.9704
Inactive	0.813	0.467	1.413	0.4625
Health care				
Use of a pain clinic (yes vs. no)	**2.286**	**1.337**	**3.909**	**0.0025**
Having a regular physician (yes vs. no)	**1.862**	**1.111**	**3.123**	**0.0184**

Reporting checklist for cohort study.

Based on the STROBE cohort guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cohortreporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	3

Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	#3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	#4	Present key elements of study design early in the paper	7
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up.	8
Eligibility criteria	#6b	For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-11
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if	9-11

		there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	
Bias	#9	Describe any efforts to address potential sources of bias	18-20
Study size	#10	Explain how the study size was arrived at	8
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	11-12
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	
11-12			
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	11-12
Statistical methods	#12c	Explain how missing data were addressed	12
Statistical methods	#12d	If applicable, explain how loss to follow-up was addressed	NA
Statistical methods	#12e	Describe any sensitivity analyses NA	

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	12, Fig 1
Participants	#13b	Give reasons for non-participation at each stage	NA
Participants	#13c	Consider use of a flow diagram	
Fig 1			
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	12, Table 1
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	
Table 1 footnote			
Descriptive data	#14c	Summarise follow-up time (eg, average and total amount)	
NA			

Outcome data	#15	Report numbers of outcome events or summary measures over time. Give information separately for exposed and unexposed groups if applicable.	
13-16			
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13-16, Supplemental Content #2
Main results	#16b	Report category boundaries when continuous variables were categorized	Tables 1 and Supplemental Content #2
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
NA			
Other analyses	#17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	16
Discussion			
Key results	#18	Summarise key results with reference to study objectives	16

Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	18-20
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	16-18
Generalisability	#21	Discuss the generalisability (external validity) of the study results	18-19
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	21

Notes:

- 14a: Table 1
- 14b: Table 1 footnote
- 16a: 13, Table 2 The STROBE checklist is distributed under the terms of the Creative Commons Attribution License CC-BY. This checklist was completed on 24. November 2022 using https://www.goodreports.org/, a tool made by the EQUATOR Network in collaboration with Penelope.ai