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Self-Reported Pain Treatment Practices Among U.S. and Canadian Adults: Findings From a Population Survey

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Abstract

Background and Objectives: Pain treatments and their efficacy have been studied extensively. Yet surprisingly little is known about the types of treatments, and combinations of treatments, that community-dwelling adults use to manage pain, as well as how treatment types are associated with individual characteristics and national-level context. To fill this gap, we evaluated self-reported pain treatment types among community-dwelling adults in the United States and Canada. We also assessed how treatment types correlate with individuals' pain levels, sociodemographic characteristics, and country of residence, and identified unique clusters of adults in terms of treatment combinations.

Research Design and Methods: We used the 2020 "Recovery and Resilience" United States–Canada general online survey with 2 041 U.S. and 2 072 Canadian community-dwelling adults. Respondents selected up to 10 pain treatment options including medication, physical therapy, exercise, etc., and an open-ended item was available for self-report of any additional treatments. Data were analyzed using descriptive, regression-based, and latent class analyses.

Results: Over-the-counter (OTC) medication was reported most frequently (by 55% of respondents, 95% CI 53%–56%), followed by "just living with pain" (41%, 95% CI 40%–43%) and exercise (40%, 95% CI 38%–41%). The modal response (29%) to the open-ended item was cannabis use. Pain was the most salient correlate, predicting a greater frequency of all pain treatments. Country differences were generally small; a notable exception was alcohol use, which was reported twice as often among U.S. versus Canadian adults. Individuals were grouped into 5 distinct clusters: 2 groups relied predominantly on medication (prescription or OTC), another favored exercise and other self-care approaches, one included adults "just living with" pain, and the cluster with the highest pain levels employed all modalities heavily.

Discussion and Implications: Our findings provide new insights into recent pain treatment strategies among North American adults and identify population subgroups with potentially unmet need for more adaptive and effective pain management.

> **Translational Significance:** This study documents how frequently community adults use a variety of pain treatment/management strategies, including pharmaceutical, nonpharmaceutical, and self-care approaches (both adaptive, such as exercise, and maladaptive, such as alcohol use). It also identifies combinations of treatment types that most frequently occur together. The findings can assist practitioners in adopting a holistic patient-centered approach, facilitating informed discussions with pain patients and caregivers, and tailoring adaptive multimodal pain treatment plans that encompass a range of self-care strategies and minimize maladaptive approaches, with the aim of optimizing pain management outcomes.

Pain is a critical global public health concern, and better understanding of its effective treatment, management, and prevention is urgently needed (1,2). There is a tremendous body of scholarship on many aspects of pain management, especially on pain medication *prescribing* patterns (3–18). However, little is known about what treatment practices community-dwelling adults use in their daily lives to address or prevent pain (19).

We use U.S. and Canadian population data to provide new insights about pharmaceutical, nonpharmaceutical, and numerous self-care approaches to managing pain. We assess how both individual-level factors such as pain level and sociodemographic characteristics, as well as the macrolevel factor of country of residence, influence the adoption of diverse pain management approaches. In addition, to provide an adequate evidence base for a patient-centered approach—which targets the right set of treatments to the right patient—we assess whether and how people cluster into different phenotypes or clusters in terms of the constellations of pain treatments they use (20).

This analysis builds on the modest body of research that has described what approaches community-dwelling adults use to treat pain. Alas, these studies have predominantly relied on small clinical cohorts (21,22), some with as few as 100 participants (23,24). These studies typically also included only a narrow range of pain management strategies, mostly physician-prescribed pharmaceutical treatments (15,25–27). Moreover, variation in study samples contributes to widely varying estimates of usage rates.

Nonetheless, this body of scholarship has shown that medications are used heavily, with prescription medications reported by 33%–60% of respondents (23,28,29), and over-the-counter (OTC) medications by 30%–80% (21,24,29,30). Simultaneously, nonpharmaceutical approaches—a wide range of doctor-prescribed or self-care approaches—are also highly prevalent, reported by 50%–76% of study participants (21,31,32). Only a small number of studies subdivided this wide category into at least some subgroups. Complementary and alternative medicine (CAM) is relatively widely used by 20%–45% of respondents (22,30,33–35), and 40%–50% of people with pain also say they use exercise to manage pain (32,36). Additional ways that people deal with pain include acceptance, an effective but understudied coping mechanism (37,38), and "alcohol use to dull the pain," a common but understudied and harmful self-management strategy (39).

Importantly, a recent study, based uniquely on a nationally representative sample of U.S. adults with chronic pain, included the option of "other" approaches, which was selected by nearly 40% of respondents. This indicates the need for a wider range of pain management options in surveys, especially self-care approaches like taking supplements or making dietary changes (mentioned by 11%–65% of study participants (23,32,40)), resting, but also maladaptive approaches like substance use. Doing "nothing" is relevant as well; 7%–30% of people with pain reported not using any active pain management approaches (30,31,36). Previous research thus provides information about prevalence of specific types of pain treatment/management, but few studies have systematically assessed a range of modalities (medical and self-care) simultaneously, to present a comprehensive, person-centered portrait of pain treatment strategies.

Additional basic questions remain, including what factors shape pain treatment practices. According to the biopsychosocial model of pain and pain treatment (41), multiple layers of factors play a role, from the most proximate impact of pain severity, to individual sociodemographic characteristics, to macrolevel national contexts that heavily shape opportunities for and barriers to different pain management options.

Relatively little is known about how pain severity influences management strategies. Therefore, we explicitly model how pain level is associated with the various approaches. Individuals' demographic and socioeconomic characteristics may also play a role in what modalities they use to treat or prevent pain. Prior research indicates that women report more frequent use of OTC (28) and prescription medication, as well as nonpharmaceutical treatment, compared to men, and that adults with higher education reported using all nonpharmaceutical modalities more than those with low education (34). With respect to race, there are known differences in pain treatment such that non-White adults tend to be less likely to be prescribed opioids (5). Despite these partial findings, however, a cohesive picture of how individual characteristics influence pain management practices is lacking.

Finally, macrolevel context shapes not only pain levels (42,43), but likely also pain management. Country-level comparisons provide a powerful lens to reveal how this upstream context affects pain management strategies. Such a comparative approach is particularly fruitful for peer countries such as the United States and Canada because they are relatively similar in numerous aspects relevant to pain burden and management, yet different in others. United States and Canada are among world countries with the highest opioid use (44), and the highest in opioid mortality (45). Both countries also exerted concerted efforts over the past decade or so to limit opioid prescribing (46). At the same time, the 2 countries differ in social support and welfare orientation toward their citizens (47), with particularly marked differences in health care systems (48), as well as numerous morbidity measures (49,50) integral to pain burden and pain management. A single prior study compared information on 105 rural Canadians with U.S. data to find that the Canadian adults reported significantly less pharmaceutical and more nonpharmaceutical interventions than their U.S. counterparts (23).

Thus, the aim of this study is to examine use, covariates, and clustering of pain treatments in the general adult population with or without pain in North America. Specifically, our research objectives and working hypotheses are:

(1) To estimate the usage frequency of a wide range of pain management options, including self-care approaches such as exercise, diet/supplements, acceptance, and alcohol use.
(2) To investigate individual-level (pain, sociodemographic correlates) and macrolevel (country of residence) correlates of pain management options. We anticipate that pain and country of residence will have a significant association with the options as the former is the most proximate determinant of treatment need, and the latter is an overarching context that shapes the availability and barriers to use of different strategies.
(3) To explore clustering of pain treatment approaches. We anticipate that individuals will cluster into distinct "phenotypes" with unique constellations of pain treatments.

Method

Data

We used the Recovery and Resilience COVID-19 survey ([51]), a general population survey developed by an interdisciplinary team at the University of Western Ontario and administered by Leger in the United States and Canada in August 2020. This cross-sectional survey included a wide range of social, political, financial, health-related, and other questions, with the aim of comparing the population impacts of COVID-19 between the 2 countries. Our research team added 2 questions about pain (frequency and interference), as well as one about pain treatment types.

The survey was completed online by 2 124 U.S. and 2 110 Canadian respondents aged 18 and older. The respondents were selected from a well-established, widely used, large (~500 000 person) ongoing Leger Panel that applies probability sampling within sex–age–region quotas. A single email invited participation in the survey; 17% of Panel participants in Canada and 25% in the United States accepted the invitation. The sampling frames for the invited individuals were designed to be representative in terms of age, gender, and census region/province population distribution. Poststratification weights were provided by Leger to adjust for nonresponse. However, the survey sample was not designed to be representative with respect to race/ethnicity, socioeconomic status, or other important characteristics; we therefore caution not to interpret the estimates, especially prevalence estimates, as unbiased population values. In the discussion section, we comment on the limitations of the sample and implications for validity and generalizability of findings. The survey was approved by the Ethics Board of the University of Western Ontario (Project ID 116046). The data set and all documentation are publicly available ([51]).

Sample definition. The analytic sample comprises all respondents who answered the pain treatment type question (*n* = 4 113). The full data set includes 4 234 cases (50.2% U.S. and 49.8% Canadian adults) but 121 chose "don't know or prefer not to answer" on the pain treatment item (2.9%) and were thus not included in the analytic sample. Missingness on covariates is addressed in the Approach subsection below.

Variables

The outcome is a set of pain intervention options. These were assessed with the question "What types of treatments, medications, or self-care do you use to deal with or prevent your pain?" The respondents were presented with 12 options (Supplementary Material Section 1 shows the item exactly as it appeared to respondents). Nine options were specific interventions (listed in Table 1), the 10th option was "nothing," the 11th option was an open-ended item inviting respondents to input other modalities, and the 12th option was "don't know/prefer not to answer" (DK). The options "nothing" and DK were mutually exclusive with all other items, that is, if respondents chose "nothing," then they could not choose any other modalities. Supplementary Material Section 2 describes the answers to the open-ended option.

Covariates included the 3 sets of potential predictors of treatment types: country of residence, sociodemographic characteristics, and pain severity. Country was coded with U.S. as reference.

Demographic covariates were age (categorized as 18–44 as reference, 45–64, and 65+), sex (with male as reference), race

Table 1. Percent Selecting Each Intervention and Total Number of Interventions Selected

Individual Interventions	%	Mean	95% CI
OTC medication	54.6		52.9, 56.2
Just live with pain	41.4		39.7, 43.0
Exercise	39.5		37.8, 41.1
Resting or in bed	27.8		26.4, 29.3
Rx medication	24.2		22.8, 25.6
Diet/supplements	13.2		12.1, 14.3
CAM	12.5		11.4, 13.6
Physical therapy	11.4		10.4, 12.5
Do nothing	10.5		9.5, 11.6
Alcohol	5.8		5.0, 6.6
Open-ended: cannabis	1.2		0.9, 1.6
Open-ended: ice or heat	0.7		0.5, 1.0
Number of interventions[*]		2.6	2.5, 2.7

Notes: Sample size *n* = 4 113; CAM = complementary or alternative medicine, OTC = over-the-counter, Rx = prescription medication. The table also lists the 2 most common open-ended item answers. The median number of treatments mentioned is 2.
[*]Among the 3 696 who mentioned any treatments; that is, excluding 417 respondents who stated they use "nothing." The number also counts any intervention in the open-ended item as one intervention.

(non-Hispanic White as reference, Black, Hispanic, Asian, and Other), immigrant (dichotomous, with born in country of residence as reference), marital status (married as reference, previously married, and never married), and parental status (does not have children as reference vs has children). The latter 2 variables were included because social ties are an important factor for patient utilization of nonpharmacological modalities ([52]). Socioeconomic status was measured with education (high school or less, some higher education, associate degree or equivalent, and bachelor's or higher as reference) and household income. Household income is categorized as $0–$29 999, $30 000–$59 999, $60 000–$89 999, $90 000–$149 999, and $150 000 or more as reference. The variable is in U.S. dollars; Canadian incomes were adjusted for purchasing power parity ([53]).

Pain was assessed with 2 items: frequency (never, rarely, sometimes, often, almost always, always) and interference (on a 1–11 scale, asked of those with pain "rarely" to "always"). Following precedent ([43]), we combined these 2 dimensions into their numerical product, which yielded a 0–55 pain severity scale from pain "never" to pain that is experienced "always" and is "completely interfering." For a subset of analyses, we categorized this scale as no or low pain, moderate pain, and high pain corresponding to pain scores of 0–5, 6–21, and 22–55 points, respectively. Supplementary Material Section 3 provides a detailed description of the pain measure including an assessment of the internal consistency of its 2 components.

Approach

All analyses were weighted. We first estimated the percent of respondents who reported each intervention (and associated 95% confidence interval). Additional detail on the distribution of the pain intervention items is in Supplementary Material Section 4, which shows the frequency of each item

by country and pain level. We also estimated the distribution of all covariates for the aggregate sample and by country.

Next, we examined factors associated with each intervention in a multivariable framework: We estimated modified Poisson models of each modality separately as a function of country of residence, pain severity, and sociodemographic covariates. The modified Poisson model (also referred to as robust or quasi-Poisson) is an alternative to the more widely used logistic model for binary outcomes; the modified Poisson's exponentiated coefficients can be interpreted as prevalence ratios, which are more intuitive than odds ratios from logistic models (54). The findings are presented as prevalence ratios.

Finally, we conducted exploratory latent class analysis (LCA). LCA, a type of finite mixture or unsupervised machine learning method, is a person-centered approach that identifies groups or typologies within a population that are qualitatively distinct from one another with respect to chosen characteristics, while being relatively homogeneous within each group (55). The groups or classes are latent (that is, not directly observable with the data at hand); their number, profile, and sets of members are assumed to be indicated by patterns of responses to a set of categorical items, in our case the pain management items. The LCA is a probabilistic model-based technique, where information criteria like Bayesian Information Criterion (BIC) and likelihood-ratio tests are used in conjunction with substantive considerations to determine the optimal number of clusters (56,57). The probabilistic nature of LCA also means that each individual is assigned a probability of belonging to each class rather than being assigned into a single class deterministically. We use the probability of the highest-probability class membership for each individual as a weight when calculating the group's characteristics. The intuition is that a person with a high probability of belonging to a given class is a better "representative" of that class in terms of their indicator profile than individuals with a lower probability, and thus their indicator profile should carry a greater weight for the class description.

We used Mplus 8.5 for the LCA analysis (58) and analyzed the *n* = 3 696 individuals who chose at least one treatment modality from among the 9 listed; 417 respondents who indicated they use "nothing" are a separate group and are thus excluded from the LCA. Model fit indices and sample code for the 5-class model are in Supplementary Material Section 5.

Missingness. As per our sample definition (above), there is no missingness in the outcome (pain management items). Missingness on covariates was low. There were no missing values for the country of residence. Pain severity was missing in 70 cases (1.7%). Regarding other covariates, age, gender, race, and employment had no missing values; education, immigrant, marital, and parental status had 6–23 cases (0%–0.5%) missing; and only household income had a higher level of missing values, 246 respondents (6.0%). We used MICE imputation to generate 20 imputed data replicates with all missing values filled in, then used Rubin's rules to combine the estimates (59). Descriptive analyses were based on a single randomly selected data set of the 20 imputed.

Supplemental sensitivity analyses were conducted to examine the robustness of findings to alternative model and variable specifications. All analyses from descriptives to LCA were conducted without poststratification weights. Multivariable analyses (like those in Table 3) were done stratified by country,

as well as with an interaction term between country and all covariates, to check whether models combining respondents from both countries were appropriate. We also estimated the multivariable models with continuous, rather than categorized, pain severity, as well as using only a single pain dimension at a time (frequency or interference). We further estimated these models with alternative economic indicators, namely, employment status (employed as reference, retired, unemployed, disabled, or other), as well as financial hardship (no hardship as reference, little, some, and serious hardship). Finally, we redid analyses using a complete-case approach rather than using the multiply imputed data, and without poststratification weights. We found that the various covariate specifications, the unimputed and imputed estimates, as well as weighted and unweighted estimates, yield comparable findings that support the same substantive conclusions. A subset of the analyses is shown in Supplementary Material Section 6.

Results

Table 1 summarizes the percent of respondents who selected each intervention and the mean number of interventions per person. OTC medication, "just living with pain," and exercise were the 3 most frequently selected practices (54.6%, 41.4%, and 39.5%, respectively). About a quarter of respondents indicated that they rested or stayed in bed (27.8%), or used prescription medications (24.2%). Diet or supplements (13.2%), CAM (12.5%), and physical therapy (11.4%) were less prevalent, whereas alcohol use was reported by 5.8% of respondents. Not counting the 10.5% who indicated that they used "nothing" to deal with pain, the median number of treatment practices selected was 2 and mean was 2.6.

Table 1 also includes the most common responses to the open-ended item among the 156 responses who used this option. The most common intervention was using cannabis (28.9% of the 156 or 1.2% of total); the second most common was using ice or heat (16.7% of the 156).

Figure 1 Panel A shows that U.S. and Canadian respondents reported most interventions with similar frequency (differences not statistically significant as shown in complementary Supplementary Material Section 4 Table). A notable exception was alcohol use, which was selected by nearly twice as many U.S. as Canadian respondents (7.8% vs 3.7% in Canada). Also, CAM was selected more often by Canadian respondents, and diet/supplements more by U.S. respondents.

Figure 1 Panel B show that pain level was associated with each treatment (Supplementary Material Section 4 Table shows the association was statistically significant for all treatments). Higher pain was associated with more interventions overall (Supplementary Material Section 4 Table), as well as with higher use of each intervention except doing "nothing," which was reported primarily among those with no or low pain (21.7% of those with low pain chose "nothing," in contrast to only 2.5% of those with high pain). Alcohol use had a particularly strong association with pain: using alcohol "to dull the pain" was mentioned by only 1.7% of those with no or low pain but 13.2% of those with high pain. In fact, as shown in Supplementary Material Section 4 Figure 4-2, alcohol use and prescription medication were associated with the highest pain scores in both countries, whereas OTC medication and exercise were selected by respondents with the lowest average pain scores.
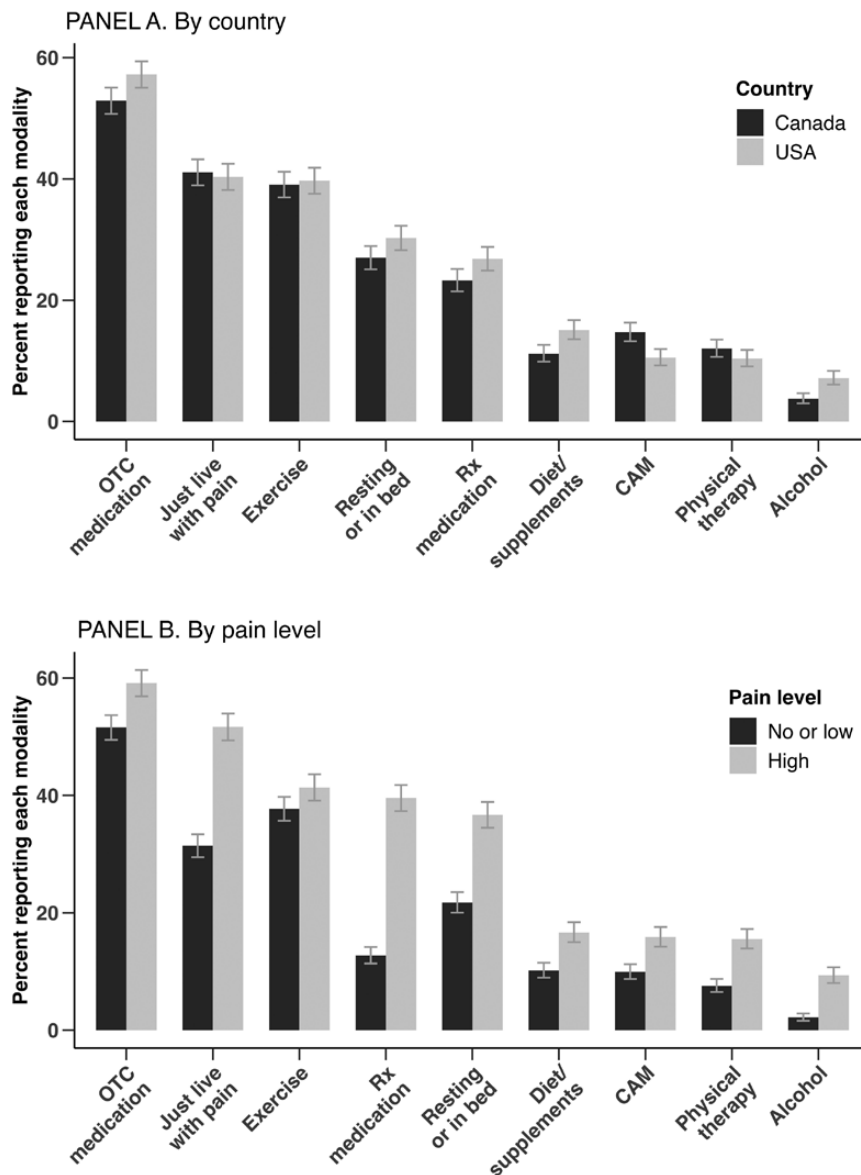
Figure 1. Percent of respondents who mentioned each pain management intervention. Sample size *n* = 3 696 who mentioned any treatments; that is, excludes 417 respondents who stated they use "nothing." The number also counts any intervention in the open-ended item as one intervention. Pain level was dichotomized as no or low versus high (using the median score of 8 as threshold (0–8 vs 9–55). CAM = complementary or alternative medicine, OTC = over-the-counter, Rx = prescription medication.

Table 2 shows the distribution of the sample with respect to all covariates in aggregate and by country. The modal participant was 18–44 years old, White, born in the country of residence, married or partnered, without children. About 44% in both countries had a BA degree, and about half reported household income below $60 000, although low education and income were more prevalent among U.S. than Canadian respondents. The categorized measure of pain shows that 18% had high pain, 40% had medium, and 41% had low pain or no pain in the past 30 days.

Table 3 presents results from multivariable models linking the frequency of each pain treatment to the 3 sets of predictors: country, pain level, and sociodemographic characteristics. With respect to national context, the differences between the United States and Canada, net of pain and individual-level characteristics, were not significant for 6 interventions (prescription and OTC medication, exercise,

rest, acceptance, and doing nothing). Country differences were significant for some interventions—Canadian adults had 26% higher frequency of physical therapy, 38% higher use of CAM, and 25% lower frequency of using diet/supplements. The largest disparity was for alcohol use "to dull the pain," which was 43% less prevalent in Canada compared to the United States.

Pain level was the most salient predictor, with significant and substantively large effects for every treatment modality. People with high pain, relative to no or low pain, were over 4 times as likely to use prescription medications, 3 times as likely to do physical therapy, twice as likely to use CAM, diet, resting, and just "living with" pain, and a staggering 7 times as likely to report alcohol use. Logically, the effect of pain was just as powerful but in the opposite direction for doing "nothing," which is 87% less common among adults with medium or high pain compared to their peers with no or low pain.

Table 2. Characteristics of the Target Population(s)

Variable	Total	Country of Residence		Diff?
		USA	Canada	
Sample size *n*	4 113	2 041	2 072	
Age				.291
18–44	44.1	45.3	42.9	
45–64	34.5	33.4	35.6	
65+	21.4	21.3	21.5	
Gender				<.001
Male	51.3	54.4	48.2	
Female	48.0	44.3	51.6	
Other	0.8	1.3	0.3	
Race				<.001
White	75.2	75.3	75.0	
Black	6.0	10.0	2.0	
Hispanic	3.7	6.1	1.3	
Asian	9.5	4.6	14.4	
Other	5.7	4.1	7.3	
Immigrant				<.001
Native-born	86.5	92.7	80.3	
Immigrant	13.5	7.3	19.7	
Marital status				.044
Married/partnered	56.9	54.8	58.9	
Previously married	13.0	13.4	12.7	
Never married	30.1	31.8	28.4	
Has children				.514
No	47.0	46.4	47.5	
Yes	53.0	53.6	52.5	
Education				<.001
High school or less	19.3	22.5	16.1	
Some higher education	21.3	23.7	19.0	
Associate's degree	15.5	10.1	20.9	
BA or higher	43.8	43.7	44.0	
Household income, in U.S. dollars				<.001
$0–$29k	27.5	32.3	22.7	
$30–$59k	25.9	25.4	26.3	
$60–$89k	21.8	17.3	26.2	
$90–$149k	18.1	16.8	19.4	
$150+	6.7	8.1	5.4	
Pain level				.001
No or low	41.4	39.6	43.2	
Medium	40.2	39.7	40.8	
High	18.4	20.8	16.0	

Note: Sample size *n* = 4 113. Weighted using poststratification weights. The column labeled "Diff?" shows *p* values from Wald *F* tests of difference between the 2 countries with respect to each categorical variable. Pain level was categorized based on the composite pain frequency and interference score of 0–5, 6–21, and 22–55 points for no to low, medium, and high pain, respectively. Canadian household incomes were adjusted for purchasing power parity (53).

Older adults were more likely to use OTC and prescription (Rx) medications and acceptance, but less likely to report CAM, diet/supplements, resting, and especially alcohol use, than younger adults. Women reported more OTC, CAM, and resting, but less alcohol use and physical therapy, compared with men. With respect to other demographic patterns, there was relatively little consistency across interventions, but overall racial/ethnic, immigrant, marital, and parental status did not seem to be powerful drivers of treatment choice net of other characteristics. Socioeconomic status (SES)—especially education—was a more salient covariate. Generally, adults with a BA degree selected each treatment more frequently (as well as doing "nothing" less frequently) than their counterparts without a BA degree. This suggests a more active approach to pain management, or a easier access to treatments, for those with BA degrees.

Table 3. Modified Poisson Regression Model of Each Intervention

Variable	OTC	Acceptance	Exercise	Rest	Rx	Diet	CAM	Physical Therapy	Nothing	Alcohol Use
Canada	0.97	1.02	0.99	0.97	1.07	0.77**	1.38***	1.27*	1.10	0.58***
Pain (Ref: No or low)										
Medium	1.17***	1.59***	1.25***	1.50***	2.31***	1.63***	1.56***	2.05***	0.13***	3.39***
High	1.11*	1.89***	1.15*	2.13***	4.31***	2.16***	2.17***	3.22***	0.13***	6.27***
Age (Ref: 18–44)										
45–64	1.22***	1.10*	1.03	0.78***	1.05	0.94	0.77**	0.88	0.72**	0.70*
65+	1.19***	1.13*	0.98	0.54***	1.17*	0.67**	0.63**	0.76	0.83	0.49**
Female	1.24***	1.05	0.99	1.32***	0.90	1.04	1.50***	0.75**	0.81*	0.57***
Race (Ref: White)										
Black	0.79**	0.69**	1.10	1.10	1.17	1.36	0.62*	1.07	1.21	0.69
Hispanic	1.11	0.87	1.22	0.90	0.89	1.79**	1.09	1.90**	1.13	0.30*
Asian	0.84*	0.81*	1.06	1.15	0.74*	1.25	0.88	1.30	1.09	0.78
Other	0.76***	1.02	1.21*	1.09	0.91	1.43*	1.24	1.28	1.18	0.94
Immigrant	0.83**	0.88	0.93	0.84	0.87	0.97	0.91	0.80	1.39*	0.94
Marital status (Ref: married)										
Previously married	0.99	1.07	0.95	1.13	0.88	1.31*	0.90	0.77	1.25	0.78
Never married	0.95	1.07	1.00	1.11	0.76***	1.00	0.73*	1.22	1.14	0.93
Has children	1.05	0.91*	1.10	0.88*	1.02	1.04	0.97	1.24	0.88	1.15
Education (Ref: BA+)										
High school or less	0.85***	1.04	0.67***	0.77**	0.93	0.52***	0.60***	0.52***	1.37*	0.83
Some college	0.93	1.07	0.79***	0.93	0.98	0.71**	0.73*	0.58***	1.43**	0.87
AA or equivalent	0.88**	1.00	0.81***	0.81*	0.94	0.77	1.08	0.65**	1.46**	0.59*
Household income (Ref: $150k+)										
$0–$29k	0.95	0.90	0.77**	1.06	1.22	0.73	0.65*	0.85	0.90	1.06
$30–$59k	1.01	1.08	0.90	1.02	1.10	0.89	0.68*	0.91	0.77	1.01
$60–$89k	1.03	0.97	0.86	0.97	1.03	0.94	0.71	0.89	0.80	1.05
$90–$149k	0.99	0.91	0.93	0.93	1.05	0.84	0.88	0.99	1.03	0.58

Notes: Acceptance = "just living with pain," CAM = complementary or alternative medicine, OTC = over-the-counter medication, Rx = prescription medication. Sample size *n* = 4 113 in all models. Prevalence ratios shown. Results from 20 multiply imputed models accounting for poststratification weights.
Pain level was categorized based on the composite pain frequency and interference score 0–5, 6–21, and 22–55 points for no to low, medium, and high pain, respectively. Household income is in U.S. dollars; Canadian incomes were adjusted for purchasing power parity.
*$p < .05$. **$p < .01$. ***$p < .001$.

The exploratory LCA results are shown in Table 4. We found the 5-class solution to be the best fit statistically and substantively (analytic details including model fit indices are in Supplementary Material Section 5). Class 1 (comprising 17% of respondents) had the lowest pain and relied nearly exclusively on OTC medication. Class 2 (the largest group, with 36%) had low–moderate pain levels, and tended toward active approaches. They reported exercise as their main strategy, and also selected physical therapy, CAM, and diet/supplements more than other classes except Class 5. Class 3 (31%) was primarily acceptance focused—100% endorsed "just living with pain"—with low rates of prescription drug use and nonpharmaceutical strategies, although fairly high OTC medication use. In contrast, Class 4, with second-highest pain scores, relied on prescription medication to the near exclusion of other strategies. Finally, Class 5 (12% of respondents) had the highest pain level, and selected most approaches with the highest frequency, including alcohol use, reported by 21% in this class.

The table also shows differences among the classes in terms of national and individual-level contexts. Country-level differences were not statistically significant: Canadian and U.S. adults had comparable treatment classes. In contrast, sociodemographic characteristics differed across the classes. Older adults were less likely to be in Class 2 or 5, whereas women were least likely to be in the exercise-focused Class 2. The exercise-focused Class 2 and the all-modalities Class 5 tended toward high SES, and the acceptance-centered Class 3 and prescription medication-heavy class 4 tended toward low SES, although it is important to remember that these were bivariate descriptives not conditioning on other important covariates (like pain), which may underlie the associations.

Discussion

This analysis provides new insights about pain treatment strategies of community-dwelling adults in North America. We (1) characterized the frequency of use of multiple types of interventions, (2) analyzed micro- to macrolevel characteristics associated with each type of intervention, and (3) identified 5 distinct phenotypes or classes of pain treatment strategies.

Regarding the first aim, we found that respondents reported using 2.6 different treatment practices on average. OTC medication was the most frequent intervention (selected by 55% of respondents), followed by acceptance (21) (captured as "just living with pain"; 41%) and exercise (40%). Resting

Table 4. LCA Results: Distribution of Pain Management Strategies and Class Characteristics

Variable	Class 1	Class 2	Class 3	Class 4	Class 5	*p* Value
Class typology						
OTC medication	100.0	37.7	57.6	35.6	82.5	
Just live with pain	0.0	9.6	100.0	0.0	97.8	
Exercise	0.0	77.7	16.7	0.0	76.9	
Resting or in bed	10.0	24.1	24.4	10.6	89.3	
Rx medication	0.0	22.3	15.9	100.0	51.1	
Diet/supplements	0.0	27.2	0.0	0.0	47.7	
CAM	0.0	23.5	2.7	3.1	32.9	
Physical therapy	2.8	22.0	1.9	6.1	26.0	
Alcohol	0.7	4.3	5.9	3.6	20.7	
Class enumeration						
Percent in each class	17.1	36.1	27.4	7.3	12.1	
n of respondents	576	1 289	1 049	297	485	
Class characteristics						
Pain score (median)	4	8	9	12	18	
Canada	49.7	50.8	48.5	54.3	44.9	.177
Age						<.001
18–44	39.1	48.6	37.7	39.2	49.9	
45–64	36.5	33.4	36.5	36.4	33.7	
65+	24.4	18.0	25.8	24.4	16.4	
Female	52.1	44.5	49.3	47.3	53.7	<.001
Race						<.001
White	79.4	69.3	81.0	77.1	75.9	
Black	5.2	7.4	4.7	8.2	5.0	
Hispanic	1.8	5.1	2.7	3.2	3.3	
Asian	9.8	12.0	5.8	7.5	8.5	
Other	3.8	6.2	5.9	4.1	7.3	
Immigrant	14.3	16.0	10.2	11.4	9.8	<.001
Married/partnered	57.6	61.3	53.6	60.1	54.4	.003
Has children	56.5	57.6	50.3	53.0	49.6	.006
Education						<.001
High school or less	21.1	15.0	23.6	29.1	15.8	
Some higher education	18.4	18.5	24.3	23.1	22.0	
Associate's degree	15.9	15.1	16.2	16.0	14.6	
BA or higher	44.5	51.5	36.0	31.8	47.6	
Household income						<.001
$0–$29k	26.7	23.8	29.0	38.0	27.4	
$30–$59k	25.3	22.8	28.7	25.0	30.2	
$60–$89k	24.1	24.1	22.4	18.8	18.3	
$90–$149k	16.8	22.0	15.0	12.8	16.9	
$150+	7.1	7.4	5.0	5.5	7.3	

Notes: CAM = complementary or alternative medicine, LCA = latent class analysis, OTC = over-the-counter, Rx = prescription medication. Sample size *n* = 3 696 (417 respondents who reported using "nothing" to manage pain are excluded from LCA). LCA used poststratification weights.
The last column shows the *p* value from Wald *F* tests comparing the distribution of all characteristics across the 5 classes. Refined poststratification weights were used for all descriptives and tests (except the frequency/number of respondents in each class, which is unweighted). Mplus code used to generate the LCA results is provided at end of Supplementary Material Section 5. Household income is in U.S. dollars; Canadian incomes were adjusted for purchasing power parity.

or staying in bed (28%) and prescription medication (24%) were also relatively common, whereas diet/supplements, CAM, physical therapy, and doing "nothing" were mentioned by 10%–13% of respondents. These findings highlight the range of predominantly self-care approaches people use to prevent or manage pain.

We highlight 3 points here. First, acceptance—the second most frequently selected option—is an important component of psychological therapies for pain and associated with good outcomes among pain patients (37,38). It should therefore be studied further at the population level given its combination of frequent use and efficacy.

Second, alcohol use "to dull the pain" was reported by nearly 6% of respondents. At the population level, this would translate to a staggering 16 million North American adults who use alcohol to cope with pain. Among adults in the high-pain latent class (Class 5), the frequency of use was 21%, only slightly lower than the 26% of adults with pain who self-reported alcohol use in an older study (39). The finding corroborates the known links between pain and substance use (60,61), and underscores the need to include substance use in future surveys of pain treatment strategies.

Third, among respondents who answered the open-ended question about additional practices, nearly one-third (29%) reported cannabis use. Although use of cannabis for pain management has been studied extensively (62,63), no other population survey has included this intervention despite the high known levels of cannabis use among adults with pain (64). Surveys should include cannabis, as well as other substances, among pain management practices to gain a comprehensive understanding of how community-dwelling adults deal with pain.

Our second aim was to identify key correlates of pain treatment strategies. Using the biopsychosocial paradigm (20,41), we considered a 3-tiered set of covariates: the most proximate factor of pain level, individual-level social characteristics, and macrolevel national context via the United States–Canada comparison. Among these, pain level was the most salient correlate of the pain treatments. Generally, greater pain was associated with greater use of each modality. Prescription medication, in particular, was 5 times as prevalent among adults with high pain scores compared with adults with no or low pain, and alcohol use nearly 8 times as prevalent. These findings further underscore the potential risk of alcohol use among individuals with severe pain, who may be unable to access care (65) or who receive care inadequate to manage pain effectively. An (unsurprising) exception to the pain–treatment association was doing "nothing," which was mentioned nearly exclusively by those with little or no pain. This is an important data validity check: "do nothing" was listed 10th among the options, meaning that respondents had to read all 9 prior options before choosing "do nothing." This finding indicates that respondents read the pain management options carefully, and thus increases confidence in the reliability of our findings.

Sociodemographic characteristics, in contrast, were not as strongly associated with pain treatment practices. One consistent finding was that adults with at least a bachelor's degree reported using all nonpharmaceutical and self-care approaches more than their less-educated counterparts. This is an important disparity, which may indicate access barriers for lower-SES individuals, or may reflect differences in awareness and knowledge of multimodal interventions (52). The educational disparity may thus be a target for patient and provider education, as well as promotion and advertising campaigns in health care systems.

Macrolevel context also had muted effects on pain management practices. Although U.S. respondents differed from their Canadian counterparts in most sociodemographic characteristics, and had higher pain (as also described previously (43)), the 2 populations used most interventions with similar frequency. One notable difference was alcohol use "to dull the pain," which was reported twice as frequently by U.S. respondents. This is a disturbing pattern for the United States because alcohol use is a maladaptive coping strategy and may in fact worsen pain (60). We note that alcohol and other substance use, as well as pain, are central components of the "deaths of despair" crisis among U.S. adults (66). High alcohol use in the United States may also reflect more limited access to health care in the United States than in Canada (67). Although this is speculative, U.S. adults also report CAM and physiotherapy less frequently, and diet/supplements more frequently, compared with Canadians, suggesting a general greater tendency to use more "DIY" approaches in the United States.

The third aim was to explore whether individuals cluster in terms of the combinations of treatments they report. The data-driven procedure identified 5 distinct phenotypes. Two groups relied primarily on medication—one on OTC and the other on prescription medications. The former group had the lowest median pain scores among the 5 groups, whereas the latter had the second highest. These groups, assuming their existence is confirmed with future studies, would be ideal targets for additional treatments such as physical therapy or exercise, CAM, or other approaches to expand the treatment toolbox beyond pharmaceuticals. The 2 largest clusters, each containing about a third of respondents, had relatively similar midlevel pain burdens, but differed fundamentally in their approaches: one group endorsed accepting—"just living with"—pain, although they also used other approaches to some degree, whereas the other group relied most heavily on exercise and other self-care and alternative approaches. Finally, the data identified a group that seemed most vulnerable: they had by far the highest median pain score and reported using most treatments heavily. This group—which comprised a nontrivial 12.1% of respondents—should be studied further, as it appears to have a profound unmet need for effective pain relief. Perhaps the modalities are ineffective for these individuals with pain, or perhaps the treatments are implemented poorly. Alternatively, perhaps this group includes adults with pain most resistant to interventions.

Our cross-sectional observational study does not permit us to disentangle the temporal and causal relationships between pain and treatments; doing so in a longitudinal framework could shed light on how changes in treatment strategies are related to changes in pain over time. There are other limitations related to the sampling design. Although the samples were selected to be representative of the U.S. and Canadian adult population with respect to sex, age, and region, some population groups, including rural and less-educated adults, were underrepresented (49). Adults without internet access were also not included, and the response rate was low. All these weaknesses need to be acknowledged as limiting the generalizability of results to the full U.S. and Canadian populations.

With respect to the variables, there are several weaknesses. The pain questions were similar but not identical to pain items more widely used in population health surveys, preventing us from comparing the pain prevalence to the published levels. Additionally, the survey should have collected more detailed information about pain, most critically to differentiate acute from chronic pain. Although, by the very nature of the different durations of acute versus chronic pain, we can assume that much of the captured pain is chronic, we regret the lack of a clear chronicity indicator, because treatment approaches differ substantially between these 2 types of pain. In addition, with respect to the pain treatments, although we included numerous options, a more exhaustive range could be useful, along with more detailed information

on existing options. For example, psychological therapies (38), and additional maladaptive modalities like smoking (68), should in the future be included among the treatment options. In addition, the broad categories we used should be disaggregated, for example, prescription medication into opioid and nonopioid modalities, or CAM into specific types of approaches, as some prior studies have done (25,26,34). Distinction between opioid and nonopioid prescription medication may be of particular clinical and policy relevance; future work should make that distinction as well. Finally, the inclusion of more specific therapies and modalities could help respondent recall (69) and provide a more comprehensive set of results.

Despite these limitations, our findings substantially expand the existing literature on pain management practices in the general population. Our study described the usage frequencies, predictors, and combinations of pain treatment strategies used by U.S. and Canadian adults, including pharmaceutical, nonpharmaceutical, self-care, psychological (acceptance), and maladaptive (alcohol use) approaches. For maximum impact, further research on this important topic should address 2 critical issues. First, the list of pain management modalities in population surveys needs to be systematized so that meaningful comparisons across populations and over time are possible. And second, the list of modalities, as our and other (34) work underscores, must be expanded beyond those provided within the health care system such as pharmaceuticals or physical/occupational therapy, and should include the numerous self-care modalities employed by individuals, including adaptive ones like exercise and dietary changes and maladaptive, potentially harmful ones like substance use. In both research and clinical contexts, we want to better recognize the impact these self-care strategies are having on patients' pain and health. At the policy level, some of our findings highlight a need to better address these approaches and their potential consequences, especially maladaptive approaches like alcohol use.

Supplementary Material

Supplementary data are available at *Innovation in Aging* online.

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Conflict of Interest

None.

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