Clinical Pain Research

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Exploring the complexities of chronic pain: The ICEPAIN study on prevalence, lifestyle factors, and quality of life in a general population

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Abstract

Objectives – The ICEPAIN study is a longitudinal research project focused on building an extensive database on health-related quality of life (HRQoL), lifestyle, and pain among the general population in Iceland. The project started with a cross-sectional data collection and will be followed by similar data collection after 5 and 10 years from participants who have agreed to be contacted again. In this article, descriptive data on the prevalence and nature of chronic pain in the Icelandic general population will be presented in relation to sociodemographic factors, lifestyle, adverse life experiences, and HRQoL.

Methods – Data were collected through a web-based platform using a national panel representing a randomised population sample of 12,400 individuals aged 18–80 years from the National Population Register of Iceland. The instruments consisted of questionnaires on pain, lifestyle factors, adverse life experiences, and HRQoL. The sample was stratified according to age, gender, and residence.

Results – The response rate was 45% (N = 5,557), and most participants (81%) agreed to be contacted again for later data collection. The mean age of the respondents was 54.8 years (SD = 13.7). Half of the participants (50.3%) had experienced some pain the previous week, and 40% had chronic pain (≥3 months). The prevalence of chronic pain was inversely related to educational level and satisfaction with household income and positively associated with body mass index. A significant correlation was found between chronic pain prevalence and several lifestyle variables, such as physical exercises, smoking habits, sleep, and adverse life experiences. Chronic pain had a significant negative impact on both physical and mental components of HRQoL.

Conclusion – These results indicate a complex relationship between chronic pain, lifestyle, and adverse life experiences. The longitudinal design will provide further information on the long-term development among these variables.

Keywords: chronic pain, prevalence, lifestyle, adverse life experiences, interpersonal violence, health-related quality of life

1 Introduction

Pain is a warning signal that is vital to the body's protective system. However, if pain persists over a long period, it usually loses its purpose and turns into a chronic and often limiting health problem [1]. According to the International Classification of Diseases, 11th Revision (ICD-11), chronic primary pain is pain in one or more anatomic regions that persists or recurs for longer than 3 months and cannot be better explained by other chronic pain conditions [2]. Chronic pain is a common, complex, and distressing problem that comprises biological, psychological, and social aspects, has a profound impact on individuals and society, and can be associated with impaired quality of life as well as sociodemographic and socioeconomic factors [1,3,4].

Chronic pain is interrelated with health-related quality of life (HRQoL) and can be associated with diverse lifestyle factors and life experiences [5,6]. HRQoL can be described as the self-perceived impact of health on a person's ability to function and their perceived wellbeing in physical, social, and psychological/mental domains of life in relation to their goals and expectations [7–9].

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Pain is a personal experience, and even though chronic pain may have a single primary cause (e.g., injury), other factors affect its duration, intensity, and effects (physical, psychological, social, and emotional) [1]. Although pain frequently emerges as a consequence of a disease or injury, it is not merely a secondary symptom but constitutes a distinct condition with its own medical definition and classification [1]. Chronic pain often arises from a series or combination of multiple events and factors. Health-related behaviours, e.g., physical activity, smoking habits, and sleep, and their outcomes, as well as diverse life experiences, e.g., accidental injuries, abuse, or interpersonal violence, are important factors in the genesis, duration, and impact of chronic pain [1,10,11]. Research has also shown an association between obesity (measured by body mass index [BMI]) and chronic pain [12,13], as well as diverse demographic and socioeconomic factors [1,4]. The perspective on the aetiology of chronic pain and its treatment is shifting from mainly a tissue- and disease-based approach toward individually tailored multimodal lifestyle explanations and treatment interventions [11], and chronic pain is now considered a disease in itself according to the most recent ICD-11 [14].

The numerous studies that have investigated the prevalence and characteristics of chronic pain have produced variable findings depending on time definition (>6 months or >3 months), methodology, and the studied population. In many studies, the definition of chronic pain has been narrowed by adding various criteria, such as different assessment windows (e.g., within the last year) [15], pattern (e.g., constant or intermittent pain, with shorter or longer pain-free periods), different severity cut-offs (e.g., ≥5 on a 0–10 scale) [16], taxonomy (e.g., stiffness, discomfort, pain), and impact on daily life. This diversity challenges the comparability of studies and the interpretation of their findings. Two previous studies have estimated the prevalence of chronic pain (>3 months) in the Icelandic general population to be 30.6–47.5% [17,18]. However, an extensive study like this on the aetiology of chronic pain in relation to lifestyle and diverse life experiences and adverse life experiences has not been done in a nation-wide general population of any country.

The ICEPAIN study contains data from a large sample of the Icelandic general adult population (18–80 years). Information on pain of various types is investigated in relation to such variables as lifestyle factors, life experiences, and HRQoL. The research project involves building an extensive database on pain, lifestyle, life experiences, and HRQoL and is intended to elucidate the complex relationships between pain and possible causative and/or modifying variables.

As the ICEPAIN study is a longitudinal project, the first step was cross-sectional. Participants were asked for permission to be contacted again for further studies on specific aspects and for similar data collection after 5 and 10 years.

In this article, descriptive data on the prevalence and nature of chronic pain in the Icelandic general population will be presented in relation to sociodemographic factors, lifestyle, adverse life experiences, and HRQoL.

2 Methods

2.1 Sample and data collection procedures

Data were collected through a web-based platform provided by a service contractor, Maskina (https://maskina.is/en/maskinan/fyrirtaekid/), using a national panel representing a randomised population sample from the National Population Register of Iceland. From Maskina's national panel, a sample of 12,400 individuals aged 18–80 years were randomly selected and invited by e-mail to participate in the study. To secure a proportional sample of men and women in all age groups and from all regions of the country, the sample was stratified by gender, age, and residence. The study protocol was approved by the Icelandic National Bioethics Committee (VSN-19-096). According to research code of ethics (The Icelandic National Bioethics committee, VSN) participants were given the option to skip any questions they did not feel comfortable answering and informed about their right to withdraw from the study at any time. This policy ensures that their participation remains voluntary and respects their autonomy in the research process.

In January 2021, the population of Iceland was 358,298 (47.7% women), of which 265,042 were aged 18–80 years (49.0% women). About 70% of the population lived in municipalities with more than 15,000 residents, and 64.1% resided in the capital area [19].

2.2 Instruments

The instruments consisted of questionnaires on pain, HRQoL, lifestyle factors (smoking habits, alcohol consumption, physical exercises, sleep), and adverse life experiences, as well as sociodemographic data. Data on sociodemographic characteristics, pain measures, lifestyle factors, adverse life experiences, and HRQoL are presented in this article.

2.2.1 Sociodemographic characteristics

The sociodemographic data collected were gender, age, marital status, education, and satisfaction with household income.

2.2.2 Pain prevalence, characteristics of pain, and interference with life

The Icelandic version of the Brief Pain Inventory (BPI) was used to evaluate pain experience, severity, and interference with life [20,21]. Participants were asked if they had experienced pain (other than minor headaches, sprains, or toothaches) the previous week and, if so, for how long the pain had lasted (years, months, weeks). Participants were also asked about the cause of pain and to indicate on a body map where they felt pain.

The BPI contains three questions regarding pain severity during the past 24 h (worst, least, and average pain) and pain at present on a scale from 0 to 10, where 0 indicates no pain and 10 is the worst pain imaginable. Interference with life is evaluated by questions on the impact of pain on seven aspects of daily life – general activity, mood, walking ability, work, social activity, sleep, and life enjoyment – on a 0 to 10 scale anchored with "does not interfere" (0) and "completely interferes" (10) [21]. By using separate means of the four severity items and the seven interference items, two composite scores, the Pain Severity Index and the Pain Interference Index, are calculated [22]. The BPI has been translated into Icelandic and validated in a general population sample of Icelandic adults experiencing pain of various origins. It has been found to be both reliable and valid [7,20].

Respondents were asked to answer a question about the pattern of pain, classified as constant (pain all the time), daily intermittent (daily pain with one to a few hours break during the day), frequent intermittent (pain most days but pain-free days in between), and periodic (pain-free periods for days or weeks but pain episodes in between).

2.2.3 Lifestyle variables

Participants were asked how often and for how long they engaged in *physical exercises*, e.g., swimming, walking, cycling, or other physical exercises. The response options for frequency were never, less than once per month, 1–3 times per month, 1–2 times per week, and 3 times per week or more. The response options for duration were less than 15 min, 15–29 min, 30–60 min, and more than 60 min. Based on information on frequency and duration, physical exercises were recoded as the following: no exercise or less than 15 min per week, little exercise (15–45 min per week), moderate exercise (45–90 min per week), and exercise (more than 90 min per week).

Participants were asked about their height and weight, which was used to calculate their *BMI*. The BMI values were further categorised into normal weight (BMI <25), overweight (BMI 25–30), or obesity (BMI ≥30). Information about *smoking* was collected by asking participants if they smoked or had ever smoked (cigarettes, cigars, pipe) and current smokers were asked about smoking habits (daily, at least once a week, less than once a week). For statistical calculations, responses were recoded into three categories: never, previous, and current smokers. Questions on the frequency of consumption of *alcoholic beverages* (wine, beer, strong alcoholic drinks) were asked to assess participants' alcoholic consumption, and responses were grouped into four categories: 2 times a month or more, 2–4 times a month, once a month or less, and never.

2.2.4 Sleep

Participants were asked how many hours (less than 5 h up to more than 10 h) they usually slept each night. Answers were collapsed into three categories: ≤6 h, 7–8 h, and ≥9 h. Sleep quality was assessed by the question, 'How often or rarely have the following occurred in the last 4 weeks in relation to sleeping at night?' The statements were (1) 'I slept continuously all night', (2) 'I woke up rested after a good night's sleep', (3) 'I had a hard time falling asleep', and (4) 'I woke up after falling asleep and had a hard time getting back to sleep'. The response options for each statement were never, seldom, sometimes, often, and every night. Responses were grouped into three categories: no, moderate, and serious sleeping problems. Those who responded to statements 1 and 2 with never or seldom and to statements 3 and 4 with often or always were considered to have serious sleeping problems. Those who responded with often or always to statements 1 and 2 and with never or seldom to statements 3 and 4 were considered having no sleeping problems. Those who responded with sometimes to all statements or seldom or sometimes to one or two statements and sometimes to others, were considered to have moderate sleeping problems.

2.2.5 Adverse life experiences

Major adverse life experiences investigated were adult trauma, such as accidents and interpersonal violence, and adverse childhood experiences (ACE).

Participants were asked if they had been in accidents (yes/no), including traffic, work, leisure, home, sport, or other accidents. In the statistical analysis, all types of accidents were collapsed into one category.

Participants were asked if they had been subjected to Interpersonal violence (physical, emotional, or sexual) (yes/no).

Data on *traumatic childhood experiences* were collected using the ACE questionnaire, a 10-item measure assessing ten types of childhood trauma. Five items are personal: physical, verbal, and sexual abuse and physical and emotional neglect. Five are related to other family members: a parent who is an alcoholic, a victim of domestic violence, a family member in jail, a family member diagnosed with a mental illness, and the disappearance of a parent through divorce, death, or abandonment [23,24]. The response options are yes/no, and the total score was calculated from the number of positive answers with a maximum score of 10. Based on previous studies showing a higher prevalence of chronic pain and other health problems among those with ≥4 ACE scores than <4 scores, the ACE parameter in the dataset was set up as a binary variable [24,25].

2.2.6 HRQoL

The Short Form 12 Health Survey version 2 (SF-12v2), is a 12-item self-rating questionnaire to assess HRQoL and perceived health status in various health conditions, measures eight domains of physical and mental health from which physical component scale (PCS) and mental component scale (MCS) scores are calculated [26]. Each of the components is scored on a 0–100 scale, with a mean of 50, where higher scores indicate better health [26,27]. The instrument's reliability and validity have been tested and confirmed in relation to public health [26,28,29] and chronic non-cancer pain [27].

2.3 Statistical analyses

Data were analysed using SPSS for Windows (version 28.0) and Stata. Descriptive statistics for continuous variables are presented as mean ± SD; point prevalence is expressed as percentages with 95% confidence intervals (CI). Multivariable associations between chronic pain and sociodemographic characteristics, lifestyle variables, and adverse life experiences were calculated as prevalence ratios with 95% CI. Prevalence ratios were adjusted for age, gender, and education. The Kruskal–Wallis test with Bonferroni correction for multiple tests was used to assess significant differences between groups. Pairwise deletion was used in the analyses to handle missing data, as the analyses focused mainly on pairwise relationships. It allows for the maximum use of available data, which can lead to more robust statistical analyses. Also, in most cases, the proportion of missing data was less than 5%.

3 Results

3.1 Characteristics of the sample

The overall response rate was 44.8% (N = 5,557), where 57.3% were women. Nineteen of 5,557 participants did not respond or categorise themselves as men or women. The mean age of respondents was 54.8 years (SD = 13.7). Response rates increased with age – rates for the age groups 18–44, 44–64, and 65–80 years were 31.1, 53.3, and 61.9%, respectively. The majority of participants (79.2%) were married or cohabiting. The chi-square test showed no statistically significant difference between responders and non-responders regarding gender and residence. Still, there was a difference in age, as younger age groups did not respond as well as the older groups. A majority of the participants (81%) agreed to be contacted again for follow-up studies.

3.2 Prevalence and characteristics/nature of chronic pain

Half of the participants (50.3%) responded that they had experienced pain during the previous week, and 40.0% had chronic pain (>3 months). The most common causes of chronic pain were myalgia (39.1%), wear and tear (30.3%), osteoarthritis (25.2%), earlier accidental injuries (22.8%), and fibromyalgia (19.7%). The most common pain locations were shoulders (46%), lower back (40%), and knees (43%). The majority reported experiencing constant or daily pain (65%), and 35% had frequent or periodic pain.

The prevalence of chronic pain was higher among women (42.7%) than men (36.5%) and higher among middle-aged participants (45–64 years, 43.4%), compared to both younger adults (18–44 years, 35.4%) and older adults (65–80 years, 38.3%). Prevalence of chronic pain was inversely related to educational level, 59.4% among individuals with the lowest level of education, decreasing to 19.0% among those with the highest level of education. Those who reported their household income as unsatisfactory were more likely to have chronic pain (53.4%) than those with a satisfactory household income (38.1%). The prevalence of chronic pain in relation to demographic factors, diverse lifestyle variables, and adverse life experiences is shown in Table 1.

3.3 Chronic pain and lifestyle variables

The prevalence of chronic pain was inversely related to the level of physical exercises, positively related to BMI, and

Table 1: Sample characteristics and the prevalence of chronic pain according to sex, age, sex, and education

	Total sample	Chronic pain prevalence			Prevalence ratios		*p*-value[a] for difference	*p*-value[b] for trend
	N	*N*	%	(95% CI)	PR	(95% CI)		
Gender								
Female	3,173	1,355	42.7	(41.0–44.4)	1.00	Ref.	<0.001	
Male	2,365	863	36.5	(34.6–38.4)	0.82	(0.76–0.88)		
Age								
18–44 years	1,335	473	35.4	(32.9–38.0)	1.00	Ref.	<0.001	0.183
45–64 years	2,660	1,154	43.4	(41.5–45.3)	1.16	(1.07–1.27)		
65–80 years	1,562	599	38.3	(35.9–40.8)	1.02	(0.93–1.13)		
Marital status								
Married/cohabit/steady relationship	4,386	1,758	40.1	(38.6–41.5)	1.00	Ref.	0.929	
Single/divorced/widowed	1,151	463	40.2	(37.4–43.1)	0.96	(0.89–1.04)		
Education								
Primary	779	463	59.4	(56.0–62.9)	1.16	(1.06–1.28)	0.006	0.002
Secondary	1,939	464	23.9	(22.0–25.8)	1.09	(1.01–1.18)		
Tertiary	2,441	465	19.0	(17.5–20.6)	1.00	Ref.		
Household income								
Satisfactory	3,956	1,508	38.1	(36.6–39.6)	1.00	Ref.	<0.001	
Unsatisfactory	1,151	615	53.4	(50.6–56.3)	1.36	(1.27–1.46)		
Physical exercises								
No exercise or less than 15 min per week	1,040	493	47.4	(44.4–50.4)	1.00	Ref.	<0.001	<0.001
Little exercise 15–45 min per week	857	388	45.3	(41.9–48.6)	0.95	(0.86–1.05)		
Moderate exercise 45–90 min per week	1,320	523	39.6	(37.0–42.3)	0.84	(0.76–0.92)		
Exercise more than 90 min per week	2,149	817	38.0	(36.0–40.1)	0.79	(0.72–0.86)		
BMI (kg/m^2)								
<25	1,186	382	32.2	(29.5–34.9)	1.00	Ref.	<0.001	<0.001
25–30	1,799	734	40.8	(38.5–43.1)	1.29	(1.17–1.43)		
>30	1,571	795	50.6	(48.1–53.1)	1.56	(1.14–1.72)		
Smoking								
Never	2,648	1,006	38.0	(36.1–39.8)	1.00	Ref.	<0.001	<0.001
Previous	1,855	852	45.9	(43.7–48.2)	1.19	(1.11–1.28)		
Current	552	239	43.3	(39.2–47.4)	1.09	(0.98–1.22)		
Alcohol drinking								
Never	879	392	44.6	(41.3–47.9)	1.16	(1.04–1.29)	<0.001	<0.001
Once a month or less	1,452	669	46.1	(43.5–48.6)	1.18	(1.07–1.29)		
2–4 times a month	1,739	680	39.1	(36.8–41.4)	1.03	(0.94–1.14)		
2 times a month or more	1,277	481	37.7	(35.0–40.3)	1.00	Ref.		
Sleep duration								
7–8 h	3,578	1,350	37.7	(36.1–39.3)	1.00	Ref.	<0.001	0.001
≤6 h	1,503	711	47.3	(44.8–49.8)	1.26	(1.18–1.35)		
≥9 h	294	151	51.4	(45.6–57.1)	1.34	(1.19–1.51)		
Sleep quality								
No sleep problem	2,273	656	28.9	(27.0–30.7)	1.00	Ref.	<0.001	<0.001
Moderate sleep problem	1,613	701	43.5	(41.0–45.9)	1.48	(1.36–1.62)		
Serious sleep problem	1,434	841	58.6	(56.1–61.2)	2.02	(1.87–2.19)		
Accidents								
No	1,683	488	29.0	(26.8–31.2)	1.00	Ref.	<0.001	
Yes	3,874	1,738	44.9	(43.3–46.4)	1.40	(1.29–1.52)		
Interpersonal violence (adult)								
Physical								
No	4,207	1,634	38.8	(37.4–40.3)	1.00	Ref.	<0.001	
Yes	1,072	564	52.6	(49.6–55.6)	1.38	(1.29–1.48)		
Emotional								
No	3,430	1,258	36.7	(35.1–38.3)	1.00	Ref.	<0.001	
Yes	1,851	939	50.7	(48.5–53.0)	1.38	(1.29–1.47)		

(Continued)

Table 1: *Continued*

	Total sample	Chronic pain prevalence			Prevalence ratios		*p*-value[a] for difference	*p*-value[b] for trend
	N	*N*	%	(95% CI)	PR	(95% CI)		
Sexual								
No	4,097	1,558	38.0	(36.5–39.5)	1.00	Ref.	<0.001	
Yes	1,169	647	55.3	(52.5–58.2)	1.46	(1.36–1.57)		
ACE scores								
<4	4,171	1,625	39.0	(37.5–40.4)	1.00	Ref.	<0.001	
≥4	895	465	52.0	(48.7–55.2)	1.30	(1.20–1.40)		

Prevalence ratios adjusted for age (continuous), sex, and education as appropriate.
[a] Chi-square test., [b] Cochran–Armitage test for trend. Pairwise deletion was used in the analyses to handle missing data.

lower among those who had never smoked than among previous or current smokers. However, the prevalence of chronic pain was inversely related to alcohol consumption (Table 1).

There was a strong association between pain prevalence and sleep duration and quality. Chronic pain prevalence was lower among participants who reported approximately 7–8 h of sleep per night (37.7%) than among those who reported ≤6 h (47.3%) or ≥9 h of sleep per night (51.4%). Chronic pain was also strongly related to sleep quality. The prevalence of chronic pain for participants reporting no, moderate, and serious sleep problems was 28.4, 38.3, and 55.5%, respectively (Table 1).

3.4 Chronic pain and adverse life experiences

The majority of participants (69.7%) had a history of previous accidents, and they were more likely to have chronic pain.

Two in five participants reported having experienced interpersonal violence in adulthood. One in five (20.3%) reported having experienced physical violence, 35.1% emotional violence, and 22.2% sexual violence in adulthood. The prevalence of chronic pain was higher among participants who had suffered interpersonal violence in adulthood compared to those who had not experienced violence and was highest among those who had suffered sexual violence (55.3%).

Of those who answered the ACE questionnaire (91.2%, *N* = 5,066), one-third (31.1%) had not experienced any childhood adversity (0 ACE), and 17.7% had suffered four or more ACE. The prevalence of chronic pain was significantly higher among participants with four or more ACE scores than among those with less than four ACE scores (Table 1).

3.5 Chronic pain and HRQoL

Table 2 shows that chronic pain had a significant negative impact on both the physical and mental components of HRQoL. *Post hoc* comparison showed significant differences between all pain groups for PCS and MCS, except for MCS between those with pain last week and those with chronic pain.

The pattern of chronic pain negatively affected HRQoL, as physical and mental component scores were significantly lower among those with constant and/or daily pain than among those with frequent intermittent or periodic pain (Table 3). Pain severity and pain interference indexes were

Table 2: Comparisons between the type of pain on the SF-12v2 PCS and MCS

HRQoL (SF-12)	No pain last week m(sd/n)	Pain last week <3 months m(sd/n)	Pain last week chronic pain ≥3 months m(sd/n)	*p*-Value*
PCS	52.2(8.3/2,635)[AB]	48.0(9.9/451)[AC]	43.6(11.0/2,221)[BC]	<0.001
MCS	50.5(9.0/2,637)[AB]	48.3(9.9/452)[AC]	47.0(10.4/2,223)[B]	<0.001

*Kruskal–Wallis test with a *post hoc* test where values have been adjusted by the Bonferroni correction for multiple tests.
[A] Significant difference between no pain last week and pain last week <3 months, $p < 0.001$. [B] Significant difference between no pain last week and pain last week chronic pain ≥3 months, $p < 0.001$. [C] Significant difference between pain last week <3 months and pain last week chronic pain ≥3 months, $p < 0.001$.

Table 3: Comparisons between the pain pattern on the SF-12v2 PCS and MCS, pain severity and interference

Pain pattern HRQoL (SF-12)	Constant m(sd/n)	Daily intermittent m(sd/n)	Frequent intermittent m(sd/n)	Periodic m(sd/n)	*p*-Value*
PCS	39.4(11.3/985)	43.1(9.98/656)	49.2(8.67/581)	52.2(6.84/318)	<0.001
MCS	45.6(10.7/986)[A]	46.9(10.1/657)[A]	49.4(9.74/582)[B]	49.1(9.47/318)[B]	<0.001
Pain severity index (0–10)	4.63(1.71/924)	3.73(1.51/628)	2.43(1.30/542)	1.71(1.32/298)	<0.001
Pain interference index (0–10)	3.97(2.34/909)	3.07(2.02/606)	1.64(1.50/551)	0.92(1.38/304)	<0.001

*Kruskal–Wallis test with a *post hoc* test where values have been adjusted by the Bonferroni correction for multiple tests. Significant difference between all groups in PCS, MCS, pain severity, and pain interference, $p \leq 0.001$, except [A]between constant and daily intermittent, $p = 0.126$ and [B]between frequent intermittent and periodic, $p = 1.000$.

also higher among those who had constant and/or daily pain than among those who experienced frequent intermittent or periodic pain (Table 3).

4 Discussion

This article presents an overview of the results from a cross-sectional study on the prevalence and nature of chronic pain and HRQoL in relation to sociodemographics, lifestyle variables, and adverse life experiences in the Icelandic general population.

Our results show a 40% prevalence rate of chronic pain, which is higher than in some previous studies [15,16,30], although other studies have reported chronic pain prevalence up to 50% [31]. Our inclusion of participants reporting mild and periodic pain lasting for more than 3 months may explain why the prevalence of chronic pain is higher in this study than in previous studies that used a narrower definition.

A higher prevalence rate among women is consistent with earlier studies [4,11,30]. The higher prevalence of chronic pain among middle-aged participants (45–64 years, 43.4%) than among older participants (65–80 years, 38.3%) differs from earlier studies, as most have reported an increased prevalence of chronic pain with age. However, a similar trend has been reported by a small number of studies. In a systematic review and meta-analysis of the prevalence of chronic widespread pain in the general population, Mansfield et al. [30] found age-bended data in 6 of 25 analysed studies, demonstrating an increase in chronic pain prevalence to around ages 40–50 and then either continually increasing prevalence or a plateauing of prevalence estimates in older age groups. Mansfield and colleagues suggested that a decrease in the prevalence of chronic pain in specific areas such as the low back shown at older ages, may partly explain the lower prevalence in older age groups [30].

The prevalence of chronic pain was inversely related to educational level and satisfaction with household income. This is in accordance with earlier studies, several of which found that people with low levels of education and perceived household income inequalities are more likely to experience chronic pain, more severe pain, and greater levels of pain-related disability than those with higher levels of education and acceptable household incomes [1,4,32].

Several lifestyle factors, including smoking and alcohol consumption, physical exercises (regular exercise versus sedentary behaviour), and poor sleep have been shown to influence and predict the onset and development of chronic pain [11,33,34]. There is also growing evidence that these lifestyle factors are associated with chronic pain severity and perpetuate the condition across all age categories [11,35]. This study's finding that the prevalence of chronic pain was lower among those who had never smoked than among previous or current smokers aligns with earlier studies [11,33,35,36].

The negative correlation found in this study between chronic pain and alcohol consumption is also in accordance with earlier studies. Results from a recent meta-analysis suggested that alcohol drinking is associated with a moderately decreased risk of chronic pain [37]. However, this relationship has been shown to be dose-dependent, with low doses associated with lower pain prevalence and high doses indicating either no association or a positive dose-related relationship [37–39]. In this study we did not ask about doses or how much alcohol was consumed, only how often participants drank alcoholic beverages.

Our findings that the prevalence of chronic pain is inversely related to physical exercises and positively related to BMI are in line with results from earlier studies. Studies have shown that people who engage in regular exercise tend to experience lower pain levels than those who lead sedentary lives [11,35]. Studies have also shown the importance of maintaining a consistent exercise routine in preventing obesity [11]. Therefore, physical exercise is crucial in preventing and managing chronic pain.

There are also a number of studies that have found that physical exercise and sleep quality are interconnected, and that physical exercise and maintenance of normal body weight may reduce the risk of chronic pain among persons with moderate sleep problems [36,40]. Our findings reveal a strong link between sleep duration, sleep quality, and chronic pain. Adequate sleep, approximately 7–8 h per night, was associated with a reduced likelihood of chronic pain, whereas both insufficient sleep (≤6 h) and excessive sleep (≥9 h) were linked to a higher prevalence of chronic pain. Quality of sleep emerged as a significant factor: individuals who reported no sleep problems exhibited a lower likelihood of experiencing chronic pain than did those who reported moderate or serious sleep problems.

Chronic pain and sleep disorders frequently interact with each other [41], and sleep disturbances are a significant risk factor for the onset and spread of chronic pain over time [11,36,42]. Although the relationship between sleep and pain may be bi-directional and sleep problems can be both a predictor and a consequence of chronic pain, evidence suggests that sleep impairment is a stronger predictor of pain than pain is of sleep impairment [40]. People with sleep issues also exhibit higher levels of pain-related anxiety, medication use, and self-reported diseases than those who sleep well [41,43]. Promoting quality sleep is therefore crucial for both preventing and managing chronic pain conditions [11,36,40,42,44].

The findings of this study highlight a significant association between chronic pain and adverse life experiences, including accidents, childhood adversity, and interpersonal violence in adulthood. The majority of participants reported experiencing an accident (traffic, work, leisure, home, or sport), and this was found to be a risk factor for chronic pain. The prevalence of chronic pain was also significantly higher among participants who had experienced ACE and interpersonal violence in adulthood, particularly sexual violence, than among those who had not experienced ACE or violence. This confirms the results of previous studies – a history of accidental injury, interpersonal violence, or adverse childhood life experiences are all known to be associated with the development of chronic pain [1,25,45,46]. Previous research has also identified a possible connection between childhood trauma and being a victim of interpersonal violence in adulthood [25,47–49]. Therefore, addressing the impact of earlier life experiences is crucial to both managing chronic pain and preventing pain from evolving into a chronic health problem.

The consequences of chronic pain on quality of life were evident in both the physical and mental domains. Participants with chronic pain reported lower scores on both the physical and mental components of HRQoL than did those without chronic pain. Even experiencing pain within the last week, despite it not being chronic, was negatively related to HRQoL. This suggests that any form of pain, whether chronic or acute, can significantly impact quality of life and overall wellbeing. However, it is difficult to determine the precise nature of this relationship, as previous studies have shown that poor HRQoL can be as much a predictor for the development of chronic pain as a consequence [5,6].

Furthermore, the pattern of chronic pain, specifically constant and/or daily pain, was associated with poorer quality of life outcomes than were frequent intermittent or periodic pain. Higher pain severity and interference scores were also observed among participants with constant and/or daily pain. These findings are consistent with previous results from Jonsdottir and colleagues [7]. Considering these results the bi-directional relationship between HRQoL and pain pattern and severity should be considered when assessing and managing chronic pain as well as when assessing the possibility of non-chronic pain developing into a long-term pain problem.

The major strength of this study is that it provides valuable data on the relationships between chronic pain and diverse demographic, lifestyle, and adverse life experiences in a total population sample. However, interpretation of these results is constrained by use of self-retrospective and self-reported data which has methodological limitations, including respondents having difficulty accurately recalling past events or feeling pressure to provide socially desirable responses. Even though the cross-sectional nature of this data collection precludes inferences and causal relationships, the longitudinal design of the ICEPAIN research project will provide further information on long-term development between these variables in later data collections.

5 Conclusion

These findings contribute to understanding chronic pain as a complex and multifaceted health problem and underscore the importance of adopting a biopsychosocial approach to pain management that considers individual characteristics, lifestyle factors, and life experiences. The results have implications for the development of targeted interventions and support programmes that address the specific needs of individuals with chronic pain, with a focus on promoting healthy lifestyles, addressing socioeconomic factors, and providing trauma-informed care. Future research should explore longitudinal and causal relationships to further elucidate the complex mechanisms underlying chronic pain and its impact on

individuals' lives as well as the complex interplay between sociodemographic variables, lifestyle, adverse life experiences, and HRQoL in this relationship.

Research ethics: Research involving human subjects complied with all relevant national regulations, institutional policies and is in accordance with the tenets of the Helsinki Declaration (as amended in 2013). This study was approved by the Icelandic National Bioethics Committee (VSN-19-096).

Informed consent: Participants received information about the study by e-mail and an invitation to participate by logging into a website containing the questionnaire. Participants gave their informed consent by answering and sending in the web-based questionnaire.

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