

Original Paper

Sex Representation and User Preferences in Pain Drawing Body Charts in Back Pain Research: Multimethod Study

Sonja Schläpfer¹, PhD; Casey Murphy¹, MBA; Yanick X Lukic^{2,3}, PhD; Concepción Campos-Asensio⁴, BPharm, MLIS; Giovanni Colacicco⁵, MD; Beatrice A Lauber⁵, DVM; Sophie Masneuf⁶, PhD; Luana Nyirö⁷, DCM; Georg W Kajdi⁸, MD; Reto Sutter⁸, Prof Dr Med; Christoph J Laux⁹, MD; Philipp Ackermann², PhD; Jesús López-Alcalde^{1,10,11}, MPH, MD; Claudia M Witt¹, Prof Dr Med

¹Complementary and Integrative Digital Health, Institute of Primary Care, University of Zurich and University Hospital Zurich, Zurich, Switzerland

²Institute of Computer Science, School of Engineering, Zurich University of Applied Sciences, Winterthur, Switzerland

³School of Medicine, University of St.Gallen, St.Gallen, Switzerland

⁴Medical Library, Hospital Universitario de Getafe, Madrid, Spain

⁵Institute of Anatomy, University of Zurich, Zurich, Switzerland

⁶Neuroscience Center Zurich, ETH and University of Zurich, Zurich, Switzerland

⁷Department of Chiropractic Medicine, Balgrist University Hospital, University of Zurich, Zurich, Switzerland

⁸Radiology Department, Balgrist University Hospital, University of Zurich, Zurich, Switzerland

⁹University Spine Center Zurich, Balgrist University Hospital, University of Zurich, Zurich, Switzerland

¹⁰Faculty of Medicine, Universidad Francisco de Vitoria (UFV), Madrid, Spain

¹¹Instituto Ramón y Cajal de Investigación Sanitaria (IRYCIS), Unidad de bioestadística clínica, Hospital Universitario Ramón y Cajal, (CIBER-ESP), Cochrane Madrid, Madrid, Spain

Corresponding Author:

Sonja Schläpfer, PhD

Complementary and Integrative Digital Health, Institute of Primary Care

University of Zurich and University Hospital Zurich

Sonneggstrasse 6

Zurich 8091

Switzerland

Phone: 41 44 255 94 51

Email: sonja.schlaepfer@usz.ch

Abstract

Background: Pain drawing (PD) body charts are widely used in back pain research, but the representation of sex in these charts has not been systematically evaluated.

Objective: This study aims to evaluate sex representation in PD body charts used in back pain research, assess the perception of a newly designed sex-neutral body chart, and explore user preferences for sex representation in PD body charts.

Methods: We conducted a multimethod study comprising: (1) a scoping review to assess sex representation and the reporting of sex in PD body charts in back pain literature, (2) an expert opinion study where anatomy experts evaluated the perceived sex of extracted body charts, and (3) a survey among a representative sample of UK adults with and without back pain to assess the perception of a newly designed sex-neutral body chart and explore preferences for sex representation in PD body charts.

Results: From 349 full-text papers, 108 articles met the inclusion criteria. Most (103/108, 95.4%) did not report the sex of the body charts used, and only 5.6% (6/108) included both male and female charts. Experts showed fair to moderate agreement (Fleiss $\kappa=0.306$; Gwet AC1=0.456) in assessing the sex of charts, with most charts assessed as male based on majority ratings (59/108, 54.6%) and classified as male-biased relative to the sex distribution of study participants (76/108, 67.7%). The newly designed sex-neutral body chart was perceived as sex-neutral by 68.5% (204/298) of survey participants across diverse groups. However, perceptions varied by racial group: 73% (181/248) of White participants viewed it as sex-neutral, compared to 42.5% (17/40) of participants from smaller racial groups ($\chi^2=15.9$; $P=.001$). Female participants slightly preferred female charts (85/154, 55.2%); male participants preferred sex-neutral ones (88/144, 61.1%). Nonetheless, most female participants (82/154, 53.3%) and male participants (107/144, 74.3%) considered the option to choose between male, female, and sex-neutral chart versions unimportant.

Conclusions: Our study reveals reporting gaps and a predominant male bias in the representation of sex in PD body charts used in back pain research. The newly developed sex-neutral body chart was widely perceived as sex-neutral, offering a promising step toward more inclusive pain assessment. However, variations in perception across racial groups highlight the need for cultural considerations in design. These findings underscore the potential of sex-neutral and culturally sensitive body charts to enhance the inclusivity and equity of back pain research and clinical practice.

JMIR Hum Factors 2026 | vol. 13 | e76175 | p. 2
doi: [10.2196/76175](https://doi.org/10.2196/76175)

Keywords: pain drawing; pain map; body chart; sex; gender; sex/gender bias; back pain

Introduction

A pain drawing (PD) is an illustration of the human body that allows individuals to draw the location and extent of their pain. These visual tools support the assessment of subjective pain, may help determine appropriate treatment strategies, and facilitate communication between patients and health care professionals [1]. Since their introduction in 1949, PDs have evolved from traditional paper-and-pencil formats into digital and, in some cases, 3D representations [2]. The body charts used in these PDs vary considerably [2], with some representing male or female figures, while others may be perceived as sex-neutral.

The first sex-specific body charts, featuring both male and female versions, were introduced in 1988 by Uden et al [3], marking an important advancement in acknowledging the need for diversity in pain reporting tools [2]. However, despite this progress, subsequent research has largely neglected the role of diversity in body chart design. Most studies have examined how a participant's sex influences pain depiction by comparing PDs from female and male participants [4,5], while overlooking whether the sex of the body chart itself influences pain reporting. In addition to this gap, it remains unclear to what extent male, female, and sex-neutral body charts are currently used in pain research.

The sex of body charts used in pain research is often poorly documented, and the prevalence of different sex representations remains largely unknown. Preliminary studies suggest that male or sex-neutral charts with male features are more commonly used than female or truly sex-neutral alternatives. Most body charts are described using terms such as “human body outline,” without explicitly identifying them as male, female, or sex-neutral [6]. This ambiguity raises important questions about how a “universal” human body is visually represented across sexes and genders, and how individuals perceive and interpret these depictions. A prevailing assumption among researchers is that most body charts are sex-neutral with distinctly male features, while truly sex-neutral representations are rare [1,7]. However, this perspective is not grounded in a comprehensive review, highlighting the need for further investigation into potential sex and gender biases in body chart design.

Another important consideration is whether individuals prefer male, female, or sex-neutral body charts. While some studies indicate a preference for sex-specific body charts [1, 8,9], their findings may be limited by the fact that body charts intended to be sex-neutral are not always perceived or interpreted as such. Understanding individuals' preferences is

critical, as these preferences may influence how users engage with the charts, their comfort in using them, and the accuracy of their pain reporting. When individuals feel represented by the body chart, they may be more likely to provide accurate and detailed pain descriptions, potentially leading to improved diagnostic outcomes [1]. Exploring these preferences also supports the development of inclusive, user-centered tools that reflect the diversity of patient populations—an essential step toward more equitable health care.

This study examines how sex is represented in PD body charts within the back pain literature, analyzing both the descriptions provided in published articles and anatomy experts' assessments of the perceived sex of the charts. Furthermore, we evaluated a newly developed sex-neutral body chart, designed by an interdisciplinary team of illustrators, computer scientists, physicians (specializing in anatomy, orthopedics, radiology, and integrative medicine), and psychologists [10]. Our aim was to determine whether this chart is perceived by individuals as truly sex-neutral, in alignment with its intended design. We also explored a range of individual factors that may influence these perceptions, alongside participants' preferences for sex-specific versus sex-neutral body charts. Taken together, this study sought to address the following research questions:

1. What is the prevalence of male, female, and sex-neutral PD body charts in the back pain literature—from its inception to the present—as reported in the articles and as assessed by experts? Additionally, what is the level of agreement among experts in their sex-based classifications of the charts?
2. How do individuals perceive a body chart explicitly designed to be sex-neutral, and what individual factors influence whether they interpret the chart as male, female, or sex-neutral?
3. In the context of back pain assessment, do individuals prefer male, female, or sex-neutral body charts, and how important is having a choice to them?

Throughout this paper, we use the terms *sex* and *gender* in accordance with the SAGER (Sex and Gender Equity in Research) guidelines [11]. We define *sex* in body charts based on anatomical characteristics, including primary and secondary sexual organs typically associated with male and female bodies, and in humans as sex assigned at birth. *Gender* refers to socially constructed roles, behaviors, and identities in humans.

Methods

Study Design

This research adopted a multimethod design comprising a scoping review, an expert opinion study, and a survey—each focusing on different aspects of sex representation in PD body charts within the context of back pain. The expert opinion study incorporated insights from anatomy experts across various medical and health sciences disciplines, while the survey gathered responses from individuals both with and without back pain. This inclusive approach ensured the integration of diverse perspectives throughout the study. We submitted the study synopsis to the Ethics Committee of Zurich, Switzerland, and after review, they stated that the study does not fall under the regulation of the Human Research Act of Switzerland (ethics ID: 2022-01475). The scoping review protocol was registered in the Open Science Framework on July 1, 2024, prior to starting the process of selecting studies for the review [12].

Ethical Considerations

The study was conducted in accordance with ethical standards. Privacy and confidentiality were ensured by pseudonymizing all data in the expert opinion study and by collecting anonymized data in the survey, with no personal identifiers recorded. All data were securely stored. Participation was voluntary, and participants were informed of their right to withdraw at any time. Participants provided electronic informed consent. Each participant received £0.75 (US \$1) as compensation for their time.

Inclusion Criteria

Review

The scoping review considered studies that have used, designed, or evaluated PDs with a full-body or torso template in paper or digital format. Studies were included if they assessed pain location and involved adults (aged ≥ 18 y) with back pain, regardless of participants' demographic characteristics (such as age, sex, or pain type and severity). The review considered all primary research studies published in English or German, conducted in any country or clinical setting. Secondary studies—including systematic reviews, narrative reviews, clinical practice guidelines, and consensus documents—were excluded.

Expert Opinion Study

The expert opinion study included experts with academic qualifications and professional expertise in medicine or related health sciences, with an equal distribution of male and female experts.

Survey

The survey included English-speaking adults aged 18 years or older who resided in the United Kingdom, had provided informed consent, and either had or had not experienced back pain, regardless of its type or severity. To ensure that the sample was approximately representative of the UK

population, participants also had to meet demographic criteria for sex, age, and race based on simplified UK Census data.

Recruitment Procedure

Review

The search strategy for the scoping review aimed to identify relevant published studies. An initial, limited search of PubMed was conducted to locate key articles, followed by an analysis of the text words in titles and abstracts, as well as the index terms used to describe those articles. Insights from this analysis informed the development of a comprehensive search strategy incorporating the identified keywords and index terms, as outlined in [Multimedia Appendix 1](#). The final search was conducted by a health librarian (CC-A) in the MEDLINE database via Ovid, covering all records from database inception through May 3, 2024.

Expert Opinion Study

Experts in anatomy and related health sciences were recruited through personal invitations extended via the professional networks of the research team. We aimed to engage a total of 6 experts—3 male and 3 female individuals—to ensure balanced representation and to capture a diverse range of perspectives across relevant areas of expertise.

Survey

The anonymous survey was conducted on Prolific [13], with a recruitment goal of 300 participants—an approximate sample size considered adequate for robust descriptive analyses in survey research [14]. Eligible individuals from the Prolific participant pool were able to self-select into the study if they met the inclusion criteria. Prior to beginning the 5-minute survey, participants provided electronic informed consent through the platform. Each participant received £0.75 (US \$1) as compensation for their time.

Assessments

Review

All identified citations were imported into EndNote (version 21.2; Clarivate Analytics), where duplicates were identified and removed. The unique records were then transferred to Rayyan [15] for study selection. The selection process involved full-text screening of all articles, including appendices, to detect images of PD body charts. Each record was independently assessed by one reviewer (CM or SS), with 10% of excluded articles cross-checked by a second reviewer (SS or CM) according to predefined eligibility criteria. Discrepancies were resolved through discussion between the two reviewers or, if needed, by consultation with a third reviewer (JL-A or CMW). Articles that mentioned the use of PD body charts but did not include images were only retained if the type of body chart used was explicitly referenced and the images could be located through the cited source.

Data were extracted from papers included in the scoping review using the data extraction tool listed in [Multimedia](#)

Appendix 2. This tool was piloted with 8 articles to ensure its reliability and comprehensiveness. Two reviewers (SS and CM) independently extracted data from the first 10 articles to establish consistency. For the remaining articles, one reviewer (either CM or SS) extracted the data, while a second reviewer cross-verified 10% of the extracted data to maintain quality control. The extracted data included specific details about the populations, concepts, contexts, and study methods relevant to the scoping review's questions and objectives. Any disagreements between the reviewers were resolved through discussion or, when necessary, by consulting a third reviewer (JL-A or CMW).

Expert Opinion Study

Following data extraction, our experts (GC, BAL, SM, LN, GWK, and CJL) independently assessed the sex representation of the PD body charts identified in the scoping review. Images of the body charts were compiled in a Microsoft Excel file for review. Experts were asked to classify each body chart by selecting one of the following predefined categories from a drop-down menu: “Male,” “Female,” “Sex-neutral,” “Male and female (>1 template),” or “Unclear.” As the original articles rarely provided detailed descriptions of the body charts, there were no predefined correct or incorrect answers; rather, the goal was to capture the experts’ subjective assessments informed by their anatomical expertise. In cases where the same body chart appeared multiple times—occasionally in slightly different versions—experts were instructed to assess each version individually. When a body chart included multiple figures with different sex representations, the category “Male and female (>1 template)” was used, where applicable. If none of the predefined categories were suitable, experts had the option to elaborate in a designated comments field.

Survey

The survey aimed to examine participants’ perceptions of body charts, focusing specifically on how they classified the chart designed by Lukic et al [10] (as female, male, or sex-neutral), their preferences for selecting a body chart to represent their pain (female, male, or sex-neutral), and the importance they placed on having the option to select from these versions. Additionally, we collected self-reported demographic information, including age, current and past experiences with back pain, country of residence, sex assigned at birth, gender identity, educational attainment, and race. The survey also included additional questions related to the acceptability and usability of the body chart; however, these were not related to the research questions addressed in this paper and were analyzed separately [10].

Analyses

Review

We conducted a descriptive analysis of the extracted data, focusing on the geographical location of the studies, whether the sex of the body chart used was reported, and whether single or multiple body charts were used. We also assessed whether the studies reported the sex of the participants and,

based on this information, whether they included both male and female participants, or exclusively one sex.

Expert Opinion Study

Due to the imbalanced distribution of ratings—51.2% of which fell into the “Male” category—both Fleiss κ and Gwet AC1 were calculated to assess inter-rater agreement. Fleiss κ provides a conservative estimate that accounts for prevalence effects, representing a “worst-case” scenario, while the Gwet AC1 offers a more robust measure in the presence of imbalanced data, reflecting a “best-case” scenario [16]. While Fleiss κ is a widely used standard metric, the Gwet AC1 is increasingly recommended for its reliability under uneven category distributions. Agreement levels for both statistics were interpreted using the guidelines established by Landis and Koch [17]. For additional context, raw percentage agreement was also calculated as a straightforward, unadjusted measure of observed consensus among raters. Analyses were performed using the *irr* (version 0.84.1), *irrCAC* (version 1.0), and *DescTools* (version 0.99.59) packages in R (R Foundation for Statistical Computing). Agreement was assessed across 5 categories reflecting experts’ judgments of the body chart’s sex: “Male,” “Female,” “Sex-neutral,” “Male and female (>1 template),” and “Unclear.” The analyses were performed for all raters collectively, as well as separately for female raters, male raters, and for all raters excluding one identified as a potential outlier based on preliminary rating patterns. Additionally, we analyzed majority ratings, defined as instances where at least 4 out of 6 raters assigned the same rating. We also evaluated the extent to which expert ratings aligned with explicit body chart descriptions reported in the literature. Finally, we investigated whether the sex classification assigned by experts corresponded with the sex of the study participants as reported in the articles, considering body charts rated as “sex-neutral” to be a match for participants of any sex.

Survey

Descriptive statistics were computed for the entire sample, followed by subgroup analyses to compare responses across sex, age groups, back pain experience (current or past), education level, and race. Chi-square tests were conducted to assess whether the distribution of responses differed significantly between subgroups. For the subgroup analyses, dichotomous groups were formed where appropriate: For age, participants were categorized into 2 groups based on the mean age: those aged older than 46 years (above the mean) and those aged 46 years or younger. Educational levels were categorized into “Non-tertiary education” (including “No formal qualification,” “Lower secondary qualification,” “Upper secondary qualification without university access,” and “University entry qualification”) and “Tertiary education” (including “Post-secondary below bachelor’s level,” “Bachelor’s level,” and “Master’s level and above”). Race was grouped into “Largest racial group” (participants identifying as White) and “Other racial groups” (including those identifying as Asian, Black, Latino or Hispanic, Middle Eastern, Indigenous, Aboriginal or First Nations, or “Other,” including multiracial participants). Participants who selected

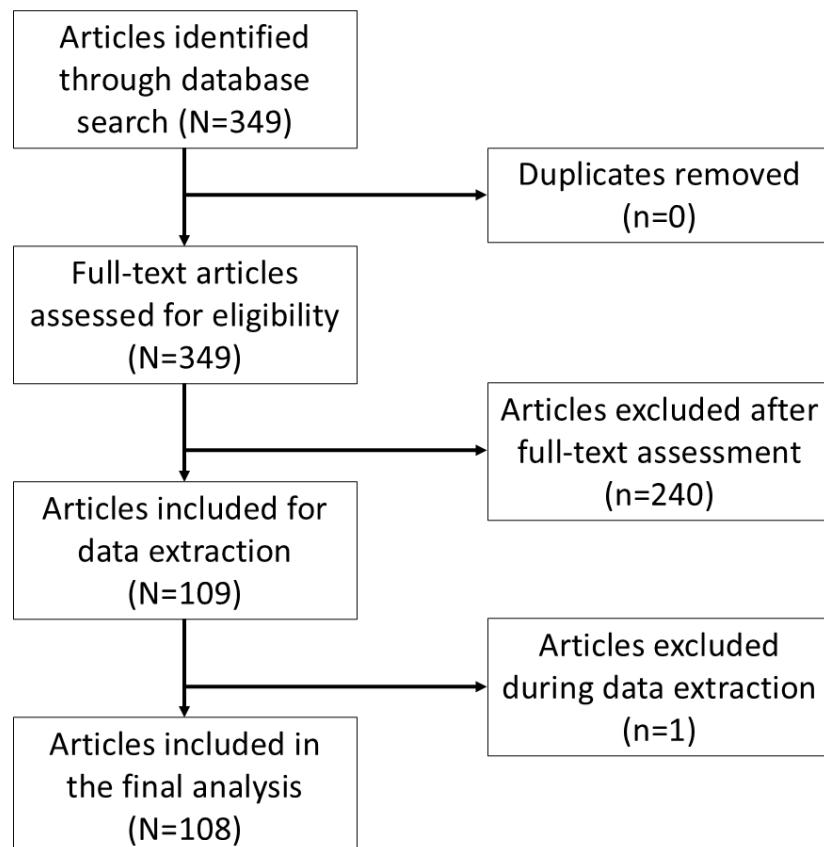
“I prefer not to answer” were excluded from race-based subgroup analyses. Due to the small number of participants with diverse gender identities, subgroup analyses by gender were not feasible. For descriptive purposes, free-text responses indicating “female” or “woman” were categorized as “woman,” and those indicating “male” or “man” as “man.” Responses unrelated to gender identity (eg, referring to sexual orientation) were classified as “other.”

Results

Scoping Review

Our search yielded 349 articles, of which 109 were selected for further analysis after full-text screening. During data extraction, one article was excluded because it used actual participant photos instead of an illustrated body chart for PD, resulting in a final sample of 108 articles (see Figure 1 and full citations in [Multimedia Appendix 3](#)).

Figure 1. Flowchart of literature search and study selection



Expert Opinion Study

The expert panel consisted of 6 raters—3 female and 3 male raters—including 4 physicians (an orthopedic spine surgeon, a radiologist, a chiropractor, and an anatomy lecturer), an anatomical dissection specialist, and a neuroscientist. All experts self-identified as White. Each expert independently assessed the sex representation of body charts from 108 articles, resulting in a total of 648 individual ratings. The distribution of ratings was as follows: 332 (51.2%) ratings were classified as “male,” 158 (24.4%) as “sex-neutral,” 74

The articles referred to studies predominantly conducted in Europe (n=60, 55.6%) and North America (n=31, 28.7%) and were published between 1988 and 2022. Notably, none of the articles explicitly stated an intention to use a sex-neutral body chart, and only 5 (4.6%) articles reported the sex of the body chart used. Among these, 4 articles [8,18-20] used 2 different body charts described as male and female, while 1 article [21] used a single body chart described as male. Out of the 108 articles, 6 (5.6%) used 2 different body charts [3,8,18-20,22], while the remaining 102 (94.4%) used a single body chart. One of the studies using two charts included only female participants [22]. Among studies using a single body chart, 70.6% (72/102) included both male and female participants [4,21,23-92], 8.8% (9/102) included only female participants [93-101], and 2.0% (2/102) included only male participants [102,103]. In 18.6% (19/102) of studies, the sex or gender of participants was not clearly reported; these studies used general terms such as “patients,” “subjects,” or “employees,” without further specification [104-122].

(11.4%) as “female,” 27 (4.2%) as “male and female” (for charts depicting two different bodies), 57 (8.8%) as “unclear,” and 0 (0%) as “other.” Female experts classified 1.42 times more body charts as “male” (195 ratings, 60.2% of their total) compared to male experts (137 ratings, 42.3% of their total). Conversely, male experts assigned more than twice as many body charts as “sex-neutral” (108 ratings, 33.3% of their total) than the female experts (50 ratings, 15.4% of their total). See [Figure 2](#) for a visual representation of these findings.

Figure 2. Body chart ratings by category and expert sex. The categories represent experts' ratings of the perceived sex of the body charts. "Mixed" refers to body charts that included multiple figures perceived as both male and female. Each group of experts—female and male—contributed 324 ratings, for a total of 648 ratings.

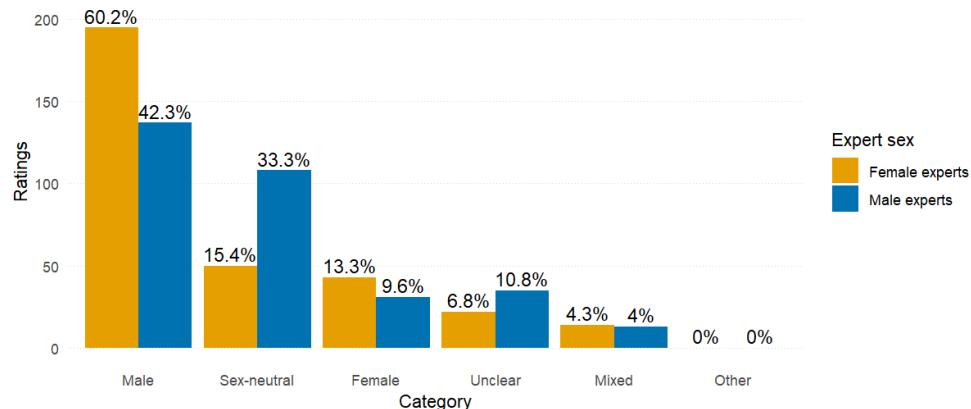


Table 1 presents the inter-rater agreement metrics for the overall sample and subgroups. Across all raters, the Fleiss κ indicated fair agreement, while the Gwet AC1 suggested moderate agreement. The simple percentage agreement was 10.2% (see [Multimedia Appendix 4](#) for images that were rated identically). Subgroup analyses revealed the following patterns: for the 3 female raters, there was moderate agreement for both Fleiss κ and Gwet AC1, and the simple percentage agreement was 52.8%. The 3 male raters

revealed slight agreement for Fleiss κ and fair agreement for Gwet AC1, with one suspected outlier; the simple percentage agreement was 13.9%. After excluding the suspected outlier, agreement among the remaining 5 raters increased to moderate agreement (Fleiss κ) and substantial (Gwet AC1), with a percentage agreement of 49.1%. All interpretations should be considered alongside the confidence intervals in **Table 1**, and percentage agreement values should be interpreted with caution due to the limited nuance.

Table 1. Inter-rater agreement metrics.

Group and metric	Metric value	95% CI	Interpretation
All raters (n=6)			
Fleiss κ	0.306	0.276-0.336	Fair agreement
Gwet AC1	0.456	0.401-0.511	Moderate agreement
Percentage agreement	10.2	N/A ^a	— ^b
Female raters (n=3)			
Fleiss κ	0.404	0.337-0.47	Moderate agreement
Gwet AC1	0.587	0.496-0.679	Moderate agreement
Percentage agreement	52.8	N/A	—
Male raters (n=3)			
Fleiss κ	0.098	0.031-0.165	Slight agreement
Gwet AC1	0.251	0.188-0.314	Fair agreement
Percentage agreement	13.9	N/A	—
Without male outlier (n=5)			
Fleiss κ	0.488	0.452-0.524	Moderate agreement
Gwet AC1	0.647	0.571-0.724	Substantial agreement
Percentage agreement	49.1	N/A	—

^aN/A: not applicable.

^b—: not available.

We also examined majority ratings, defined as at least 4 out of 6 raters assigning the same classification. Body charts were categorized as "male" in more than half of the articles (59/108, 54.6%), "female" in 10 (9.3%) articles, "sex-neutral" in 8 (7.4%) articles, "male and female" in 4 (3.7%) articles, and "unclear" in 1 (0.9%) article. In 26 articles (24.1%), ratings were too inconsistent to achieve a majority.

Of the 108 articles, only 5 explicitly described the body charts as male, female, or sex-neutral. Four of these articles included 2 body charts each, described as "male" and "female." In three of these articles, all raters classified the sex of the charts in line with the article descriptions. In the fourth, however, rater assessments diverged: four classified both charts as "female," and two as "sex-neutral." The fifth

article included a single body chart described as male, which 5 experts identified as “male” and one as “unclear.”

Finally, we assessed alignment between the expert-assigned sex of the body charts and the sex of study participants as reported in the articles. Of the 108 articles, 40 (37.0%) provided unclear descriptions of participants’ sex or lacked a majority rating from the experts. In the remaining 68 articles, 22.1% (15/68) showed a match between the chart and participant sex. The majority, 67.7% (46/68), were male-biased (ie, male body charts used in studies not exclusively involving male participants), while 10.3% (7/68) were female-biased.

Survey

A total of 300 individuals participated in the survey; however, two were excluded due to technical issues, resulting in a

final sample of 298 participants. Descriptive statistics for the sample are presented in [Table 2](#), and subgroup comparisons, including chi-square test results, are shown in [Table 3](#). The majority of respondents (204/298, 68.5%) perceived Lukic et al’s [10] body chart as sex-neutral. In contrast, 20.1% (60/298) identified it as representing a male body, while 11.4% (34/298) perceived it as female. Chi-square tests revealed no significant differences in response distributions based on sex, age group, current or past back pain experience, or educational background. However, a significant association was observed for race: participants who identified as White were more likely to perceive the body chart as sex-neutral compared to those who identified as Asian; Black; Latino or Hispanic; Middle Eastern; Indigenous, Aboriginal, or First Nations; or “Other” ([Table 3](#)).

Table 2. Survey sample characteristics (n=298).

Characteristics	Value
Age (y)	
Mean (SD)	46.16 (15.35)
Min	18
Max	79
Current back pain, n (%)	
Yes	154 (51.7)
Back pain in past, n (%)	
Yes	239 (80.2)
Participants’ sex, n (%)	
Female	154 (51.7)
Male	144 (48.3)
Participants’ gender, n (%)	
Woman	148 (49.7)
Man	133 (44.6)
Other	2 (0.7)
Missing	15 (5)
Education, n (%)	
Nontertiary	134 (45)
No formal qualification	2
Lower secondary qualification	21
Upper secondary qualification without university access	80
University entry qualification	31
Tertiary	164 (55)
Post-secondary below bachelor’s level	10
Bachelor’s level	96
Master’s level and higher	58
Race, n (%)	
Asian	24 (8.1)
Black	12 (4)
Indigenous, Aboriginal, or First Nations	0 (0)
Latino or Hispanic	1 (0.3)
Middle Eastern	6 (2)

Characteristics	Value
Other	6 (2)
White	248 (83.2)
I prefer not to answer	5 (1.7)

Table 3. Responses to the question: “Does this body chart represent a female, male, or sex-neutral body?” by participants’ sex, age, back pain experience, education, and race.

Variable	Body chart, n (%)			Chi-square (df)	P value
	Sex-neutral	Male	Female		
Participants’ sex				0.3 (2)	.92
Female (n=154)	104 (67.5)	31 (20.1)	19 (12.3)		
Male (n=144)	100 (69.4)	29 (20.1)	15 (10.4)		
Age groups (y)				4.3 (2)	.13
≤46 (n=139)	87 (62.6)	34 (24.5)	18 (13)		
>46 (n=159)	117 (73.6)	26 (16.4)	16 (10.1)		
Current back pain				0.9 (2)	.66
No (n=144)	97 (67.4)	32 (22.2)	15 (10.4)		
Yes (n=154)	107 (69.5)	28 (18.2)	19 (12.3)		
Past back pain				1.1 (2)	.57
No (n=59)	38 (64.4)	12 (20.3)	9 (15.3)		
Yes (n=239)	166 (69.5)	48 (20.1)	25 (10.5)		
Educational attainment				1.0 (2)	.61
Nontertiary (n=134)	93 (69.4)	24 (17.9)	17 (12.7)		
Tertiary (n=164)	111 (67.7)	36 (22)	17 (10.4)		
Race				15.9 (2)	.001
Other racial groups ^a (n=40)	17 (42.5)	13 (32.5)	10 (25)		
Largest racial group ^b (n=248)	181 (73)	44 (17.7)	23 (9.3)		

^a “Other racial groups” includes participants who identified as Asian, Black, Middle Eastern, Latino or Hispanic, Indigenous, Aboriginal, First Nations, or “Other” (including multiracial).

^b “Largest racial group” includes participants who identified as White.

Most participants (189/298, 63.4%) indicated that it was not important to them to be able to choose between female, male, or sex-neutral versions of the body chart. This included 53.3% (82/154) of female participants and 74.3% (107/144) of male participants. When given the option, over half of the female participants (85/154; 55.2%) said they would choose a female body chart, while 46.1% (71/154) preferred a sex-neutral body chart, and 2 (1.3%) selected a male body chart. In contrast, nearly two-thirds of male participants (88/144, 61.1%) preferred a sex-neutral body chart, 36.1% (52/144) chose a male body chart, 2.8% (4/144) opted for a female body chart. Two participants did not identify with the sex assigned to them at birth; both were assigned male and identified as women. One rated the body chart as male, preferred a female body chart, and expressed that having the option to choose is important. The other rated the chart as sex-neutral, preferred a sex-neutral chart, and reported that the option to choose is not important. Due to the small number of participants with diverse gender identities, no conclusions can be drawn regarding their perceptions and preferences.

Discussion

Principal Results

Our review revealed that the vast majority of articles in the back pain literature do not explicitly report the sex of the body chart used, nor do they indicate an intention of sex neutrality. Very few articles included both male and female versions of body charts. In our expert opinion study, over half of the body charts were classified as “male” and did not accurately reflect the sex of the study participants. Specifically, two-thirds were identified as male-biased—meaning male body charts were used in studies that did not exclusively involve male participants. Agreement among expert raters ranged from fair to moderate, with stronger agreement observed among female raters than male raters. This suggests that assessing the sex of body charts is inherently challenging. While many charts may have been designed to be sex-neutral, they are not consistently perceived as such. In contrast, Lukic et al’s [10] body chart—explicitly designed as sex-neutral by an interdisciplinary team—was perceived as sex-neutral by two-thirds of male and female survey participants, regardless of age, back pain experience (current or past), or education

level. However, a significant difference emerged by race: participants who identified as White were more likely to perceive the chart as sex-neutral compared to those who did not identify as White. In terms of preference, female participants showed a slight inclination toward female body charts over sex-neutral ones, while male participants clearly preferred sex-neutral charts over male ones. Notably, both male and female participants generally considered the ability to choose among body chart versions to be of little importance. These findings suggest that a well-designed sex-neutral body chart is broadly accepted by both male and female users and holds the potential for promoting greater sex and gender inclusivity in PDs.

Comparison With Prior Work

Despite the introduction of sex-specific PD body charts in the late 1980s [3], our findings show that most subsequent studies have continued to use a single body chart—typically perceived as male—to represent both male and female participants. This supports previous observations noting that most PD body charts used in the literature are male [1,7]. To more accurately reflect the diversity of study participants, future studies could either provide different versions of body charts that align with the sex or gender of participants [8,19, 20] or offer a sex-neutral version that is broadly perceived as truly neutral [10].

The variability in expert ratings underscores the subjectivity involved in perceiving sex representations. What one expert identifies as male, female, or sex-neutral may differ from another's interpretation, even when both have similar anatomical training and expertise. This echoes earlier findings showing variability in how study participants perceive sex in body charts [7]. Such discrepancies may stem from individual experiences and implicit biases, as well as from the design of body charts that omit explicit sex-specific cues. While the absence of these cues is likely intended to enhance neutrality, it may also make interpretation difficult, leading to the fair to moderate agreement levels observed in our study. This suggests that many of the body charts found in the literature were likely intended to be sex-neutral but were not consistently interpreted as such—instead, they are most often interpreted as “male.”

A male bias has been well-documented in human sex perception and anatomical illustrations. Research indicates that when faced with ambiguity or uncertainty, humans are more likely to perceive a figure as male [123,124]. This perceptual bias may have evolutionary roots: misidentifying a potentially dangerous individual (typically male) as female could have higher survival costs, aligning with instinctual self-preservation mechanisms [123]. Therefore, “male” often becomes the default in sex perception, while “female” is only assumed when explicit female sex cues are present [124]. This phenomenon aligns with our findings and may help explain why body charts with ambiguous or unclear sex cues were predominantly perceived as male. Additionally, the design of the body charts themselves—even when designed to be sex-neutral—may reflect a bias toward male figures. Such bias is not unique to PDs but mirrors a broader trend

in anatomical illustrations, where male figures are overrepresented, reinforcing the male body as the normative standard [125-129].

Given this observed male bias and the imbalance in sex representation, it is essential to consider the needs and preferences of individuals currently underrepresented in PD tools. Our survey results suggest that a truly sex-neutral body chart is well-accepted by both male and female individuals. While female individuals showed a slight preference for a female-specific body chart, the option to choose between different body chart versions was generally not considered crucial. This nuance builds on the findings of Egsgaard et al [1], who reported a preference among female participants for female body charts. It is important to note, however, that participants in Egsgaard et al's study [1] were only presented with male and female options—without the inclusion of a sex-neutral alternative. Interestingly, while female participants in that study expressed a clear preference for female body charts over male ones, more than half indicated that the ability to choose was not particularly important. This aligns with our results, suggesting that although preferences exist, they may not be a crucial factor in pain reporting. The methodological difference in body chart options presented likely accounts for the partial discrepancy in findings between our study and the study by Egsgaard et al [1]. Together, these insights highlight the potential value of including truly sex-neutral body charts in PD tools, as they may offer a more inclusive and representative option for diverse patient populations while still accommodating those with a preference for sex-specific representations.

Limitations

Our scoping review aimed for comprehensiveness but was limited by language restrictions (English and German) and the exclusive use of the MEDLINE database. These constraints may have introduced selection bias, potentially excluding relevant literature and culturally specific body charts. Future research should expand language criteria and database inclusion to ensure a more comprehensive review. Another potential limitation is that some articles may have displayed only a single body chart, despite using multiple charts in their study. This could have led to misinterpretations and inaccurate conclusions in our review.

Regarding the expert assessment, an important limitation was the lack of cultural diversity among the experts, as all experts self-identified as White. Future studies should aim to include a more diverse panel to assess how cultural backgrounds might influence perceptions of the body charts.

Similarly, of the 298 survey participants, only 40 did not identify as White, which limits the generalizability of our findings to racially diverse populations. Despite this, the survey sample was broad in terms of age and educational background and approximately balanced in terms of sex. Future research should explore how the body chart designed by Lukic et al [10] is perceived by individuals from a broader range of racial and cultural backgrounds to better understand its cross-cultural applicability and inclusivity.

Clinical Implications

The observed acceptance of our sex-neutral body chart across sexes highlights the potential of sex-neutral PD tools to offer a more universally applicable approach to pain assessment. These tools may be particularly valuable in clinical settings where traditional sex-specific charts are impractical or where sex information is unavailable or deemed nonessential—for example, in emergency care settings, large-scale epidemiological studies, or in the care of nonbinary and transgender individuals. This approach aligns with a growing shift toward inclusivity in medical tools, such as the development of non-sex-specific growth charts for transgender youth [125]. Moreover, sex-neutral PD tools could be particularly beneficial in digital health applications, where standardized, sex-neutral inputs would facilitate automated analysis and improve consistency across diverse populations.

Conclusions

Our scoping review and subsequent studies reveal important gaps and biases in the reporting and representation of sex

Funding

This research was supported by the Digitalization Initiative of the Zurich Higher Education Institutions. The views expressed in this publication are those of the authors and do not necessarily reflect those of the funding body. The funder had no role in the study's design, data collection, analysis, interpretation, or manuscript writing.

Authors' Contributions

Conceptualization: CMW (lead), SS (supporting), CM (equal), YXL (equal), CC-A (equal), GC (equal), RS (equal), CJL (equal), PA (equal), JL-A (supporting)

Data curation: SS

Formal analysis: SS

Funding acquisition: CMW (equal), PA (equal)

Investigation: SS (lead), CM (equal), YXL (equal), CC-A (equal), GC (equal), BAL (equal), SM (equal), LN (equal), GWK (equal), CJL (equal), JL-A (supporting), CMW (supporting)

Methodology: SS (lead), YXL (equal), JL-A (equal), CMW (equal)

Project administration: SS (lead), JL-A (supporting)

Resources: CMW

Supervision: CMW (lead), JL-A (supporting)

Visualization: SS

Writing – original draft: SS

Writing – review & editing: CMW (lead), CM (equal), YXL (equal), CC-A (equal), GC (equal), BAL (equal), SM (equal), LN (equal), GWK (equal), RS (equal), CJL (equal), PA (equal), JL-A (equal)

Conflicts of Interest

CMW has active research grants to the University for digital health projects from the Digitalization Initiative of the Zurich Higher Education Institutions, the Swiss Cancer Research Foundation, the Swiss National Science Foundation, the German Health Care Innovation Fund, and Newsense Lab GmbH and has received honoraria from Swiss hospitals for scientific presentations on digitalization and artificial intelligence in medicine. The radiology department of the Balgrist University Hospital has an academic research collaboration with Siemens Healthineers and Bayer. The remaining authors declare no conflicts of interest.

Multimedia Appendix 1

Search strategy.

[[DOCX File \(Microsoft Word File\), 15 KB](#)-[Multimedia Appendix 1](#)]

Multimedia Appendix 2

Data extraction tool.

[[XLSX File \(Microsoft Excel File\), 13 KB](#)-[Multimedia Appendix 2](#)]

Multimedia Appendix 3

References to included studies.

[[DOCX File \(Microsoft Word File\), 131 KB-Multimedia Appendix 3](#)]

Multimedia Appendix 4

Body charts with 100% agreement among all 6 experts.

[[DOCX File \(Microsoft Word File\), 1269 KB-Multimedia Appendix 4](#)]

References

1. Egsgaard LL, Christensen TS, Petersen IM, Brønnum DS, Boudreau SA. Do gender-specific and high-resolution three dimensional body charts facilitate the communication of pain for women? A quantitative and qualitative study. *JMIR Hum Factors*. Jul 20, 2016;3(2):e19. [doi: [10.2196/humanfactors.5693](#)] [Medline: [27440737](#)]
2. Shaballout N, Neubert TA, Boudreau S, Beissner F. From paper to digital applications of the pain drawing: systematic review of methodological milestones. *JMIR mHealth mHealth*. Sep 5, 2019;7(9):e14569. [doi: [10.2196/14569](#)] [Medline: [31489841](#)]
3. Udén A, Aström M, Bergenudd H. Pain drawings in chronic back pain. *Spine (Phila Pa 1976)*. Apr 1988;13(4):389-392. [doi: [10.1097/00007632-198804000-00002](#)] [Medline: [2970123](#)]
4. Toomingas A. Characteristics of pain drawings in the neck-shoulder region among the working population. *Int Arch Occup Environ Health*. Mar 1999;72(2):98-106. [doi: [10.1007/s004200050344](#)] [Medline: [10197481](#)]
5. George SZ, Bialosky JE, Wittmer VT, Robinson ME. Sex differences in pain drawing area for individuals with chronic musculoskeletal pain. *J Orthop Sports Phys Ther*. Mar 2007;37(3):115-121. [doi: [10.2519/jospt.2007.2399](#)] [Medline: [17416126](#)]
6. Jamison RN, Fanciullo GJ, Baird JC. Usefulness of pain drawings in identifying real or imagined pain: accuracy of pain professionals, nonprofessionals, and a decision model. *J Pain*. Nov 2004;5(9):476-482. [doi: [10.1016/j.jpain.2004.08.004](#)] [Medline: [15556825](#)]
7. Szczypien N, Ruchay Z, Ruchay Z, Müller SV, Kaiser C, Klawonn F. Sex-specific differences in pain localization in female patients with endometriosis: a comparison of sexless and female human body outlines. *Brain Behav*. Dec 2023;13(12):e3285. [doi: [10.1002/brb3.3285](#)] [Medline: [37853673](#)]
8. Cruder C, Falla D, Mangili F, et al. Profiling the location and extent of musicians' pain using digital pain drawings. *Pain Pract*. Jan 2018;18(1):53-66. [doi: [10.1111/papr.12581](#)] [Medline: [28466572](#)]
9. Neubert TA, Dusch M, Karst M, Beissner F. Designing a tablet-based software app for mapping bodily symptoms: usability evaluation and reproducibility analysis. *JMIR mHealth uHealth*. May 30, 2018;6(5):e127. [doi: [10.2196/mhealth.8409](#)] [Medline: [29848470](#)]
10. Lukic YX, Schläpfer S, Holler A, et al. Open-source anatomical illustration for digital back pain documentation: development and evaluation. *JMIR Preprints*. [doi: [10.2196/preprints.75737](#)]
11. 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):2. [doi: [10.1186/s41073-016-0007-6](#)] [Medline: [29451543](#)]
12. Schläpfer S, Lopez-Alcalde J, Murphy C, et al. Scoping review. Open Science Framework. Mar 20, 2025. URL: <https://osf.io/pbuch/> [Accessed 2024-07-01]
13. Prolific. 2024. URL: <https://www.prolific.com> [Accessed 2026-01-17]
14. Lavrakas P. Encyclopedia of Survey Research Methods. Sage Publications, Inc; 2008. [doi: [10.4135/9781412963947](#)] ISBN: 9781506317885
15. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. *Syst Rev*. Dec 5, 2016;5(1):210. [doi: [10.1186/s13643-016-0384-4](#)] [Medline: [27919275](#)]
16. Gwet K. Handbook of Inter-Rater Reliability: The Definitive Guide to Measuring the Extent of Agreement Among Raters. Advanced Analytics, LLC; 2014. ISBN: 9780970806284
17. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics*. Mar 1977;33(1):159-174. [doi: [10.2307/2529310](#)] [Medline: [843571](#)]
18. Alter BJ, Anderson NP, Gillman AG, Yin Q, Jeong JH, Wasan AD. Hierarchical clustering by patient-reported pain distribution alone identifies distinct chronic pain subgroups differing by pain intensity, quality, and clinical outcomes. *PLoS ONE*. 2021;16(8):e0254862. [doi: [10.1371/journal.pone.0254862](#)] [Medline: [34347793](#)]
19. Barbero M, Moresi F, Leoni D, Gatti R, Egloff M, Falla D. Test-retest reliability of pain extent and pain location using a novel method for pain drawing analysis. *Eur J Pain*. Sep 2015;19(8):1129-1138. [doi: [10.1002/ejp.636](#)] [Medline: [25565607](#)]

20. Barbero M, Piff M, Evans D, Falla D. Do metrics derived from self-reported and clinician-reported pain drawings agree for individuals with chronic low back pain? *Musculoskelet Sci Pract.* Nov 2023;68:102871. [doi: [10.1016/j.msksp.2023.102871](https://doi.org/10.1016/j.msksp.2023.102871)] [Medline: [37832508](https://pubmed.ncbi.nlm.nih.gov/37832508/)]
21. Hildebrandt J, Franz CE, Choroba-mehnen B, Temme M. The use of pain drawings in screening for psychological involvement in complaints of low-back pain. *Spine (Phila Pa 1986).* Jun 1988;13(6):681-685. [doi: [10.1097/00007632-198813060-00016](https://doi.org/10.1097/00007632-198813060-00016)] [Medline: [2972073](https://pubmed.ncbi.nlm.nih.gov/2972073/)]
22. Starzec M, Truszczyńska-Baszak A, Tarnowski A, Rongies W. Pregnancy-related pelvic girdle pain in Polish and Norwegian women. *J Manipulative Physiol Ther.* Feb 2019;42(2):117-124. [doi: [10.1016/j.jmpt.2019.03.002](https://doi.org/10.1016/j.jmpt.2019.03.002)] [Medline: [31126521](https://pubmed.ncbi.nlm.nih.gov/31126521/)]
23. Abbott JH, Foster M, Hamilton L, Ravenwood M, Tan N. Validity of pain drawings for predicting psychological status outcome in patients with recurrent or chronic low back pain. *J Man Manip Ther.* Feb 2015;23(1):12-19. [doi: [10.1179/2042618613Y.0000000046](https://doi.org/10.1179/2042618613Y.0000000046)] [Medline: [26309377](https://pubmed.ncbi.nlm.nih.gov/26309377/)]
24. Albert HB, Hansen JK, Søgaard H, Kent P. Where do patients with MRI-confirmed single-level radiculopathy experience pain, and what is the clinical interpretability of these pain patterns? A cross-sectional diagnostic accuracy study. *Chiropr Man Therap.* 2019;27(1):50. [doi: [10.1186/s12998-019-0273-8](https://doi.org/10.1186/s12998-019-0273-8)] [Medline: [31608144](https://pubmed.ncbi.nlm.nih.gov/31608144/)]
25. Alev L, Fujikoshi S, Yoshikawa A, et al. Duloxetine 60 mg for chronic low back pain: post hoc responder analysis of double-blind, placebo-controlled trials. *J Pain Res.* 2017;10:1723-1731. [doi: [10.2147/JPR.S138297](https://doi.org/10.2147/JPR.S138297)] [Medline: [28769588](https://pubmed.ncbi.nlm.nih.gov/28769588/)]
26. Andersen T, Christensen FB, Hansen ES, Bünger C. Pain 5 years after instrumented and non-instrumented posterolateral lumbar spinal fusion. *Eur Spine J.* Aug 2003;12(4):393-399. [doi: [10.1007/s00586-003-0547-6](https://doi.org/10.1007/s00586-003-0547-6)] [Medline: [12756629](https://pubmed.ncbi.nlm.nih.gov/12756629/)]
27. Andersen T, Christensen FB, Høy KW, et al. The predictive value of pain drawings in lumbar spinal fusion surgery. *Spine J.* May 2010;10(5):372-379. [doi: [10.1016/j.spinee.2010.02.002](https://doi.org/10.1016/j.spinee.2010.02.002)] [Medline: [20421073](https://pubmed.ncbi.nlm.nih.gov/20421073/)]
28. Apeldoorn AT, Bosselaar H, Ostelo RW, et al. Identification of patients with chronic low back pain who might benefit from additional psychological assessment. *Clin J Pain.* Jan 2012;28(1):23-31. [doi: [10.1097/AJP.0b013e31822019d0](https://doi.org/10.1097/AJP.0b013e31822019d0)] [Medline: [21677570](https://pubmed.ncbi.nlm.nih.gov/21677570/)]
29. Bertilson BC, Brosjö E, Billing H, Strender LE. Assessment of nerve involvement in the lumbar spine: agreement between magnetic resonance imaging, physical examination and pain drawing findings. *BMC Musculoskelet Disord.* Sep 10, 2010;11:202. [doi: [10.1186/1471-2474-11-202](https://doi.org/10.1186/1471-2474-11-202)] [Medline: [20831785](https://pubmed.ncbi.nlm.nih.gov/20831785/)]
30. Bishop MD, Horn ME, George SZ, Robinson ME. Self-reported pain and disability outcomes from an endogenous model of muscular back pain. *BMC Musculoskelet Disord.* Feb 2, 2011;12:35. [doi: [10.1186/1471-2474-12-35](https://doi.org/10.1186/1471-2474-12-35)] [Medline: [21288349](https://pubmed.ncbi.nlm.nih.gov/21288349/)]
31. Bishop MD, Horn ME, Lott DJ, Arpan I, George SZ. Magnitude of spinal muscle damage is not statistically associated with exercise-induced low back pain intensity. *Spine J.* Dec 2011;11(12):1135-1142. [doi: [10.1016/j.spinee.2011.11.005](https://doi.org/10.1016/j.spinee.2011.11.005)] [Medline: [22208857](https://pubmed.ncbi.nlm.nih.gov/22208857/)]
32. Boudreau SA, Badsberg S, Christensen SW, Egsgaard LL. Digital pain drawings: assessing touch-screen technology and 3D body schemas. *Clin J Pain.* Feb 2016;32(2):139-145. [doi: [10.1097/AJP.0000000000000230](https://doi.org/10.1097/AJP.0000000000000230)] [Medline: [25756558](https://pubmed.ncbi.nlm.nih.gov/25756558/)]
33. Burkey AR, Kanetsky PA. Development of a novel location-based assessment of sensory symptoms in cancer patients: preliminary reliability and validity assessment. *J Pain Symptom Manage.* May 2009;37(5):848-862. [doi: [10.1016/j.jpainsympman.2008.05.013](https://doi.org/10.1016/j.jpainsympman.2008.05.013)] [Medline: [19059751](https://pubmed.ncbi.nlm.nih.gov/19059751/)]
34. Falla D, Peolsson A, Peterson G, et al. Perceived pain extent is associated with disability, depression and self-efficacy in individuals with whiplash-associated disorders. *Eur J Pain.* Oct 2016;20(9):1490-1501. [doi: [10.1002/ejp.873](https://doi.org/10.1002/ejp.873)] [Medline: [27149920](https://pubmed.ncbi.nlm.nih.gov/27149920/)]
35. Friedrich M, Gittler G, Pieler-Bruha E. Misleading history of pain location in 51 patients with osteoporotic vertebral fractures. *Eur Spine J.* Dec 2006;15(12):1797-1800. [doi: [10.1007/s00586-006-0065-4](https://doi.org/10.1007/s00586-006-0065-4)] [Medline: [16463199](https://pubmed.ncbi.nlm.nih.gov/16463199/)]
36. Hägg O, Fritzell P, Hedlund R, et al. Pain-drawing does not predict the outcome of fusion surgery for chronic low-back pain: a report from the Swedish Lumbar Spine Study. *Eur Spine J.* Feb 2003;12(1):2-11. [doi: [10.1007/s00586-002-0427-5](https://doi.org/10.1007/s00586-002-0427-5)] [Medline: [12592541](https://pubmed.ncbi.nlm.nih.gov/12592541/)]
37. Chan CW, Goldman S, Ilstrup DM, Kunselman AR, O'Neill PI. The pain drawing and Waddell's nonorganic physical signs in chronic low-back pain. *Spine (Phila Pa 1976).* Oct 1, 1993;18(13):1717-1722. [doi: [10.1097/00007632-199310000-00001](https://doi.org/10.1097/00007632-199310000-00001)] [Medline: [8235853](https://pubmed.ncbi.nlm.nih.gov/8235853/)]
38. Cleland JA, Childs JD, Palmer JA, Eberhart S. Slump stretching in the management of non-radicular low back pain: a pilot clinical trial. *Man Ther.* Nov 2006;11(4):279-286. [doi: [10.1016/j.math.2005.07.002](https://doi.org/10.1016/j.math.2005.07.002)] [Medline: [16380286](https://pubmed.ncbi.nlm.nih.gov/16380286/)]
39. Corrêa LA, Bittencourt JV, Ferreira A de S, Reis F, de Almeida RS, Nogueira LAC. The reliability and concurrent validity of PainMAP software for automated quantification of pain drawings on body charts of patients with low back pain. *Pain Pract.* Jun 2020;20(5):462-470. [doi: [10.1111/papr.12872](https://doi.org/10.1111/papr.12872)] [Medline: [31961038](https://pubmed.ncbi.nlm.nih.gov/31961038/)]

40. De Oliveira Paes Leme M, Yuan SLK, Oliveira Magalhães M, Ferreira de Meneses SR, Marques AP. Pain and quality of life in knee osteoarthritis, chronic low back pain and fibromyalgia: a comparative cross-sectional study. *Reumatismo*. Jul 9, 2019;71(2):68-74. [doi: [10.4081/reumatismo.2019.1104](https://doi.org/10.4081/reumatismo.2019.1104)] [Medline: [31309776](https://pubmed.ncbi.nlm.nih.gov/31309776/)]

41. Dean LE, Arnold L, Crofford L, et al. Impact of moving from a widespread to multisite pain definition on other fibromyalgia symptoms. *Arthritis Care Res (Hoboken)*. Dec 2017;69(12):1878-1886. [doi: [10.1002/acr.23214](https://doi.org/10.1002/acr.23214)] [Medline: [28182834](https://pubmed.ncbi.nlm.nih.gov/28182834/)]

42. Dyrehag LE, Widerström-Noga EG, Carlsson SG, et al. Relations between self-rated musculoskeletal symptoms and signs and psychological distress in chronic neck and shoulder pain. *Scand J Rehabil Med*. Dec 1998;30(4):235-242. [doi: [10.1080/003655098443986](https://doi.org/10.1080/003655098443986)] [Medline: [9825388](https://pubmed.ncbi.nlm.nih.gov/9825388/)]

43. Ekman P, Möller H, Hedlund R. Predictive factors for the outcome of fusion in adult isthmic spondylolisthesis. *Spine (Phila Pa 1976)*. May 15, 2009;34(11):1204-1210. [doi: [10.1097/BRS.0b013e3181a19e66](https://doi.org/10.1097/BRS.0b013e3181a19e66)] [Medline: [19444068](https://pubmed.ncbi.nlm.nih.gov/19444068/)]

44. Galve Villa M, Palsson TS, Boudreau SA. Spatiotemporal patterns of pain distribution and recall accuracy: a dose-response study. *Scand J Pain*. Jan 27, 2022;22(1):154-166. [doi: [10.1515/sjpain-2021-0032](https://doi.org/10.1515/sjpain-2021-0032)] [Medline: [34343420](https://pubmed.ncbi.nlm.nih.gov/34343420/)]

45. Georgopoulos V, Akin-Akinyosoye K, Smith S, McWilliams DF, Hendrick P, Walsh DA. An observational study of centrally facilitated pain in individuals with chronic low back pain. *Pain Rep*. 2022;7(3):e1003. [doi: [10.1097/PR9.0000000000001003](https://doi.org/10.1097/PR9.0000000000001003)] [Medline: [35441119](https://pubmed.ncbi.nlm.nih.gov/35441119/)]

46. Gerhardt A, Hartmann M, Blumenstiel K, Tesarz J, Eich W. The prevalence rate and the role of the spatial extent of pain in nonspecific chronic back pain--a population-based study in the south-west of Germany. *Pain Med*. Jul 2014;15(7):1200-1210. [doi: [10.1111/pme.12286](https://doi.org/10.1111/pme.12286)] [Medline: [24341931](https://pubmed.ncbi.nlm.nih.gov/24341931/)]

47. Gerhardt A, Eich W, Janke S, Leisner S, Treede RD, Tesarz J. Chronic widespread back pain is distinct from chronic local back pain: evidence from quantitative sensory testing, pain drawings, and psychometrics. *Clin J Pain*. Jul 2016;32(7):568-579. [doi: [10.1097/AJP.0000000000000300](https://doi.org/10.1097/AJP.0000000000000300)] [Medline: [26379077](https://pubmed.ncbi.nlm.nih.gov/26379077/)]

48. Gerhardt A, Eich W, Treede RD, Tesarz J. Conditioned pain modulation in patients with nonspecific chronic back pain with chronic local pain, chronic widespread pain, and fibromyalgia. *Pain*. Mar 2017;158(3):430-439. [doi: [10.1097/j.pain.0000000000000777](https://doi.org/10.1097/j.pain.0000000000000777)] [Medline: [27902566](https://pubmed.ncbi.nlm.nih.gov/27902566/)]

49. Goldstein P, Ashar Y, Tesarz J, Kazgan M, Cetin B, Wager TD. Emerging clinical technology: application of machine learning to chronic pain assessments based on emotional body maps. *Neurotherapeutics*. Jul 2020;17(3):774-783. [doi: [10.1007/s13311-020-00886-7](https://doi.org/10.1007/s13311-020-00886-7)] [Medline: [32767227](https://pubmed.ncbi.nlm.nih.gov/32767227/)]

50. Grunnesjö M, Bøgefældt J, Blomberg S, Delaney H, Svärdsudd K. The course of pain drawings during a 10-week treatment period in patients with acute and sub-acute low back pain. *BMC Musculoskelet Disord*. Aug 11, 2006;7:65. [doi: [10.1186/1471-2474-7-65](https://doi.org/10.1186/1471-2474-7-65)] [Medline: [16901354](https://pubmed.ncbi.nlm.nih.gov/16901354/)]

51. Hartvigsen J, Davidsen M, Hestbaek L, Sogaard K, Roos EM. Patterns of musculoskeletal pain in the population: a latent class analysis using a nationally representative interviewer-based survey of 4817 Danes. *Eur J Pain*. Mar 2013;17(3):452-460. [doi: [10.1002/j.1532-2149.2012.00225.x](https://doi.org/10.1002/j.1532-2149.2012.00225.x)] [Medline: [23042697](https://pubmed.ncbi.nlm.nih.gov/23042697/)]

52. Hayashi K, Arai YCP, Morimoto A, et al. Associations between pain drawing and psychological characteristics of different body region pains. *Pain Pract*. Apr 2015;15(4):300-307. [doi: [10.1111/papr.12173](https://doi.org/10.1111/papr.12173)] [Medline: [24571521](https://pubmed.ncbi.nlm.nih.gov/24571521/)]

53. Kapitza C, Lüdtke K, Tampin B, Ballenberger N. Application and utility of a clinical framework for spinally referred neck-arm pain: a cross-sectional and longitudinal study protocol. *PLoS One*. 2020;15(12):e0244137. [doi: [10.1371/journal.pone.0244137](https://doi.org/10.1371/journal.pone.0244137)] [Medline: [33370389](https://pubmed.ncbi.nlm.nih.gov/33370389/)]

54. Kennedy DJ, Mattie R, Nguyen Q, Hamilton S, Conrad B. Glenohumeral joint pain referral patterns: a descriptive study. *Pain Med*. Aug 2015;16(8):1603-1609. [doi: [10.1111/pme.12797](https://doi.org/10.1111/pme.12797)] [Medline: [26184392](https://pubmed.ncbi.nlm.nih.gov/26184392/)]

55. Hoshino H, Sasaki N, Ide K, Yamato Y, Watanabe Y, Matsuyama Y. Effect of central sensitization inventory on the number of painful sites and pain severity in a Japanese regional population cohort. *J Orthop Sci*. Jul 2022;27(4):929-934. [doi: [10.1016/j.jos.2021.05.003](https://doi.org/10.1016/j.jos.2021.05.003)] [Medline: [34120827](https://pubmed.ncbi.nlm.nih.gov/34120827/)]

56. Hsieh PH, Chang Y, Chen DW, Lee MS, Shih HN, Ueng SWN. Pain distribution and response to total hip arthroplasty: a prospective observational study in 113 patients with end-stage hip disease. *J Orthop Sci*. May 2012;17(3):213-218. [doi: [10.1007/s00776-012-0204-1](https://doi.org/10.1007/s00776-012-0204-1)] [Medline: [22427017](https://pubmed.ncbi.nlm.nih.gov/22427017/)]

57. Huang P, Sengupta DK. How fast pain, numbness, and paresthesia resolves after lumbar nerve root decompression: a retrospective study of patient's self-reported computerized pain drawing. *Spine (Phila Pa 1976)*. Apr 15, 2014;39(8):E529-E536. [doi: [10.1097/BRS.000000000000240](https://doi.org/10.1097/BRS.000000000000240)] [Medline: [24480941](https://pubmed.ncbi.nlm.nih.gov/24480941/)]

58. Knox PJ, Simon CB, Pohlig RT, et al. Movement-evoked pain versus widespread pain: a longitudinal comparison in older adults with chronic low back pain from the Delaware Spine Studies. *J Pain*. Jun 2023;24(6):980-990. [doi: [10.1016/j.jpain.2023.01.012](https://doi.org/10.1016/j.jpain.2023.01.012)] [Medline: [36706887](https://pubmed.ncbi.nlm.nih.gov/36706887/)]

59. Lam K, Peolsson A, Soldini E, et al. Larger pain extent is associated with greater pain intensity and disability but not with general health status or psychosocial features in patients with cervical radiculopathy. *Medicine (Baltimore)*. Feb 26, 2021;100(8):e23718. [doi: [10.1097/MD.00000000000023718](https://doi.org/10.1097/MD.00000000000023718)] [Medline: [33663038](https://pubmed.ncbi.nlm.nih.gov/33663038/)]

60. Larsen LH, Hirata RP, Graven-Nielsen T. Pain-evoked trunk muscle activity changes during fatigue and DOMS. *Eur J Pain*. May 2017;21(5):907-917. [doi: [10.1002/ejp.993](https://doi.org/10.1002/ejp.993)] [Medline: [28106312](https://pubmed.ncbi.nlm.nih.gov/28106312/)]
61. Larsen LH, Hirata RP, Graven-Nielsen T. Reorganized trunk muscle activity during multidirectional floor perturbations after experimental low back pain: a comparison of bilateral versus unilateral pain. *J Pain*. Feb 2016;17(2):223-235. [doi: [10.1016/j.jpain.2015.10.012](https://doi.org/10.1016/j.jpain.2015.10.012)] [Medline: [26548972](https://pubmed.ncbi.nlm.nih.gov/26548972/)]
62. MacDowall A, Robinson Y, Skeppholm M, Olerud C. Anxiety and depression affect pain drawings in cervical degenerative disc disease. *Ups J Med Sci*. Jun 2017;122(2):99-107. [doi: [10.1080/03009734.2017.1319441](https://doi.org/10.1080/03009734.2017.1319441)] [Medline: [28503982](https://pubmed.ncbi.nlm.nih.gov/28503982/)]
63. Masferrer R, Prendergast V, Hagell P. Colored pain drawings: preliminary observations in a neurosurgical practice. *Eur J Pain*. 2003;7(3):213-217. [doi: [10.1016/S1090-3801\(02\)00113-1](https://doi.org/10.1016/S1090-3801(02)00113-1)] [Medline: [12725843](https://pubmed.ncbi.nlm.nih.gov/12725843/)]
64. McCormick ZL, Sperry BP, Boody BS, et al. Pain location and exacerbating activities associated with treatment success following basivertebral nerve ablation: an aggregated cohort study of multicenter prospective clinical trial data. *Pain Med*. Jul 20, 2022;23(Suppl 2):S14-S33. [doi: [10.1093/pm/pnac069](https://doi.org/10.1093/pm/pnac069)] [Medline: [35856332](https://pubmed.ncbi.nlm.nih.gov/35856332/)]
65. O'Neill S, Jensen TS, Kent P. Computerized quantification of pain drawings. *Scand J Pain*. Dec 18, 2019;20(1):175-189. [doi: [10.1515/sjpain-2019-0082](https://doi.org/10.1515/sjpain-2019-0082)] [Medline: [31605599](https://pubmed.ncbi.nlm.nih.gov/31605599/)]
66. Ohnmeiss DD. Repeatability of pain drawings in a low back pain population. *Spine (Phila Pa 1976)*. Apr 15, 2000;25(8):980-988. [doi: [10.1097/00007632-200004150-00014](https://doi.org/10.1097/00007632-200004150-00014)] [Medline: [10767812](https://pubmed.ncbi.nlm.nih.gov/10767812/)]
67. Ohnmeiss DD, Vanharanta H, Ekholm J. Degree of disc disruption and lower extremity pain. *Spine (Phila Pa 1976)*. Jul 15, 1997;22(14):1600-1605. [doi: [10.1097/00007632-199707150-00015](https://doi.org/10.1097/00007632-199707150-00015)] [Medline: [9253095](https://pubmed.ncbi.nlm.nih.gov/9253095/)]
68. Ohrbach R, Sharma S, Fillingim RB, Greenspan JD, Rosen JD, Slade GD. Clinical characteristics of pain among five chronic overlapping pain conditions. *J Oral Facial Pain Headache*. 2020;34(Suppl):s29-s42. [doi: [10.11607/ofph.2573](https://doi.org/10.11607/ofph.2573)] [Medline: [32975539](https://pubmed.ncbi.nlm.nih.gov/32975539/)]
69. Pfingsten M, Baller M, Liebeck H, Strube J, Hildebrandt J, Schöps P. Psychometric properties of the pain drawing and the Ransford technique in patients with chronic low back pain. *Schmerz*. Oct 2003;17(5):332-340. [doi: [10.1007/s00482-003-0223-0](https://doi.org/10.1007/s00482-003-0223-0)] [Medline: [14513340](https://pubmed.ncbi.nlm.nih.gov/14513340/)]
70. Prins MR, van der Wurff P, Groen GJ. Chronic low back pain patients with accompanying leg pain: the relationship between pain extent and pain intensity, disability and health status. *J Back Musculoskelet Rehabil*. 2013;26(1):55-61. [doi: [10.3233/BMR-2012-00350](https://doi.org/10.3233/BMR-2012-00350)] [Medline: [23411649](https://pubmed.ncbi.nlm.nih.gov/23411649/)]
71. Provenzano DA, Fanciullo GJ, Jamison RN, McHugo GJ, Baird JC. Computer assessment and diagnostic classification of chronic pain patients. *Pain Med*. Oct 2007;8 Suppl 3:S167-S175. [doi: [10.1111/j.1526-4637.2007.00379.x](https://doi.org/10.1111/j.1526-4637.2007.00379.x)] [Medline: [17877526](https://pubmed.ncbi.nlm.nih.gov/17877526/)]
72. Ris I, Barbero M, Falla D, et al. Pain extent is more strongly associated with disability, psychological factors, and neck muscle function in people with non-traumatic versus traumatic chronic neck pain: a cross sectional study. *Eur J Phys Rehabil Med*. Feb 2019;55(1):71-78. [doi: [10.23736/S1973-9087.18.04977-8](https://doi.org/10.23736/S1973-9087.18.04977-8)] [Medline: [30156084](https://pubmed.ncbi.nlm.nih.gov/30156084/)]
73. Rising DW, Bennett BC, Hursh K, Plesh O. Reports of body pain in a dental student population. *J Am Dent Assoc*. Jan 2005;136(1):81-86. [doi: [10.14219/jada.archive.2005.0032](https://doi.org/10.14219/jada.archive.2005.0032)] [Medline: [15693502](https://pubmed.ncbi.nlm.nih.gov/15693502/)]
74. Sorensen CJ, Johnson MB, Callaghan JP, George SZ, Van Dillen LR. Validity of a paradigm for low back pain symptom development during prolonged standing. *Clin J Pain*. Jul 2015;31(7):652-659. [doi: [10.1097/AJP.0000000000000148](https://doi.org/10.1097/AJP.0000000000000148)] [Medline: [25171636](https://pubmed.ncbi.nlm.nih.gov/25171636/)]
75. Southerst D, Stupar M, Côté P, Mior S, Stern P. The reliability of measuring pain distribution and location using body pain diagrams in patients with acute whiplash-associated disorders. *J Manipulative Physiol Ther*. Sep 2013;36(7):395-402. [doi: [10.1016/j.jmpt.2013.05.023](https://doi.org/10.1016/j.jmpt.2013.05.023)] [Medline: [23891480](https://pubmed.ncbi.nlm.nih.gov/23891480/)]
76. Spyridonis F, Ghinea G. A pilot study to examine the relationship of 3D pain drawings with objective measures in mobility impaired people suffering from low back-pain. *Annu Int Conf IEEE Eng Med Biol Soc*. 2010;2010:3895-3898. [doi: [10.1109/IEMBS.2010.5627668](https://doi.org/10.1109/IEMBS.2010.5627668)] [Medline: [21097077](https://pubmed.ncbi.nlm.nih.gov/21097077/)]
77. Sator-Katzenschlager S, Fiala K, Kress HG, et al. Subcutaneous target stimulation (STS) in chronic noncancer pain: a nationwide retrospective study. *Pain Pract*. 2010;10(4):279-286. [doi: [10.1111/j.1533-2500.2009.00351.x](https://doi.org/10.1111/j.1533-2500.2009.00351.x)] [Medline: [20230450](https://pubmed.ncbi.nlm.nih.gov/20230450/)]
78. Tesarz J, Gerhardt A, Leisner S, Janke S, Treede RD, Eich W. Distinct quantitative sensory testing profiles in nonspecific chronic back pain subjects with and without psychological trauma. *Pain*. Apr 2015;156(4):577-586. [doi: [10.1097/01.j.pain.0000460350.30707.8d](https://doi.org/10.1097/01.j.pain.0000460350.30707.8d)] [Medline: [25790450](https://pubmed.ncbi.nlm.nih.gov/25790450/)]
79. Vingård E, Mortimer M, Wiktorin C, et al. Seeking care for low back pain in the general population: a two-year follow-up study: results from the MUSIC-Norrtälje Study. *Spine (Phila Pa 1976)*. Oct 1, 2002;27(19):2159-2165. [doi: [10.1097/00007632-200210010-00016](https://doi.org/10.1097/00007632-200210010-00016)] [Medline: [12394932](https://pubmed.ncbi.nlm.nih.gov/12394932/)]

80. Vogel S, Magerl W, Treede RD, Schilder A. Dose-dependent pain and pain radiation after chemical stimulation of the thoracolumbar fascia and multifidus muscle: a single-blinded, cross-over study revealing a higher impact of fascia stimulation. *Life (Basel)*. Feb 25, 2022;12(3):340. [doi: [10.3390/life12030340](https://doi.org/10.3390/life12030340)] [Medline: [35330091](#)]

81. Wand BM, Keeves J, Bourgoin C, et al. Mislocalization of sensory information in people with chronic low back pain: a preliminary investigation. *Clin J Pain*. Aug 2013;29(8):737-743. [doi: [10.1097/AJP.0b013e318274b320](https://doi.org/10.1097/AJP.0b013e318274b320)] [Medline: [23835768](#)]

82. Tucker KJ, Fels M, Walker SR, Hodges PW. Comparison of location, depth, quality, and intensity of experimentally induced pain in 6 low back muscles. *Clin J Pain*. Sep 2014;30(9):800-808. [doi: [10.1097/AJP.0000000000000026](https://doi.org/10.1097/AJP.0000000000000026)] [Medline: [25098553](#)]

83. van den Hoven LHJ, Gorter KJ, Picavet HSJ. Measuring musculoskeletal pain by questionnaires: the manikin versus written questions. *Eur J Pain*. Mar 2010;14(3):335-338. [doi: [10.1016/j.ejpain.2009.06.002](https://doi.org/10.1016/j.ejpain.2009.06.002)] [Medline: [19699125](#)]

84. Weßollek K, Kowark A, Czaplik M, Rossaint R, Kowark P. Pain drawing as a screening tool for anxiety, depression and reduced health-related quality of life in back pain patients: a cohort study. *PLoS One*. 2021;16(10):e0258329. [doi: [10.1371/journal.pone.0258329](https://doi.org/10.1371/journal.pone.0258329)] [Medline: [34634060](#)]

85. Faucett J, Meyers J, Tejeda D, Janowitz I, Miles J, Kabashima J. An instrument to measure musculoskeletal symptoms among immigrant Hispanic farmworkers: validation in the nursery industry. *J Agric Saf Health*. Aug 2001;7(3):185-198. [doi: [10.13031/2013.5442](https://doi.org/10.13031/2013.5442)] [Medline: [11587195](#)]

86. Albaran J, Durham B, Gowers J, Dwight J, Chappell G. Is the radiation of chest pain a useful indicator of myocardial infarction? A prospective study of 541 patients. *Accid Emerg Nurs*. Jan 2002;10(1):2-9. [doi: [10.1054/aaen.2001.0304](https://doi.org/10.1054/aaen.2001.0304)] [Medline: [11998580](#)]

87. Cooper G, Bailey B, Bogduk N. Cervical zygapophysial joint pain maps. *Pain Med*. 2007;8(4):344-353. [doi: [10.1111/j.1526-4637.2006.00201.x](https://doi.org/10.1111/j.1526-4637.2006.00201.x)] [Medline: [17610457](#)]

88. Ohnmeiss DD, Vanharanta H, Ekholm J. Relation between pain location and disc pathology: a study of pain drawings and CT/discography. *Clin J Pain*. Sep 1999;15(3):210-217. [doi: [10.1097/00002508-199909000-00008](https://doi.org/10.1097/00002508-199909000-00008)] [Medline: [10524474](#)]

89. Ohnmeiss DD, Vanharanta H, Ekholm J. Relationship of pain drawings to invasive tests assessing intervertebral disc pathology. *Eur Spine J*. 1999;8(2):126-131. [doi: [10.1007/s005860050141](https://doi.org/10.1007/s005860050141)] [Medline: [10333151](#)]

90. Ohnmeiss DD, Vanharanta H, Guyer RD. The association between pain drawings and computed tomographic/discographic pain responses. *Spine (Phila Pa 1976)*. Mar 15, 1995;20(6):729-733. [doi: [10.1097/00007632-199503150-00015](https://doi.org/10.1097/00007632-199503150-00015)] [Medline: [7604350](#)]

91. Spyridonis F, Ghinea G. 3-D pain drawings and seating pressure maps: relationships and challenges. *IEEE Trans Inf Technol Biomed*. May 2011;15(3):409-415. [doi: [10.1109/TITB.2011.2107578](https://doi.org/10.1109/TITB.2011.2107578)] [Medline: [21257385](#)]

92. Visscher CM, Lobbezoo F, de Boer W, van der Meulen M, Naeije M. Psychological distress in chronic craniomandibular and cervical spinal pain patients. *Eur J Oral Sci*. Jun 2001;109(3):165-171. [doi: [10.1034/j.1600-0722.2001.00008.x](https://doi.org/10.1034/j.1600-0722.2001.00008.x)] [Medline: [11456346](#)]

93. Abichandani D, Barbero M, Cescon C, et al. Can people with chronic neck pain recognize their own digital pain drawing? *Pain Physician*. Mar 2020;23(2):E231-E240. [doi: [10.36076/ppj.2020/23/E231](https://doi.org/10.36076/ppj.2020/23/E231)] [Medline: [32214308](#)]

94. Clark EM, Hutchinson AP, McCloskey EV, et al. Lateral back pain identifies prevalent vertebral fractures in post-menopausal women: cross-sectional analysis of a primary care-based cohort. *Rheumatology (Oxford)*. Mar 2010;49(3):505-512. [doi: [10.1093/rheumatology/kep414](https://doi.org/10.1093/rheumatology/kep414)] [Medline: [20015975](#)]

95. Killinger KA, Boura JA, Peters KM. Pain in interstitial cystitis/bladder pain syndrome: do characteristics differ in ulcerative and non-ulcerative subtypes? *Int Urogynecol J*. Aug 2013;24(8):1295-1301. [doi: [10.1007/s00192-012-2003-9](https://doi.org/10.1007/s00192-012-2003-9)] [Medline: [23208005](#)]

96. Nilsson-Wikmar L, Pilo C, Pahlbäck M, Harms-Ringdahl K. Perceived pain and self-estimated activity limitations in women with back pain post-partum. *Physiother Res Int*. 2003;8(1):23-35. [doi: [10.1002/pri.269](https://doi.org/10.1002/pri.269)] [Medline: [12701463](#)]

97. Sturesson B, Udén G, Udén A. Pain pattern in pregnancy and “catching” of the leg in pregnant women with posterior pelvic pain. *Spine (Phila Pa 1976)*. Aug 15, 1997;22(16):1880-1883. [doi: [10.1097/00007632-199708150-00013](https://doi.org/10.1097/00007632-199708150-00013)] [Medline: [9280024](#)]

98. Türp JC, Kowalski CJ, O’Leary N, Stohler CS. Pain maps from facial pain patients indicate a broad pain geography. *J Dent Res*. Jun 1998;77(6):1465-1472. [doi: [10.1177/00220345980770061101](https://doi.org/10.1177/00220345980770061101)] [Medline: [9649175](#)]

99. Louw A, Schmidt SG, Louw C, Puentedura EJ. Moving without moving: immediate management following lumbar spine surgery using a graded motor imagery approach: a case report. *Physiother Theory Pract*. 2015;31(7):509-517. [doi: [10.3109/09593985.2015.1060656](https://doi.org/10.3109/09593985.2015.1060656)] [Medline: [26395828](#)]

100. Waling K, Sundelin G, Ahlgren C, Järvhholm B. Perceived pain before and after three exercise programs—a controlled clinical trial of women with work-related trapezius myalgia. *Pain*. Mar 2000;85(1-2):201-207. [doi: [10.1016/s0304-3959\(99\)00265-1](https://doi.org/10.1016/s0304-3959(99)00265-1)] [Medline: [10692619](#)]

101. Petersen EJ, Thurmond SM. Differential diagnosis in a patient presenting with both systemic and neuromusculoskeletal pathology: resident's case problem. *J Orthop Sports Phys Ther*. Jun 2018;48(6):496-503. [doi: [10.2519/jospt.2018.7652](https://doi.org/10.2519/jospt.2018.7652)] [Medline: [29406836](https://pubmed.ncbi.nlm.nih.gov/29406836/)]
102. Sandmark H, Nisell R. Measurement of pain among electricians with neck dysfunction. *Scand J Rehabil Med*. Dec 1994;26(4):203-209. [Medline: [7878395](https://pubmed.ncbi.nlm.nih.gov/7878395/)]
103. Türp JC, Kowalski CJ, Stohler CS. Temporomandibular disorders--pain outside the head and face is rarely acknowledged in the chief complaint. *J Prosthet Dent*. Dec 1997;78(6):592-595. [doi: [10.1016/s0022-3913\(97\)70010-6](https://doi.org/10.1016/s0022-3913(97)70010-6)] [Medline: [9421788](https://pubmed.ncbi.nlm.nih.gov/9421788/)]
104. Fukui S, Ohseto K, Shiotani M. Patterns of pain induced by distending the thoracic zygapophyseal joints. *Reg Anesth*. 1997;22(4):332-336. [doi: [10.1016/s1098-7339\(97\)80007-7](https://doi.org/10.1016/s1098-7339(97)80007-7)] [Medline: [9223198](https://pubmed.ncbi.nlm.nih.gov/9223198/)]
105. Jefferson JR, McGrath PJ. Back pain and peripheral joint pain in an industrial setting. *Arch Phys Med Rehabil*. Apr 1996;77(4):385-390. [doi: [10.1016/s0003-9993\(96\)90089-1](https://doi.org/10.1016/s0003-9993(96)90089-1)] [Medline: [8607764](https://pubmed.ncbi.nlm.nih.gov/8607764/)]
106. Hülleman P, Keller T, Kabelitz M, Freyhagen R, Tölle T, Baron R. Pain drawings improve subgrouping of low back pain patients. *Pain Pract*. Mar 2017;17(3):293-304. [doi: [10.1111/papr.12470](https://doi.org/10.1111/papr.12470)] [Medline: [27334429](https://pubmed.ncbi.nlm.nih.gov/27334429/)]
107. Kloimstein H, Likar R, Kern M, et al. Peripheral nerve field stimulation (PNFS) in chronic low back pain: a prospective multicenter study. *Neuromodulation*. Feb 2014;17(2):180-187. [doi: [10.1111/ner.12139](https://doi.org/10.1111/ner.12139)] [Medline: [24320718](https://pubmed.ncbi.nlm.nih.gov/24320718/)]
108. Lorenc T, Gołębowski M, Syganiec D, Glinkowski WM. Associations between patient report of pain and intervertebral foramina changes visible on axial-loaded lumbar magnetic resonance imaging. *Diagnostics (Basel)*. Feb 23, 2022;12(3):563. [doi: [10.3390/diagnostics12030563](https://doi.org/10.3390/diagnostics12030563)] [Medline: [35328116](https://pubmed.ncbi.nlm.nih.gov/35328116/)]
109. Lee H, Nicholson LL, Adams RD, Bae SS. Body chart pain location and side-specific physical impairment in subclinical neck pain. *J Manipulative Physiol Ther*. Sep 2005;28(7):479-486. [doi: [10.1016/j.jmpt.2005.07.004](https://doi.org/10.1016/j.jmpt.2005.07.004)] [Medline: [16182021](https://pubmed.ncbi.nlm.nih.gov/16182021/)]
110. Mann NH III, Brown MD, Enger I. Expert performance in low-back disorder recognition using patient pain drawings. *J Spinal Disord*. Sep 1992;5(3):254-259. [doi: [10.1097/00002517-199209000-00002](https://doi.org/10.1097/00002517-199209000-00002)] [Medline: [1387821](https://pubmed.ncbi.nlm.nih.gov/1387821/)]
111. Ohlund C, Eek C, Palmblad S, Areskoug B, Nachemson A. Quantified pain drawing in subacute low back pain. Validation in a nonselected outpatient industrial sample. *Spine (Phila Pa 1976)*. May 1, 1996;21(9):1021-1030. [doi: [10.1097/00007632-199605010-00005](https://doi.org/10.1097/00007632-199605010-00005)] [Medline: [8724085](https://pubmed.ncbi.nlm.nih.gov/8724085/)]
112. Pande KC, Khurjekar K, Kanikdaley V. Correlation of low back pain to a high-intensity zone of the lumbar disc in Indian patients. *J Orthop Surg (Hong Kong)*. Aug 2009;17(2):190-193. [doi: [10.1177/230949900901700214](https://doi.org/10.1177/230949900901700214)] [Medline: [19721150](https://pubmed.ncbi.nlm.nih.gov/19721150/)]
113. Parker H, Wood PL, Main CJ. The use of the pain drawing as a screening measure to predict psychological distress in chronic low back pain. *Spine (Phila Pa 1976)*. Jan 15, 1995;20(2):236-243. [doi: [10.1097/00007632-199501150-00022](https://doi.org/10.1097/00007632-199501150-00022)] [Medline: [7716631](https://pubmed.ncbi.nlm.nih.gov/7716631/)]
114. Potier T, Tims E, Kilbride C, Rantell K. Evaluation of an evidence based quality improvement innovation for patients with musculoskeletal low back pain in an accident and emergency setting. *BMJ Qual Improv Rep*. 2015;4(1):u205903.w2411. [doi: [10.1136/bmjquality.u205903.w2411](https://doi.org/10.1136/bmjquality.u205903.w2411)] [Medline: [26734383](https://pubmed.ncbi.nlm.nih.gov/26734383/)]
115. Sanders NW, Mann NH III, Spengler DM. Pain drawing scoring is not improved by inclusion of patient-reported pain sensation. *Spine (Phila Pa 1976)*. Nov 1, 2006;31(23):2735-2741. [doi: [10.1097/01.brs.0000244674.99258.f9](https://doi.org/10.1097/01.brs.0000244674.99258.f9)] [Medline: [17077744](https://pubmed.ncbi.nlm.nih.gov/17077744/)]
116. Serif T, Ghinea G. Recording of time-varying back-pain data: a wireless solution. *IEEE Trans Inf Technol Biomed*. Sep 2005;9(3):447-458. [doi: [10.1109/titb.2005.847514](https://doi.org/10.1109/titb.2005.847514)] [Medline: [16167699](https://pubmed.ncbi.nlm.nih.gov/16167699/)]
117. Vučetić N, Määttänen H, Svensson O. Pain and pathology in lumbar disc hernia. *Clin Orthop Relat Res*. Nov 1995(320):65-72. [Medline: [7586844](https://pubmed.ncbi.nlm.nih.gov/7586844/)]
118. Bryner P. Extent measurement in localised low-back pain: a comparison of four methods. *Pain*. Nov 1994;59(2):281-285. [doi: [10.1016/0304-3959\(94\)90081-7](https://doi.org/10.1016/0304-3959(94)90081-7)] [Medline: [7892026](https://pubmed.ncbi.nlm.nih.gov/7892026/)]
119. Mann NH III, Brown MD, Hertz DB, Enger I, Tompkins J. Initial-impression diagnosis using low-back pain patient pain drawings. *Spine (Phila Pa 1976)*. Jan 1993;18(1):41-53. [doi: [10.1097/00007632-199301000-00008](https://doi.org/10.1097/00007632-199301000-00008)] [Medline: [8434324](https://pubmed.ncbi.nlm.nih.gov/8434324/)]
120. Sanders NW, Mann NH. Automated scoring of patient pain drawings using artificial neural networks: efforts toward a low back pain triage application. *Comput Biol Med*. Sep 2000;30(5):287-298. [doi: [10.1016/s0010-4825\(00\)00013-5](https://doi.org/10.1016/s0010-4825(00)00013-5)] [Medline: [10913774](https://pubmed.ncbi.nlm.nih.gov/10913774/)]
121. Takata K, Hirotani H. Pain drawing in the evaluation of low back pain. *Int Orthop*. 1995;19(6):361-366. [doi: [10.1007/BF00178350](https://doi.org/10.1007/BF00178350)] [Medline: [8567153](https://pubmed.ncbi.nlm.nih.gov/8567153/)]
122. Mann NH III, Brown MD, Enger I. Statistical diagnosis of lumbar spine disorders using computerized patient pain drawings. *Comput Biol Med*. 1991;21(6):383-397. [doi: [10.1016/0010-4825\(91\)90040-g](https://doi.org/10.1016/0010-4825(91)90040-g)] [Medline: [1838724](https://pubmed.ncbi.nlm.nih.gov/1838724/)]
123. Gaetano J, van der Zwan R, Oxner M, et al. Converging evidence of ubiquitous male bias in human sex perception. *PLoS One*. 2016;11(2):e0148623. [doi: [10.1371/journal.pone.0148623](https://doi.org/10.1371/journal.pone.0148623)] [Medline: [26859570](https://pubmed.ncbi.nlm.nih.gov/26859570/)]
124. Gandolfo M, Downing PE. Asymmetric visual representation of sex from human body shape. *Cognition*. Dec 2020;205:104436. [doi: [10.1016/j.cognition.2020.104436](https://doi.org/10.1016/j.cognition.2020.104436)] [Medline: [32919115](https://pubmed.ncbi.nlm.nih.gov/32919115/)]

125. Mendelsohn KD, Nieman LZ, Isaacs K, Lee S, Levison SP. Sex and gender bias in anatomy and physical diagnosis text illustrations. *JAMA*. Oct 26, 1994;272(16):1267-1270. [doi: [10.1001/jama.1994.03520160051042](https://doi.org/10.1001/jama.1994.03520160051042)] [Medline: [7933371](https://pubmed.ncbi.nlm.nih.gov/7933371/)]
126. Morgan S, Plaisant O, Lignier B, Moxham BJ. Medical students and professional anatomists do not perceive gender bias within imagery featuring anatomy. *Clin Anat*. Sep 2017;30(6):711-732. [doi: [10.1002/ca.22922](https://doi.org/10.1002/ca.22922)] [Medline: [28547745](https://pubmed.ncbi.nlm.nih.gov/28547745/)]
127. Morgan S, Plaisant O, Lignier B, Moxham BJ. Sexism and anatomy, as discerned in textbooks and as perceived by medical students at Cardiff University and University of Paris Descartes. *J Anat*. Mar 2014;224(3):352-365. [doi: [10.1111/joa.12070](https://doi.org/10.1111/joa.12070)] [Medline: [23781866](https://pubmed.ncbi.nlm.nih.gov/23781866/)]
128. Parker R, Larkin T, Cockburn J. A visual analysis of gender bias in contemporary anatomy textbooks. *Soc Sci Med*. May 2017;180:106-113. [doi: [10.1016/j.socscimed.2017.03.032](https://doi.org/10.1016/j.socscimed.2017.03.032)] [Medline: [28343109](https://pubmed.ncbi.nlm.nih.gov/28343109/)]
129. Beresheim A, Zepeda D, Pharel M, Soy T, Wilson AB, Ferrigno C. Anatomy's missing faces: an assessment of representation gaps in atlas and textbook imagery. *Anat Sci Educ*. 2024;17(5):1055-1070. [doi: [10.1002/ase.2432](https://doi.org/10.1002/ase.2432)] [Medline: [38695348](https://pubmed.ncbi.nlm.nih.gov/38695348/)]

Abbreviations

PD: pain drawing

SAGER: Sex and Gender Equity in Research

Edited by Andre Kushniruk; peer-reviewed by Brian Pervis; submitted 17.Apr.2025; accepted 28.Dec.2025; published 09.Feb.2026

Please cite as:

Schläpfer S, Murphy C, Lukic YX, Campos-Asensio C, Colacicco G, Lauber BA, Masneuf S, Nyirö L, Kajdi GW, Sutter R, Laux CJ, Ackermann P, López-Alcalde J, Witt CM

Sex Representation and User Preferences in Pain Drawing Body Charts in Back Pain Research: Multimethod Study

JMIR Hum Factors 2026;13:e76175

URL: <https://humanfactors.jmir.org/2026/1/e76175>

doi: [10.2196/76175](https://doi.org/10.2196/76175)

© Sonja Schläpfer, Casey Murphy, Yanick X Lukic, Concepción Campos-Asensio, Giovanni Colacicco, Beatrice A Lauber, Sophie Masneuf, Luana Nyirö, Georg W Kajdi, Reto Sutter, Christoph J Laux, Philipp Ackermann, Jesús López-Alcalde, Claudia M Witt. Originally published in JMIR Human Factors (<https://humanfactors.jmir.org>), 09.Feb.2026. This is an open-access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Human Factors, is properly cited. The complete bibliographic information, a link to the original publication on <https://humanfactors.jmir.org>, as well as this copyright and license information must be included.