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Perception of typical migraine images on the internet: Comparison between a metropolis and a smaller rural city in Germany

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Abstract

The medial portrayal of migraine is often stereotypical and inaccurate but reflects how society perceives migraine. The discrepancy between others' views and the reality of affected individuals may negatively affect access to treatment and the disease course of patients with migraine. This study aimed to investigate whether images presented in the media as typical migraine attacks are perceived as realistic and representative by migraine patients in Rostock, a smaller town in rural Germany, and compare the results to those from Berlin, a large metropolis. We performed an online survey in Rostock. Migraine patients were shown ten images of migraine attacks, which were among the most downloaded stock pictures on the internet under the search term "migraine". They rated on a scale of 0–100 to what extent the pictures were realistic for migraine attacks (realism score), representative of their own migraine (representation score), or the society's view of migraine (society score). In addition, we compared our results with a recently published study from the metropolitan region of Berlin. A total of 174 migraine patients completed our survey. Mean (SD) realism, representation, and society scores were 59.9 (17.5), 56.7 (18.3), and 58.4 (17.1) respectively. Images of older patients were perceived as significantly more realistic and representative than those of younger patients (*P* < .001). Patients in Rostock (rural region) rated the images as significantly more realistic and representative than survey participants in Berlin (metropolis). Migraine patients in a rural region found typical migraine images only moderately realistic and representative but to a higher degree than their counterparts from a metropolis.

Introduction

Migraine is one of the most frequent primary headache disorders and is associated with high levels of impairment in multiple facets of daily life [1–4]. Migraine affects about 20% of women and 8% of men worldwide and causes the highest number of years lived with disability in patients aged 15–49 years [5].

Despite the high prevalence and burden, patients experience significant levels of stigma [6, 7] that further impact daily life [8]. The stigma surrounding migraine may be rooted in the condition's invisible nature, as it is often imperceptible to bystanders due to the lack of discernible outward signs, particularly in interictal periods, and the paucity of reliable diagnostic imaging or biomarkers to objectify its presence [9, 10]. As a result, patients face barriers to being believed and their pain often gets dismissed or trivialized [11]. Numerous studies have also shown that migraine patients are undertreated even in resource-rich settings [12–14]. The high female prevalence of migraine may contribute to stigma and undertreatment, as women's pain is often underestimated and undertreated by physicians compared to men's [15–17]. Reduced help seeking, possibly aggravated by internalized stigma, may also lead to inadequate medical care. In fact, internalized stigma in patients suffering from mental-health disorders has been shown to be associated with reduced help-seeking [18]. Compared to healthy controls, migraine patients were found to have significantly lower rates of seeking psychiatric help, despite having higher levels of psychiatric symptoms [19].

Stigma impacts the lives of migraine patients negatively on multiple levels. For example, it may compel patients to hide their condition from their workplace supervisors, causing them to miss out on potential workplace accommodations that may minimize triggers and reduce disability [20, 21]. If they do disclose their condition, they may come across coworkers who disapprove of their frequent sick leaves leading to feelings of isolation and low mood [21]. Even the medical establishment seems to neglect migraine in both research and treatment, as reflected by the disproportionate underfunding for headache research [22], and the relative lack of headache medicine specialists in some countries [23], and stigma may play a significant role in these trends.

Reversing social misconceptions and stigma about migraine requires educating the public about the true nature of its symptoms and resulting disability [24]. Visual communications are one of the most effective ways to disperse health information to a wider audience, and are being used increasingly in healthcare interventions [25]. The use of image-based health communications is a powerful tool for conveying complex information, but currently lacks guiding theories or research evidence [25–27]. Two studies [28, 29] exist that have examined images depicting migraine attacks and both suggest conventional photographic representations of migraine attacks are inadequate. Gvantseladze et al. [28] searched popular online image banks for images representing migraine attacks, and found that they were predominantly photos of ectomorph, white, and female adults, half of whom had their hands on both temporal regions at the same time. They propose that the disparity between common images used to depict migraine and actual presentations of migraine attacks may lead to further social stigmatization [28].

A recent study from Berlin showed that patients with migraine do not consider this prevalent photographic representations of migraine attacks realistic [29]. In this study, patients with migraine and healthcare professionals were shown commonly downloaded images representing migraine attacks and were asked to rate them on their realism and representativeness of their own migraine. Interestingly, portrayals of men and elderly models were deemed more realistic than those of younger and middle-aged, female models, which stays in contrast with the epidemiology of migraine in Germany [30]. The analyzed patient cohort in this cohort was part of a metropolitan population.

Epidemiological studies comparing migraine prevalence in urban and rural regions have found a lower prevalence of migraine in rural regions [31]. Inhabitants of large urban areas have different access to the media but also to medical information than people in rural regions [32]. Thus, perception of the medial representation of migraine may differ based on the urbanity of the place of residence. Access to specialty care may also be more limited in rural areas, leading to more patients being treated by general practitioners [33] and resulting in differences in their care when compared to urban areas. For example, studies have shown that especially chronic migraine patients treated by general practitioners often do not get referred to a specialist and tend to receive acute and preventive medication not in accordance with local and international guidelines [34, 35]. This may lead to generally lessened awareness of migraine, its characteristics and proper treatment in public discourse.

Here, we aimed to expand the findings from the Berlin study [29] by surveying patients with migraine living in the Rostock area. Rostock is an old Hanseatic city at the Baltic Sea. With its around 200.000 inhabitants and sparsely populated rural peripheries, it's a regiopolitan region of the state of Mecklenburg-West Pomerania. Our objective was to assess how patients living in a smaller city in a rural region perceive such stereotypical pictures of migraine. Moreover, we intended to analyze the differences between Rostock and Berlin—a comparison between the capital of Germany (metropolitan area) and a sparsely populated area in east-Germany.

Methods

Study design

This is an anonymous web-based survey study performed on evasys.uni-rostock.de–the survey system of the University of Rostock. The survey was distributed via e-mail with a personalized, one-time link. We emailed all patients from the Headache Center of the University of Rostock ("Headache Center North East") who received a diagnosis of migraine per International Classification of Headache Disorders–3 (ICHD-3) criteria [36] from January 2021 until July 2022. If the questionnaire was not completed after three weeks, we sent reminders for a maximum of four times.

After an electronic written consent form, the survey included questions about demographic, occupational, and migraine characteristics, as described in a previous publication [29]. For this study, we added a question about the place of residence and whether the patients perceive their place of residence to be more rural or urban.

We then presented participants with ten photos representing migraine attacks. Details of photo selection have been published elsewhere [29]. In short, these were the ten most often downloaded one-person portrayal under the search term "migraine" from the stock photo website Adobe Stock [37]. The participants were asked to rate each photo on a scale from 0 to 100 for the following categories:

1. extent to which the photo represents a realistic migraine attack (realism score)

2. extent to which the photo represents their own migraine attacks (representation score)

3. extent to which the photo represents the society's view on migraine attacks (society score) (S1 Appendix).

A score of 0 meant "not realistic/representable at all" and a score of 100 meant "fully realistic/representable". If the score ranged from 0 to 33, we rated it as low, between 34 and 66 as moderate, and between 67 and 100 as high.

The realism and representation scores were recorded in the same way in the Berlin study, while the society score represents a new, additional item peculiar to this survey. In the Berlin

study, all patients with a diagnosis of migraine being treated at a tertiary headache center at Charité—Universitätsmedizin Berlin received invitations to participate in the survey via mail.

Objectives and outcomes

Primary outcomes were the mean realism score, representation score, and society score for all pictures. Secondary outcomes were the mean scores for the following categories of photos: female models (n = 7) vs. male models (n = 3), unilateral pain posture (n = 6) vs. bilateral pain posture (n = 3), and); younger models (n = 5) vs. older models (n = 4) [29]. Images were classified into these categories based on the models' physical characteristics, such as facial wrinkles and on unanimous agreement of all authors. It should be noted that the exact age of the models depicted in photographs was unknown. The division was therefore made into "older" and "younger", whereby the younger models appeared to be around 30–35 years old and the older ones around 60 years or older. One photo could not be unanimously allocated to one posture or age category, and was excluded from analyses for those categories.

Furthermore, we compared the mean realism and representation scores between Rostock migraine patients (RM) and Berlin migraine patients (BM) for all pictures and each category. Data for BM was extracted from a previously published study [29].

Statistical analysis

Demographic and anamnestic characteristics as well as the realism, representation, and society scores were summarized with descriptive statistics. We report absolute frequencies (%) for categorical variables and mean and standard deviation (SD) for continuous variables. We compared scores within the RM group using paired-sample t-tests, and between RM and BM using independent t-tests. Dependent and independent continuous variables were tested for normality using the Shapiro-Wilk test of normality.

In addition, we assessed the association between the primary outcome with sex, age, body-mass-index (BMI), the highest level of education (1 = in school, 2 = school finished without graduation, 3 = secondary school diploma, 4 = high school diploma, 5 = completed apprenticeship, 6 = technical baccalaureate, 7 = baccalaureate, 8 = university degree), and the perception of the residence being rural or urban (1 = urban, 2 = mixed, 3 = rural). For this, we performed multiple regression analyses for each of the primary outcomes. Linearity was assessed by partial regression plots and plots of studentized residuals against predicted values. Independence of observations was assessed using the Durbin-Watson statistic. Homoscedasticity was assessed by visual inspection of a plot of studentized residuals against unstandardized predicted values. Multicollinearity was assessed by tolerance (> 0.1) and variance inflation factor (< 10) values. We checked for outliers using Cook's distance (< 1).

Using a two-way mixed ANOVA we examined whether concordance of sex between image and participant influenced how the images were rated. The participant's sex was the between-subjects factor, and score for images with male vs. female models the within-subjects factor. Homogeneity of variances (p $>$ .05) and covariances (p $>$ .001) was assessed by Levene's test of homogeneity of variances and Box's M test.

A P value $\leq$ .05 after correction for multiple comparisons with the Bonferroni method was considered statistically significant.

Ethics approval and consent to participate

The study was approved by the ethics committee of the Universitätsmedizin Rostock (A 2022–0036). Participants were required to provide electronic consent prior to completing the survey.

The Berlin study [29] had been approved by the ethics committee of the Charité–Universitäts-medizin Berlin (EA1/213/20).

Results

Population

Between March and July 2022, of the 481 patients being treated at our headache clinic with the diagnosis of migraine, 437 with an e-mail address received the survey link via e-mail. Among those, 174 patients completed the survey (response rate: 40%).

The demographic characteristics of RM are shown in comparison to BM in Table 1. Body weight was higher in RM compared to BM (75.5, SD 16.9 kg vs. 69.4, SD 14.6 kg, $P < .001$). In addition, RM had a lower average level of education, a more homogenous ethnic background, and fewer family members with migraine.

When asked about their place of residence, 82 RM (47.1%) indicated that they live in an urban place, 50 (28.7%) in a rural area, and 42 (24.1%) in a mixed urban and rural area.

Realism score in patients with migraine from Rostock

The mean realism score for all pictures was 59.9, SD 17.5. Photos with older models were perceived to be more realistic than those with younger ones (old: 65.7, SD 18.5 vs. young: 59.0, SD 19.5, $P < .001$). The differences between male and female models (male: 60.5, SD 20.6 vs. female: 59.7, SD 17.4, $P = .42$) and unilateral and bilateral pain postures (unilateral: 60.2, SD 21.2 vs. bilateral: 62.8 SD 18.5, $P = .051$) were not significant (Fig 1). There were no significant associations between the realism score and age, sex, education, and place of residence (S2 Table). S1 Table shows the mean scores for each individual picture.

Representation score in patients with migraine from Rostock

The mean representation score for the ten photos was 56.7 SD 18.3. Photos with older models were rated more representative than those with younger models (old: 63.1, SD 20.9 vs. young: 54.7, SD 20.7, $P < .001$, Fig 2). There was no significant difference between male and female

Table 1. Demographic characteristics of the participants.

Characteristics	Rostock (n = 174)	Berlin (n = 366)
Age (years)	43.3 ±12.7	45.3 ± 12.7
Female sex	145 (83.3)	318 (86.6)
Northern or Central European descent	163 (93.7) [a]	314 (85.6)
Height (cm)	169.3 ± 9.6	168.9 ± 8.1
Weight (kg)	75.5 ±16.9 [a]	69.4 ± 14.6
Highest level of education		
University degree	54 (31.0) [a]	154 (42.1)
High School diploma	26 (14.9) [a]	63 (17.2)
Technical baccalaureate	14 (8.0) [a]	29 (7.9)
Apprenticeship	26 (14.9) [a]	60 (16.4)
Intermediate secondary school diploma	44 (25.3) [a]	38 (10.4)
General secondary school diploma	6 (3.4) [a]	4 (1.1)
Other	4 (2.3) [a]	19 (4.9)
Close friends or family members with migraine	58 (43.3) [a]	196 (53.4)

Values are given in mean ± SD or n (%). RM = patients in Rostock. BM = patients in Berlin.

[a] Indicates P-value of $P < .05$ in the comparison between patients from Rostock vs. Berlin
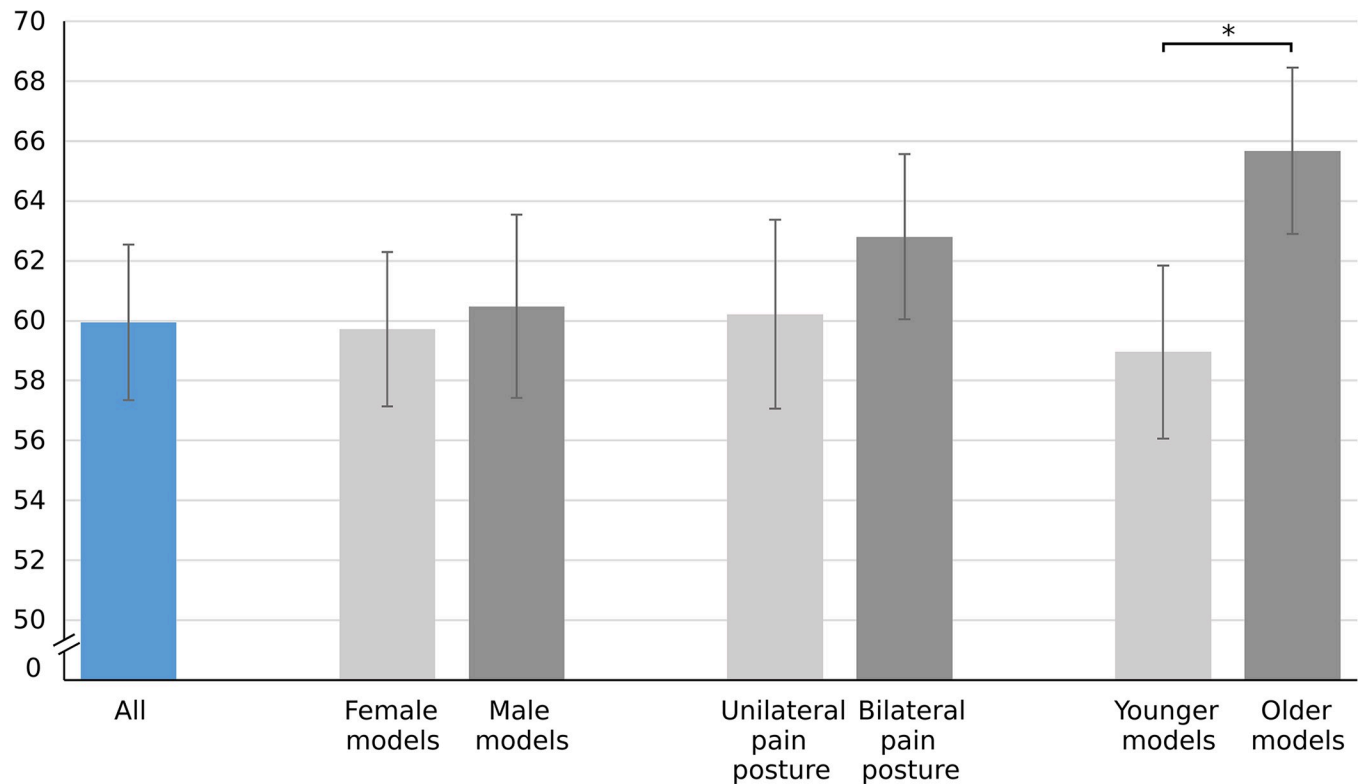
Fig 1. Mean realism scores for different image categories. The error bars represent 95% confidence intervals. * = statistically significant.

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models (male: 57.5, SD 22.5 vs. female: 56.3, SD 18.1, P = .27) and unilateral and bilateral pain postures (unilateral: 57.7, SD 21.8 vs. bilateral: 58.8, SD 20.4, P = .44). We did not detect any significant association between the representation score and the participant's age, sex, education, or place of residence (S2 Table).

There was a statistically significant interaction between the participant's sex and representation scores for images with female and male models $F(1,170)$ = 5.60, P = 0.02, partial η^2 = 0.03. Images with male models were given significantly higher representation scores by male participants, when compared to those given female participants (mean difference [MD] 9.33, standard error [SE] 4.71, P = 0.05). Male participants gave significantly higher representation scores for images with male models than for images with female models (MD 7.21, SE 2.82, P = 0.02). There was no statistically significant difference in representation scores for images with female and male models given by female participants (MD -0.016, SE 1.20, P = .99).

Society score in patients with migraine from Rostock

The mean society score for all photos was 59.7, SD 16.3. Male models, older models, and pictures with a bilateral pain posture reached significantly higher scores than female, younger and unilateral ones, respectively (Table 2). Of the demographic variables, age was negatively associated with the society score (β = -0.26, P = .002, S2 Table).

Comparison between patients with migraine from Rostock and Berlin

In direct comparison, the photos reached higher representation and realism scores in RM than in BM (Table 3). This applied to all pictures as well as to each subgroup.
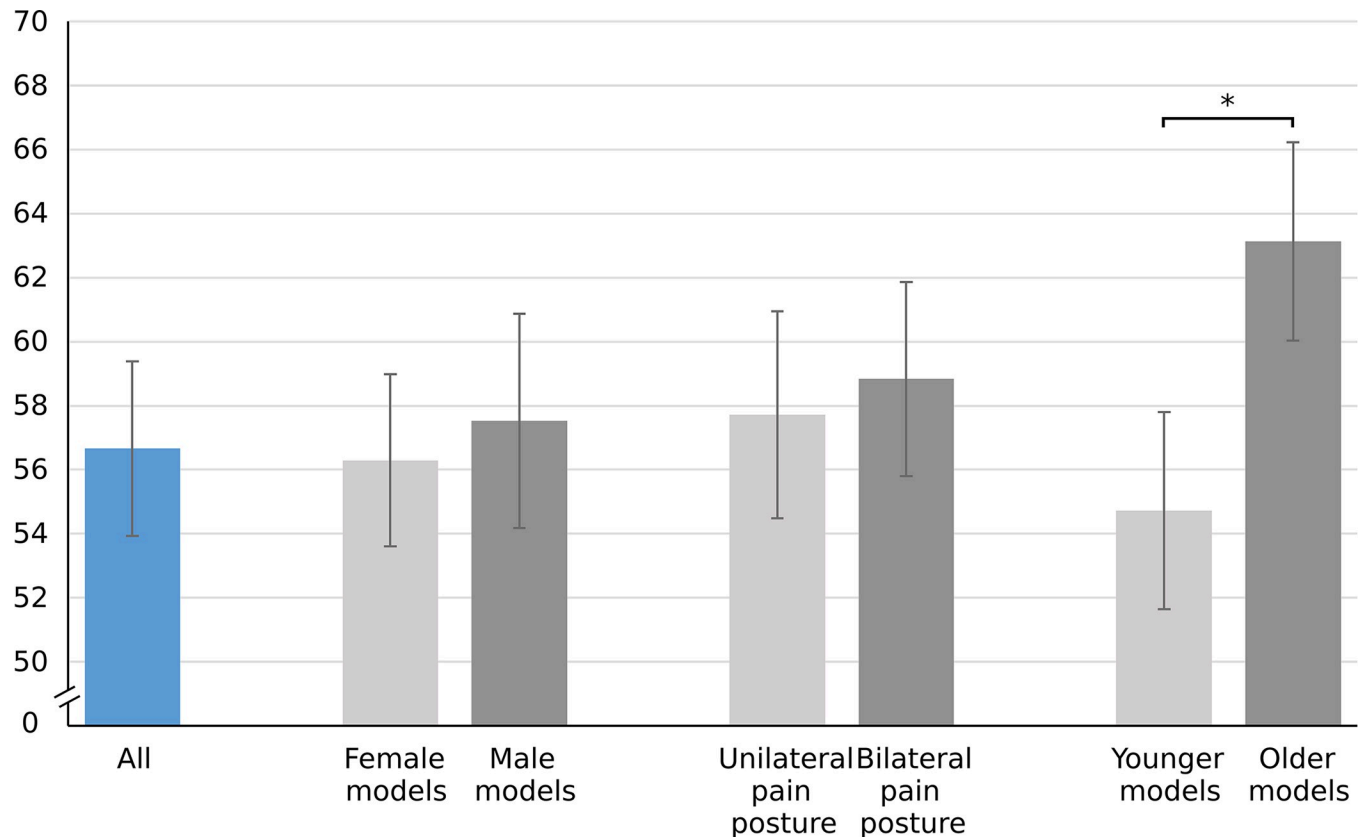
Fig 2. Mean representation scores for different image categories. The error bars represent 95% confidence intervals. * = statistically significant.

Discussion

Our study shows that migraine patients living in a sparsely populated region perceive typical migraine pictures as only moderately realistic and representative of their migraine attacks. Pictures with older models were considered more realistic and representative than those with younger ones. In addition, participants classified older male models with bilateral pain postures as most representative of the society's perception of migraine. In this cohort, the scores for realism and representation were significantly higher compared to previous study results in a metropolitan population. Furthermore, differences in the perception of images with male vs. female models seen in the Berlin cohort was not seen in the Rostock cohort.

Both mean realism and representation scores as well as the society score were under 60%. These are sobering results when considering that these ten pictures are the most frequently downloaded ones under the search term "migraine". Especially images of the younger models or female models, who represent the main part of the migraine population [1], were given significantly lower society scores compared to their male and older counterparts.

Table 2. Society scores for different image categories.

Criteria	Mean society score (SD)	Cohen's d	P
Female vs. male model	57.1 (17.5) vs. 61.7 (18.9)	0.39	< .001
Unilateral vs. bilateral pain posture	56.2 (20.7) vs. 63.2 (17.4)	0.51	< .001
Younger vs. older model	58.0 (19.0) vs. 64.5 (18.1)	0.50	< .001

Table 3. Differences between mean realism and representation scores from RM and BM.

		RM	BM	Cohen's d	P
Mean realism Score (SD)	All photos	59.9 (17.5)	48.8 (18.0)	0.63	< .001
	Female models	59.7 (17.4)	47.8 (18.3)	0.66	< .001
	Male models	60.5 (20.6)	51.0 (22.4)	0.43	< .001
	Unilateral pain posture	60.2 (21.2)	49.7 (21.0)	0.46	< .001
	Bilateral pain posture	62.8 (18.5)	51.8 (20.1)	0.56	< .001
	Younger models	59.0 (19.5)	47.7 (20.3)	0.56	< .001
	Older models	65.7 (18.7)	55.4 (20.9)	0.51	< .001
Mean representation score (SD)	All photos	56.7 (18.3)	44.4 (19.3)	0.64	< .001
	Female models	56.3 (18.1)	44.3 (19.8)	0.62	< .001
	Male models	57.5 (22.5)	44.8 (25.0)	0.52	< .001
	Unilateral pain posture	57.7 (21.8)	46.9 (26.0)	0.44	< .001
	Bilateral pain posture	58.8 (20.4)	46.0 (21.9)	0.60	< .001
	Younger models	54.7 (20.7)	43.2 (21.9)	0.54	< .001
	Older models	63.1 (20.9)	50.4 (22.7)	0.58	< .001

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Images depicting older models yielded significantly higher society, realism, and representation scores. It has been previously observed that expressions of pain in older faces lead to higher pain ratings compared to those of younger faces [38–40]. Participants in our study may have perceived the images with older models as having more pain, and thus as more realistic and representative of their own headache. Images of younger models could have been perceived as not capturing the intensity of a migraine attack. Additionally, although the incidence of migraine is highest in in young adulthood, migraine is most prevalent in adults aged 35–39 years [1], an age range that is typically no longer referred to as "young", and the higher score given for older models may imply adults in that age range identify themselves more with older and elderly persons, rather than younger ones. Overall, these results are similar to the results from Raffaelli et al. [29], even though our study took place in a different setting.

The fact that pain reported by males is considered more believable and severe has been an often-observed phenomenon within gender bias in medicine [41, 42], leading to systematic underestimation and undertreatment of women's pain [16]. In the study by Raffaelli et al. [29] images with female models yielded significantly lower realism scores, while in the present study, this gender difference was observed for the society score. It is paradoxical that images with male models are perceived to be more representative of society's views on migraine attacks, when considering that the majority of individuals with migraine are women. It may imply an entrenched bias in the judgment of other's pain that disproportionately minimizes pain suffered by women.

In the Rostock cohort, there was no significant difference between realism and representation scores of images with male and female models, in contrast to the results of the Berlin study, where images with male models were seen as more realistic. One hypothesis that could explain this difference is the cultural legacy of the socialist system of East Germany (Rostock being entirely part of former East Germany, and Berlin of former East and West Germany), where thirty years after reunification, women are still more likely to work full-time than in West Germany [43]. During the Socialist era in East Germany, more equal gender norms were instilled, while in West Germany, traditional norms with higher male earnings prevailed [44]. More equal gender norms may lead to less divergence in the perception of pain experienced by male and female models.

We also saw that male patients were more likely to give higher representation scores for images with male models, while the reverse was not true, that is, female patients were not more

likely to give higher representation scores for images with female models. On the one hand, this might imply that male migraine patients feel even less well represented by the images of migraine that predominantly contain female models, while for female patients, the gender of the model showing a migraine attack is not as important. On the other hand, it might reflect a higher empathy of female participants for images of the opposite sex or their general habituation to untailored information materials, such as masculine images, in a male-dominated world. Exploring factors such as patient empathy, societal gender norms, and individual perceptions can provide valuable insights into addressing and improving the representation of both male and female migraine patients.

This is the very first study to assess the perception of migraine images by migraine patients in a small city with rural peripheries and compared the results to those from a metropolitan region. Our results reveal significant differences in the perception of migraine pictures depending on the place of residence: Patients from Rostock gave consistently higher realism and representation scores across all categories than the Berlin participants. Given that similar surveys with the same images were used in both studies, the reasons for this disparity are most likely associated with the inherent differences between the two cohorts. In addition to the contrasting level of urbanity, baseline characteristics of participants differed significantly. Rostock migraine patients have a lower average level of education, higher weight, fewer close contacts suffering from migraine, and a more ethnically homogeneous background.

Cross-sectional survey studies have shown that subjects with lower levels of education tend to trust health information and advertisements from television to a higher degree [45–47]. The tendency to trust medial representations shown to the general public may have led the participants in Rostock to accept the images shown more readily as an accurate portrayal of migraine.

Images that serve as illustrations for migraine may be used in mass media such as in newspaper or magazine articles, or in advertisements for products related to migraine. In the interest of attractiveness and overall appeal, creators of such material may prefer using images that depict models of a certain age and body shape. Previous studies showed that the majority of images of the typical migraine attack show a slim white female with a bilateral pain posture [28]. Our study shows that such pictures are not perceived as realistic or representative by migraine patients in a less urban area of Germany, similar to how they were perceived in a large metropolitan region [29], with differences that may be explained by factors such as level of education and require further exploration. The characterization of a typical migraine patient as a young, otherwise healthy female suffering from mild headache might even minimize the extent of disability and diverse symptoms that migraine causes [29, 48]. Portraying migraine attacks using such images may reinforce negative stereotypes about people with migraines, suggesting migraine sufferers are mentally weak and unable to cope with normal pressures and stress of daily life. Our study shows that certain populations more readily accept potentially stigmatizing images as realistic and representative and highlights a need to avoid such medial representations especially in more susceptible populations. One alternative could be to select images that show the full breadth and diversity of symptoms that migraine sufferers have to deal with, such as nausea and vomiting, sensitivity to light and noise, and severe headaches resulting in significant disability [48]. It is uncertain however, to what extent the use of such images in public media can help in destigmatizing migraine.

Misrepresentation and stigma surrounding an illness negatively influence the course of disease. Stigma represents a significant barrier to seeking help, reporting symptoms, and adhering to treatment recommendations [49]. Migraine patients report similar levels of stigma to patients with other disabling chronic illnesses such as epilepsy [7], preventing them from receiving adequate treatment [19]. Campaigns aimed at reducing stigma and educating the

workforce on the nature of migraine disorders led to decreased indirect and total costs of migraine [50–52], some citing a return on investment as high as 490% [51]. Proper education that provides an accurate understanding of migraine has the potential not only to positively impact the lives of millions of sufferers but also to increase productivity and reduce migraine-related disability in young adults of working age. Adequate public education campaigns could start by using accurate, realistic portrayals of patients with migraine. Our results suggest that accurate depictions in media may be particularly important depending on the place of residence. An accurate representation of migraine in the media, especially in regions where the population is more vulnerable to its influences, could lead to a better understanding of migraine by both patients and the general public and encourage patients to seek adequate treatment.

One limitation of this study is the anonymity of the online-based survey. The lack of supervision could have led to less reliable data. We also informed our patients that the results of the survey would be compared against those from Berlin. This could have led to participants wanting to perform better in comparison and being more lenient in scoring the photos. In addition, the survey was only administered to migraine patients, precluding a comparison between views of affected and non-affected individuals, which may have provided additional insights.

Another limitation could stem from the fact that study participants were all patients being treated at a tertiary headache clinic, which may not adequately reflect the perception of common migraine images in all migraine sufferers living in rural areas. Patients referred to tertiary headache centers are similar in that they are more likely to have chronic migraine, a longer disease duration and larger disease burden compared to those who remain under the care of the general practitioner [53]. Comparing patients of two different tertiary headache centers may not provide sufficient contrast to draw meaningful conclusions about differences attributable to rurality.

To conclude, migraine patients from a small city in rural Germany perceived typical migraine images to be only moderately realistic and representative, albeit with higher ratings than those given by migraine patients from a large metropolitan area. These results highlight the need for more accurate portrayals of migraine in mass media, perhaps more so in less urban regions, where patients may be more susceptible to medial representations. More studies are needed to determine ways of visually representing migraine that reduce the stigma associated with the condition.

Supporting information

S1 Checklist. STROBE statement—checklist of items that should be included in reports of observational studies.
(DOCX)

S1 Table. Mean realism, representation, and society scores, as well as features for each image in the questionnaire.
(DOCX)

S2 Table. Multiple regression results for realism, society and representation scores. Multiple regression analyses for dependent variables realism, society and representation scores, with age, sex, BMI, degree of rurality and highest level of education entered into the model as independent variables.
(DOCX)

S1 Appendix. Example questionnaire item (English translation).
(DOCX)

S1 Data.
(CSV)

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References

1. Ashina M, Katsarava Z, Do TP, Buse DC, Pozo-Rosich P, Özge A, et al. Migraine: epidemiology and systems of care. The Lancet. 2021; 397: 1485–1495. https://doi.org/10.1016/S0140-6736(20)32160-7 PMID: 33773613

2. Stewart WF, Lipton RB, Whyte J, Dowson A, Kolodner K, Liberman JN, et al. An international study to assess reliability of the Migraine Disability Assessment (MIDAS) score. Neurology. 1999; 53: 988. https://doi.org/10.1212/wnl.53.5.988 PMID: 10496257

3. Buse DC, Manack AN, Fanning KM, Serrano D, Reed ML, Turkel CC, et al. Chronic Migraine Prevalence, Disability, and Sociodemographic Factors: Results From the American Migraine Prevalence and Prevention Study. Headache: The Journal of Head and Face Pain. 2012; 52: 1456–1470. https://doi.org/10.1111/j.1526-4610.2012.02223.x PMID: 22830411

4. Eigenbrodt AK, Ashina H, Khan S, Diener H-C, Mitsikostas DD, Sinclair AJ, et al. Diagnosis and management of migraine in ten steps. Nat Rev Neurol. 2021; 17: 501–514. https://doi.org/10.1038/s41582-021-00509-5 PMID: 34145431

5. Steiner TJ, Stovner LJ, Jensen R, Uluduz D, Katsarava Z. Migraine remains second among the world's causes of disability, and first among young women: findings from GBD2019. J Headache Pain. 2020; 21: 137, s10194-020-01208–0. https://doi.org/10.1186/s10194-020-01208-0 PMID: 33267788

6. Seng EK, Shapiro RE, Buse DC, Robbins MS, Lipton RB, Parker A. The unique role of stigma in migraine-related disability and quality of life. Headache. 2022; 62: 1354–1364. https://doi.org/10.1111/head.14401 PMID: 36321956

7. Young WB, Park JE, Tian IX, Kempner J. The Stigma of Migraine. Preux P-M, editor. PLoS ONE. 2013; 8: e54074. https://doi.org/10.1371/journal.pone.0054074 PMID: 23342079

8. Martínez-Fernández A, Rueda Vega M, Quintas S, De Toledo Heras M, Díaz De Terán J, Latorre González G, et al. Psychosocial repercussion of migraine: is it a stigmatized disease? Neurol Sci. 2020; 41: 2207–2213. https://doi.org/10.1007/s10072-020-04332-6 PMID: 32172402

9. Perugino F, De Angelis V, Pompili M, Martelletti P. Stigma and Chronic Pain. Pain Ther. 2022; 11: 1085–1094. https://doi.org/10.1007/s40122-022-00418-5 PMID: 35930220

10. Ashina M, Terwindt GM, Al-Karagholi MA-M, de Boer I, Lee MJ, Hay DL, et al. Migraine: disease characterisation, biomarkers, and precision medicine. The Lancet. 2021; 397: 1496–1504. https://doi.org/10.1016/S0140-6736(20)32162-0 PMID: 33773610

11. Estave PM, Beeghly S, Anderson R, Margol C, Shakir M, George G, et al. Learning the full impact of migraine through patient voices: A qualitative study. Headache. 2021; 61: 1004–1020. https://doi.org/10.1111/head.14151 PMID: 34081779

12. Katsarava Z, Mania M, Lampl C, Herberhold J, Steiner TJ. Poor medical care for people with migraine in Europe–evidence from the Eurolight study. J Headache Pain. 2018; 19: 10. https://doi.org/10.1186/s10194-018-0839-1 PMID: 29392600

13. Cevoli S, D'Amico D, Martelletti P, Valguarnera F, Bene ED, Simone RD, et al. Underdiagnosis and Undertreatment of Migraine in Italy: A Survey of Patients Attending for The First Time 10 Headache Centres. Cephalalgia. 2009; 29: 1285–1293. https://doi.org/10.1111/j.1468-2982.2009.01874.x PMID: 19438916

14. Guerrero AL, Negro A, Ryvlin P, Skorobogatykh K, Sanchez-De La Rosa R, Israel-Willner H, et al. Need of guidance in disabling and chronic migraine identification in the primary care setting, results from the european MyLife anamnesis survey. BMC Fam Pract. 2021; 22: 54. https://doi.org/10.1186/s12875-021-01402-2 PMID: 33743604

15. Hoffmann DE, Tarzian AJ. The Girl Who Cried Pain: A Bias against Women in the Treatment of Pain. J Law Med Ethics. 2001; 29: 13–27. https://doi.org/10.1111/j.1748-720x.2001.tb00037.x PMID: 11521267

16. Chen EH, Shofer FS, Dean AJ, Hollander JE, Baxt WG, Robey JL, et al. Gender disparity in analgesic treatment of emergency department patients with acute abdominal pain. Academic emergency medicine: official journal of the Society for Academic Emergency Medicine. 2008; 15: 414–8. https://doi.org/10.1111/j.1553-2712.2008.00100.x PMID: 18439195

17. Samulowitz A, Gremyr I, Eriksson E, Hensing G. "Brave Men" and "Emotional Women": A Theory-Guided Literature Review on Gender Bias in Health Care and Gendered Norms towards Patients with Chronic Pain. Pain Research and Management. 2018; 2018: 1–14. https://doi.org/10.1155/2018/6358624 PMID: 29682130

18. Clement S, Schauman O, Graham T, Maggioni F, Evans-Lacko S, Bezborodovs N, et al. What is the impact of mental health-related stigma on help-seeking? A systematic review of quantitative and qualitative studies. Psychol Med. 2015; 45: 11–27. https://doi.org/10.1017/S0033291714000129 PMID: 24569086

19. Korkmaz S, Kazgan A, Korucu T, Gönen M, Yilmaz MZ, Atmaca M. Psychiatric symptoms in migraine patients and their attitudes towards psychological support on stigmatization. Journal of Clinical Neuroscience. 2019; 62: 180–183. https://doi.org/10.1016/j.jocn.2018.11.035 PMID: 30472336

20. Pescosolido BA, Martin JK. The Stigma Complex. Annu Rev Sociol. 2015; 41: 87–116. https://doi.org/10.1146/annurev-soc-071312-145702 PMID: 26855471

21. Parikh SK, Kempner J, Young WB. Stigma and Migraine: Developing Effective Interventions. Curr Pain Headache Rep. 2021; 25: 75. https://doi.org/10.1007/s11916-021-00982-z PMID: 34873646

22. Schwedt TJ, Shapiro RE. Funding of Research on Headache Disorders by the National Institutes of Health. Headache: The Journal of Head and Face Pain. 2009; 49: 162–169. https://doi.org/10.1111/j.1526-4610.2008.01323.x PMID: 19222590

23. Minen MT, Monteith T, Strauss LD, Starling A. New Investigator and Trainee Task Force Survey on the Recruitment and Retention of Headache Specialists. Headache: The Journal of Head and Face Pain. 2015; 55: 1092–1101. https://doi.org/10.1111/head.12623 PMID: 26234315

24. Gross E, Ruiz De La Torre E, Martelletti P. The Migraine Stigma Kaleidoscope View. Neurol Ther. 2023; 12: 703–709. https://doi.org/10.1007/s40120-023-00456-x PMID: 36871256

25. Williams B, Cameron L. Images in Health Care: Potential and Problems. J Health Serv Res Policy. 2009; 14: 251–254. https://doi.org/10.1258/jhsrp.2009.008168 PMID: 19770125

26. Murray J, Williams B. The Role of Images on Illness Behaviour: Interdisciplinary Theory, Evidence, and Ideas. Psychol Rep. 2021; 124: 2453–2475. https://doi.org/10.1177/0033294120945602 PMID: 32757718

27. Young R, Subramanian R, Hinnant A. Stigmatizing Images in Obesity Health Campaign Messages and Healthy Behavioral Intentions. Health Educ Behav. 2016; 43: 412–419. https://doi.org/10.1177/1090198115604624 PMID: 26377522

28. Gvantseladze K, Do TP, Hansen JM, Shapiro RE, Ashina M. The Stereotypical Image of a Person With Migraine According to Mass Media. Headache: The Journal of Head and Face Pain. 2020; 60: 1465–1471. https://doi.org/10.1111/head.13846 PMID: 32459017

29. Raffaelli B, Kull P, Mecklenburg J, Overeem LH, Storch E, Terhart M, et al. Patients' and Health Care Workers' Perception of Migraine Images on the Internet: Cross-sectional Survey Study. J Med Internet Res. 2021; 23: e32707. https://doi.org/10.2196/32707 PMID: 34766918

30. Gendolla A, Rauer N, Kraemer S, Schwerdtner I, Straube A. Epidemiology, Demographics, Triptan Contraindications, and Prescription Patterns of Patients with Migraine: A German Claims Database Study. Neurol Ther. 2022; 11: 167–183. https://doi.org/10.1007/s40120-021-00304-w PMID: 34837636

31. Pfaffenrath V, Fendrich K, Vennemann M, Meisinger C, Ladwig K-H, Evers S, et al. Regional Variations in the Prevalence of Migraine and Tension-Type Headache Applying the new IHS Criteria: The German DMKG Headache Study. Cephalalgia. 2009; 29: 48–57. https://doi.org/10.1111/j.1468-2982.2008.01699.x PMID: 18771491

32. Chen X, Orom H, Hay JL, Waters EA, Schofield E, Li Y, et al. Differences in Rural and Urban Health Information Access and Use: Rural-Urban Health Information Access and Use. The Journal of Rural Health. 2019; 35: 405–417. https://doi.org/10.1111/jrh.12335 PMID: 30444935

33. Thiele A, Strauß S, Angermaier A, Klehr L, Bartsch L, Kronenbuerger M, et al. Treatment Realities of Headache Disorders in Rural Germany by the Example of the Region of Western Pomerania. Brain Sciences. 2021; 11: 839. https://doi.org/10.3390/brainsci11070839 PMID: 34202861

34. Ryvlin P, Skorobogatykh K, Negro A, Sanchez-De La Rosa R, Israel-Willner H, Sundal C, et al. Current clinical practice in disabling and chronic migraine in the primary care setting: results from the European My-LIFE anamnesis survey. BMC Neurol. 2021; 21: 1. https://doi.org/10.1186/s12883-020-02014-6 PMID: 33390161

35. Khu JV, Siow HC, Ho KH. Headache diagnosis, management and morbidity in the Singapore primary care setting: findings from a general practice survey. Singapore Med J. 2008; 49: 774–779. PMID: 18946609

36. Headache Classification Committee of the International Headache Society (IHS) The International Classification of Headache Disorders, 3rd edition. Cephalalgia. 2018;38: 1–211. https://doi.org/10.1177/0333102417738202

37. Adobe Stock 2021. [cited 29 Aug 2021]. Available: https://stock.adobe.com

38. Hadjistavropoulos T, LaChapelle D, Hale C, MacLeod FK. Age- and appearance-related stereotypes about patients undergoing a painful medical procedure. The Pain Clinic. 2000; 12: 25–33. https://doi.org/10.1163/156856900750228060

39. Stopyn RJN, Hadjistavropoulos T, Loucks J. An Eye Tracking Investigation of Pain Decoding Based on Older and Younger Adults' Facial Expressions. J Nonverbal Behav. 2021; 45: 31–52. https://doi.org/10.1007/s10919-020-00344-0 PMID: 33678933

40. Hampton AJD, Hadjistavropoulos T, Gagnon MM. Contextual influences in decoding pain expressions: effects of patient age, informational priming, and observer characteristics. Pain. 2018; 159: 2363–2374. https://doi.org/10.1097/j.pain.0000000000001345 PMID: 30015709

41. Schäfer G, Prkachin KM, Kaseweter KA, Williams AC de C. Health care providers' judgments in chronic pain: the influence of gender and trustworthiness. Pain. 2016; 157: 1618–1625. https://doi.org/10.1097/j.pain.0000000000000536 PMID: 26934512

42. Zhang L, Losin EAR, Ashar YK, Koban L, Wager TD. Gender Biases in Estimation of Others' Pain. The Journal of Pain. 2021; 22: 1048–1059. https://doi.org/10.1016/j.jpain.2021.03.001 PMID: 33684539

43. Lippmann Q, Senik C. The Impact of the Socialist Episode on Gender Norms in Germany. ifo DICE Report. 2019; 17: 30–35.

44. Lippmann Q, Georgieff A, Senik C. Undoing Gender with Institutions: Lessons from the German Division and Reunification. The Economic Journal. 2020; 130: 1445–1470. https://doi.org/10.1093/ej/uez057

45. Jilani HS, Pohlabeln H, Buchecker K, Gwozdz W, De Henauw S, Eiben G, et al. Association between parental consumer attitudes with their children's sensory taste preferences as well as their food choice. Foo LH, editor. PLoS ONE. 2018; 13: e0200413. https://doi.org/10.1371/journal.pone.0200413 PMID: 30067786

46. Fareed N, Jonnalagadda P, Swoboda CM, Samineni P, Griesenbrock T, Huerta T. Socioeconomic Factors Influence Health Information Seeking and Trust Over Time: Evidence From a Cross-Sectional, Pooled Analyses of HINTS Data. Am J Health Promot. 2021; 35: 1084–1094. https://doi.org/10.1177/08901171211018135 PMID: 34008418

47. McKay DL, Houser RF, Blumberg JB, Goldberg JP. Nutrition Information Sources Vary with Education Level in a Population of Older Adults. Journal of the American Dietetic Association. 2006; 106: 1108–1111. https://doi.org/10.1016/j.jada.2006.04.021 PMID: 16815128

48. Headache and Migraine Disease Language and Image Guide. Coalition For Headache And Migraine Patients; 2018. Available: https://headachemigraine.org/headache-and-migraine-disease-language-and-image-guide

49. Stangl AL, Earnshaw VA, Logie CH, van Brakel W, C. Simbayi L, Barré I, et al. The Health Stigma and Discrimination Framework: a global, crosscutting framework to inform research, intervention

development, and policy on health-related stigmas. BMC Med. 2019; 17: 31. https://doi.org/10.1186/s12916-019-1271-3 PMID: 30764826

50. Page MJ, Paramore LC, Doshi D, Rupnow MFT. Evaluation of Resource Utilization and Cost Burden Before and After an Employer-Based Migraine Education Program. Journal of Occupational & Environmental Medicine. 2009; 51: 213–220. https://doi.org/10.1097/JOM.0b013e318192bcd1 PMID: 19209043

51. Schaetz L, Rimner T, Pathak P, Fang J, Chandrasekhar D, Mueller J, et al. Employee and Employer Benefits From a Migraine Management Program: Disease Outcomes and Cost Analysis. Headache: The Journal of Head and Face Pain. 2020; 60: 1947–1960. https://doi.org/10.1111/head.13933 PMID: 32799346

52. Aguirrezabal I, Pérez de San Román MS, Cobos-Campos R, Orruño E, Goicoechea A, Martínez de la Eranueva R, et al. Effectiveness of a primary care-based group educational intervention in the management of patients with migraine: a randomized controlled trial. Prim Health Care Res Dev. 2019; 20: e155. https://doi.org/10.1017/S1463423619000720 PMID: 31833464

53. Peres MFP, Swerts DB, De Oliveira AB, Silva-Neto RP. Migraine patients' journey until a tertiary headache center: an observational study. J Headache Pain. 2019; 20: 88. https://doi.org/10.1186/s10194-019-1039-3 PMID: 31416424