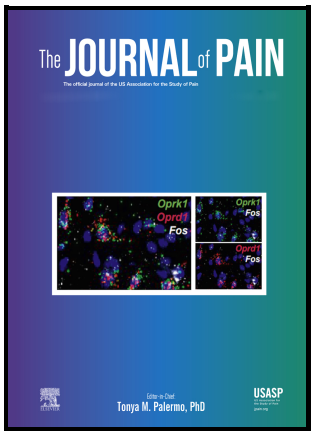

Pain-related beliefs, coping, and function: An observational study on the moderating influence of country of originRUNNING TITLE: Country moderates beliefs/coping's effect on pain

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Pain-related beliefs, coping, and function: An observational study on the moderating influence of country of origin

RUNNING TITLE: Country moderates beliefs/coping's effect on pain

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Abstract

Chronic pain is a multidimensional experience and pain treatments targeting psychosocial factors reduce pain and improve function. These treatments often overlook the sociocultural factors that influence pain and the psychological factors associated with function in people with chronic pain. Although preliminary findings suggest that cultural background may influence pain and function via their effects on beliefs and coping, no previous study has directly tested if the country of origin moderates the associations between these psychological factors and pain and function. This study sought to address this knowledge gap. Five hundred sixty-one adults with chronic pain, born and living in the USA (*n*=273) or Portugal (*n*=288), completed measures of pain, function, pain-related beliefs, and coping. Between-country similarities were found in the endorsement of beliefs related to disability, pain control, and emotion, and in asking for assistance, task persistence, and coping

self-statements responses. Portuguese participants reported greater endorsement of harm, medication, solicitude, and medical cure beliefs, more frequent use of relaxation and support seeking, and less frequent use of guarding, resting, and exercising/stretching. In both countries, disability and harm beliefs and guarding responses, were associated with worse outcomes; pain control and task persistence were associated with better outcomes. Six country-related small effect-size moderation effects emerged, such that task persistence and guarding are stronger predictors of pain and function in adults from the USA, but pain control, disability, emotion, and medication beliefs are more important in adults from Portugal. Some modifications may be needed when adapting multidisciplinary treatments from one country to another.

Perspective

This article examines the similarities/differences in beliefs and coping endorsed by adults with chronic pain from two countries, and the potential moderation effects of country on the associations between these variables and pain and function. The findings suggest that few modifications may be needed when culturally customizing psychological pain treatments.

Keywords: Chronic pain; Cross-cultural; Pain-related beliefs; Pain coping; Moderation

Introduction

Chronic pain is a significant and prevalent public health problem [6,17,34] influenced by an interplay between biopsychosocial factors [2,5,21,25,27,39,48,55,56]. Chronic pain is also one of the leading causes of disability globally [58]. Research based on biopsychosocial models has improved our understanding of the mechanisms contributing to chronic pain and has informed the development of treatment programs targeting biomedical and psychosocial factors associated with pain and its impact.

Despite their demonstrated efficacy, pain treatments targeting biological and psychological aspects have only modest effects [50]. This may be attributed to the complex nature of chronic pain [11], interindividual variability in response to pain treatments [13,27], and a tendency to overlook sociocultural factors that may influence pain [57]. Culture (i.e., a set of shared social norms, attitudes, values, goals, beliefs, and traditions, usually reflected by one's country of origin, or religious, ethnic, or socioeconomic group [32,47,48,53]) may influence pain experience itself [4,45], as well as the context- and culturally-determined psychosocial variables (e.g., beliefs, coping) that are associated with pain and function in people with chronic pain [1,48].

In support of this idea, three recent systematic reviews [39,43,48] have noted some differences in pain-related beliefs and pain coping responses as a function of country of origin, socioeconomic status, and racial/ethnic group. For example, guarding and resting are most common among people with chronic pain from the United States of America (USA) than their counterparts from Portugal and Singapore; people with chronic pain who identify as Black tend to pray/hope more than those who identify as White [39,43]. Moreover, preliminary research suggests that cultural background (as reflected for example by country of origin) may also moderate the associations between psychological factors and both pain and function. Cultural background may also influence the efficacy of pain treatments targeting such factors [23,25]. If so, pain treatments (including those targeting psychological factors) developed for and tested in individuals from one country, may not necessarily be effective for individuals from another country. Findings from cross-cultural research could provide an empirical foundation for determining if, and how, these treatments might need to be adapted to make them most appropriate and effective in populations from different countries.

The few published studies that focus on these issues have compared samples of individuals from different ethnic groups living in the same country [7], or made indirect comparisons of their findings with pre-existing data from studies conducted in different countries [23,25,38]. These preliminary findings suggest that cultural background influences the associations between key pain-related variables. For example, Ferreira-Valente and colleagues [23] found differences in the strength

of the associations of task persistence and support-seeking responses with function in individuals from the USA (an individualist, indulgence-oriented country/culture) and Portugal (a collectivist, restraint-oriented country/culture) [32,33]. However, no previous study has tested such a moderation effect by collecting data in different countries concurrently using similar measures and procedures. This study sought to: (1) identify similarities and differences between people with chronic pain from two countries (the USA and Portugal) in the endorsement of pain-related beliefs and pain coping responses; and (2) determine if country of origin moderates the associations of pain-related beliefs and pain coping responses with pain severity, pain interference, general physical function, and psychological function in people with chronic pain. Because no prior study has examined such a moderation effect, and only a few prior studies have directly examined between-country comparisons relative to pain-related beliefs and pain coping responses in a single study, no *a priori* hypotheses were formulated.

Materials and Methods

Study design and participants

This was a cross-cultural cross-sectional observational questionnaire-based study. Participants were adults with chronic pain born and currently living in the USA or Portugal. Prospective participants could participate in the study if they: (1) were adults (≥18 years old); (2) were born either in the USA or in Portugal and were still living in the country of their birth; (3) could read, speak, and understand English (if from the USA) or Portuguese (if from Portugal); (4) reported they had experienced significant, disabling, bothersome pain at least 50% of the days for at least the last three months [12,14]; (5) reported they had pain associated with osteoarthritis, low back pain, or migraine (all three of which are among the most common causes of years lived with disability) [58]; and (6) were willing to participate in the study. Exclusion criteria included: (1) having a significant cognitive impairment that would prevent participation; and (2) having significant psychopathology (e.g., having been admitted to a hospital due to psychopathology in the previous six months, endorsing significant suicidal ideation with a plan for self-harm in the past six months).

The minimum sample size recommended to detect a significant effect in moderation analysis using ordinary least squares (OLS) multiple linear regression-based trajectory analyses was determined *a priori* using the software G*Power, assuming a small effect size R^2 of .03 [23–25], an α level of 0.05, and a statistical power of 0.80 [9]. This calculation resulted in a minimum sample size requirement of 256 participants for detecting only a moderation effect, and a minimum sample size of 421 participants for detecting a significant effect for the total model.

Of the 1419 prospective participants who agreed to participate and who completed the screening questions, 55% (Total *n*=786; USA: *n*=369; Portugal: *n*=417) did not meet the study eligibility criteria and were excluded from the study sample. Six hundred and thirty-three participants (USA: *n*=292; Portugal: *n*=341) provided at least some information. Complete data for the measures used in the reported statistical analysis were available for 561 participants (USA: *n*=273; Portugal: *n*=288) who were included in this study sample.

[Insert Table 1]

Measures

Study participants completed a sociodemographic (e.g., sex assigned at birth, age, education level, occupation, family/household net income, native language, country of origin) and pain history (e.g., pain etiology, pain duration) questionnaire, and measures of pain severity, pain interference, general physical function, psychological function, pain-related beliefs, and pain coping responses.

Socioeconomic status. A composite variable socioeconomic status was computed, by transforming the categorical variables education level, occupation, family/household net income, using Multiple Correspondence Analysis (MCA) [28,29], into a single composite score. The three categorical variables saturated on one dimension with good reliability (Cronbach's α=.81). The factorial score was computed and saved as a quantitative variable assessing participants' socioeconomic status, which was used as a control variable in the statistical analyses, as described below.

Pain severity. Pain severity was assessed with the 4-item Brief Pain Inventory – Short Form (BPI) Pain Severity scale [3,8]. This scale asks respondents to rate their current pain intensity and worst, least, and average pain intensity in the past 24 hours on a 0 to 10 numerical rating scale (0-10 NRS) ranging from 0 ("No pain") to 10 ("Pain as bad as you can imagine"). As recommended by the developers of this measure, an average composite score was computed, with higher scores indicating more pain severity. Both the English and the Portuguese versions of the BPI Pain Severity scale used in this study have shown adequate psychometric properties in samples of adults with chronic pain [3,8]. This measure showed good internal consistency in both subsamples (USA: Cronbach's α=.84; Portugal: Cronbach's α=.83) of the current study.

Pain interference. Pain interference with daily function was assessed using the 7-item Brief Pain Inventory – Short Form (BPI) Pain Interference scale [3,8,26]. With these items, respondents are asked to rate the degree of interference of pain on seven domains of daily function (e.g., general activity, mood, normal work, and relations with other people) on 0-10 NRS's ranging from 0 ("Does not interfere") to 10 ("Completely interferes"). A composite score (mean of the seven items) ranging from 0 to 10 was computed [8]. Higher scores indicate greater pain interference in daily function. The English and Portuguese versions of the BPI Pain Interference scale were used. These versions have demonstrated adequate psychometric properties in samples of adults with chronic pain [3,8,26]. This scale evidenced excellent internal consistency in the USA (Cronbach's α=.90) and Portuguese (Cronbach's α=.92) subsamples.

General physical function. The Medical Outcomes Study 12-Item Short Form Health Survey (SF-12) Physical Component Summary (PCS) was used as a measure of general physical function [18–20,59,60]. Six of the SF-12's items were used to compute the PCS score. Theoretically, the scores can range from 0 to 100. Higher scores indicate better physical health status. Previous research supports the adequate psychometric properties of the English and Portuguese versions of this measure in adults from the general population [18–20,59,60]. It showed good internal consistency in the study subsamples (USA: Cronbach's α=.89; Portugal: Cronbach's α=.80).

Psychological function. Psychological function was evaluated using the Medical Outcomes Study 12-Item Short Form Health Survey (SF-12) Mental Component Summary (MCS) [18–20,59,60], with higher MCS scores (ranging, theoretically, from 0 to 100) indicating better mental health status. It showed acceptable to good internal consistency in the USA (Cronbach's α=.78) and Portuguese (Cronbach's α=.82) subsamples.

Pain-related beliefs. The English and Portuguese versions of the 35-item Survey of Pain Attitudes (SOPA) were used as a measure of pain-related beliefs [36]. The scale has seven subscales of five-items each that measure seven different pain-related beliefs and attitudes towards pain: Harm (belief that pain indicates that physical damage is being done), Medication (belief that pain medication intake is an appropriate course of treatment for chronic pain), Solicitude (belief that a solicitous response from others to pain behaviors is adequate), Disability (belief that one is disabled by pain), Pain Control (belief that one can control pain), Medical Cure (belief that there is a medical cure for pain), and Emotion (belief that emotions impact pain). With the SOPA, respondents are asked to rate their degree of agreement with each item/statement using a Likert scale ranging from 0 ("This is very untrue for me") to 4 ("This is very true for me"). The responses to the items for each scale are averaged, resulting in seven scores ranging from 0 to 4. Higher scores indicate a greater degree of agreement with the pain-related belief or attitude about pain reflected in the scale name. The English version of this measure has shown adequate psychometric properties in a sample of adults with chronic pain [36]. The Portuguese version has also shown adequate psychometric properties in a sample of Portuguese adults with chronic pain (Ferreira-Valente A et al., 2022, unpublished poster communication presented at the IASP 2022 World Congress of Pain). Cronbach's alphas for all of the SOPA subscales in the current sample ranged from .67 to .84 in the USA participants, and .63 to .90 in the Portuguese participants, indicating borderline to excellent internal consistency, except for the SOPA Medical Cure subscale in the Portuguese subsample (Cronbach's α=.58).

Pain coping responses. Pain coping responses were assessed through the English and Portuguese versions of the 2-items *per* scale Chronic Pain Coping Inventory (CPCI) [23,35]. This measure has 16 items grouped in eight subscales, each reflecting a different type of pain coping response: Guarding, Resting, Asking for Assistance, Relaxation, Task Persistence, Exercise/Stretch, Support Seeking, and Coping Self-statements. Participants were asked to indicate the number of days, in the past seven days, in which they used the strategy described in each item to cope with their pain. The eight scores, one per subscale, are computed by calculating the average of the two items for each scale, and can range from 0 to 7. Higher scores indicate a greater frequency of use of the pain coping response reflected by the scale's name. Both versions used in the current study have demonstrated validity through correlations with the corresponding dimensions of the original version of this measure (*r*'s ≥ .70), and with criterion measures (e.g., pain and physical and psychological function) in samples of adults with chronic pain [23,35]. Given that each scale of this measure has only two items, which were selected to assess different components of the coping response being assessed (i.e., to avoid assessing the same component in two ways), low Spearman-Brown coefficients would be expected. The Spearman-Brown coefficient is the most adequate coefficient to assess the reliability of two-item scales [16]. For all of the CPCI subscales, the Spearman-Brown coefficients ranged from .53 to .87 in the USA participants, and .53 to .80 in the Portuguese participants of the current sample, indicating borderline to good internal consistency, except for the CPCI Resting subscale.

Procedures

All study procedures were reviewed and approved by the Institutional Review Board (IRB) at the University of Washington (IRB ID: STUDY00004728) and by the Ethical Review Board for Research of Ispa – Instituto Universitário (Reference: I/005/03/2018). The study was conducted in accordance with the Declaration of Helsinki.

The study data were collected between October 2019 and September 2021, both in Portugal and in the USA. Participants from the USA were recruited from four primary sources:. These

included (1) individuals diagnosed with low back pain or osteoarthritis registered at the University of Washington Department of Rehabilitation Medicine Participant Pool (a registry of individuals interested in research involvement who agreed to be contacted about future research opportunities); and (2) medical records coding lists of patients with diagnostic codes for low back pain, osteoarthritis, and/or migraine who had been seen within the University of Washington medical system. Individuals from these sources had their medical records prescreened by the research staff for one of the study's inclusion diagnoses, and checked for potential exclusion criteria; those meeting these criteria were mailed an approach letter with information about the study with an invitation to participate in the study. Research staff also telephoned individuals 1-2 weeks after the approach letter was mailed if the individual had not responded to the letter. Participants from the USA were also recruited from the general population through (3) social media platforms (e.g., Facebook); and (4) research recruitment websites.

Participants from Portugal were recruited from four primary sources. These included: (1) the outpatients of the Rehabilitation Medicine Department of the Central Lisbon University Hospital Center with diagnosis of low back pain and/or osteoarthritis, identified through the review of the outpatients' clinical records by a healthcare provider of this healthcare service; and (2) the patients of the North Rehabilitation Center Dr. Ferreira Alves with diagnosis of low back pain, osteoarthritis, and/or migraine, identified through the review of the outpatients' clinical records by a healthcare provider of this healthcare service. Individuals from these sources had their medical records prescreened by a healthcare professional of the respective healthcare institutions for one of the study's inclusion diagnoses and checked for potential exclusion criteria. These healthcare professionals either telephoned or approached those individuals potentially meeting these requirements in-person, to provide information about the study, and invited them to participate in the study. Participants from Portugal were also recruited from the general population through (3) circular emails and letters (e.g., educational and health institutions); and (4) social media platforms (e.g., Facebook).

In both countries, data collection was completed using a survey questionnaire with online, paper-and-pencil, and telephone administration options available to participants. Prospective participants who expressed interest in participating in the study were informed of the study aims and procedures and screened for eligibility through their preferred study completion medium (online, telephone, or paper-and-pencil). Participants who preferred to complete the survey questionnaire either on paper or via telephone were screened via telephone before being sent a hardcopy of the informed consent form, the survey questionnaire, and, if applicable, a pre-stamped envelope. Portuguese participants preferring to complete the survey questionnaire on paper could also be screened in-person by a research assistant before being given a hardcopy of the informed consent form, the survey questionnaire, and, if applicable, a pre-stamped envelope. Participants who preferred to complete the survey questionnaire online were screened either via telephone or through an online screening questionnaire. Those eligible to participate were given access to a link to the informed consent form and the online survey questionnaire available from the Research Electronic Data Capture (REDCap) data collection system hosted by the University of Washington, or from the Qualtrics online survey platform hosted by the William James Center for Research.

Regardless of recruitment source or completion medium (online, telephone, or paper-and-pencil), all participants who agreed to complete the survey questionnaire were assured their participation was anonymous, confidential, and voluntary. They were told that they were free to not answer any questions for any reason, and that they could withdraw from the study at any time. The survey questionnaire took, on average, 30-45 minutes to complete. Informed consent was obtained from all study participants.

Data analysis. We first computed frequencies (n, %), means (M), and standard deviations (SD) of the study variables. Then, a MCA, using an optimal scaling procedure, was conducted to attribute an optimal quantification to the categories of education level, occupation, and family net income, in order to compute a composite variable assessing participants' socioeconomic status, as recommended by Gifi [28] and Greenacre [29]. Next, we determined if the assumptions required for the

planned statistical analyses were met. Skewness and kurtosis of the study measures were computed to assess the absence of severe violation of the normality assumption. Absolute values of skewness and kurtosis lower than 3 and 10, respectively, were considered as indicating an absence of severe deviation from a normal distribution [37]. Levene's test was performed to evaluate homogeneity of variances. Residuals' homoscedasticity and normality of residual distribution were both assessed graphically, through the inspection of the normal probability plot of the residuals [54]. The Durbin-Watson statistic was used to evaluate errors' independence. Values close to 2 suggest absence of violation of this assumption. The absence of multicollinearity was evaluated by computing analysis of the variance inflation factors (VIFs) for the predictor variables. VIFs lower than 5 suggest an absence of multicollinearity [10].

To identify possible differences in the degree of agreement with pain-related beliefs and frequency of use of the different pain coping responses between the USA and Portuguese samples, we conducted a series of independent sample *t*-tests with SOPA and CPCI subscales as the dependent variables, and country of origin as the independent variable. In the event that a violation of the homogeneity of variances assumption was found, we planned to use the Welch correction to set the degrees of freedom. We also computed partial correlation coefficients among the study measures (controlling for sex and socioeconomic status) to assess the univariate associations between them. The Fisher's r-to-z transformation was used to assess the significance of the difference between pairs (Portugal subsample *versus* USA subsample) of the coefficients between the measures of pain-related beliefs and pain coping responses, on one hand, and measures of pain severity, pain interference, general physical function, and psychological function, on the other.

Finally, to test for possible moderation effects of country of origin on the associations between measures of pain-related beliefs and pain coping responses, on one hand, and criterion measures, on the other, moderation analyses were performed using Ordinary Least Squares (OLS) multiple linear regression-based trajectory analyses, as proposed by Hayes [30] and Hayes and Matthes [31]. Hayes's Model 1 [30], testing one moderator and one predictor, controlling for sex and

socioeconomic status, was used. Thus, 15 models (one per each pain-related belief and pain coping response assessed) were tested per dependent variable, resulting in a total of 60 moderation analyses. Interaction effects were tested and probed using a pick-a-point approach. Sex and socioeconomic status were included as covariates. Individuals with missing data were excluded from the analyses. Cohen's *d*'s and Cohen's f^2's were computed as estimates of the effect sizes for between-sample comparisons and OLS multiple linear regression-based trajectory analyses, respectively, using an online calculator [9,51,52]. Cohen's *d*'s and Cohen's f^2's were classified as small (*d*=0.20, f^2=0.02), medium (*d*=0.50, f^2=0.15), or large (*d*=0.80, f^2=0.35) [9].

IBM SPSS Statistics (v. 28; SPSS Inc, Chicago, IL) and PROCESS macro for SPSS (v. 4.1; available from http://www.processmacro.org) were used to perform all statistical analyses. Although conducting multiple tests increases the chances of Type I errors, the usual procedures employed to control for this type of statistical error (e.g., setting a lower significance level; employing unilateral tests) increase the probability of Type II errors [46]. Therefore, given the exploratory nature of this study, the alpha was maintained at 0.05. Statistically significant findings of between-sample comparisons and OLS multiple linear regression-based trajectory analyses associated with larger effect sizes are assumed to be more likely to be reliable and to be replicated in future research.

Results

Sample sociodemographic and clinical characteristics

Table 1 summarizes the characteristics of the study sample. As can be seen, most participants were women (overall sample: *n*=385, 69%; USA subsample: *n*=166, 61%; Portugal subsample: *n*=219, 76%). Participants' ages ranged from 19 to 92 years old (*M*=54.02, *SD*=16.45) in the overall sample, ranging from 21 to 92 years old (*M*=54.60, *SD*=14.66) in the participants from the USA, and from 19 to 90 years old (*M*=54.10, *SD*=17.99) in the participants from Portugal. Most participants were married or were in a domestic partnership (overall sample: *n*=322, 58%; USA: *n*=154, 57%; Portugal: *n*=168, 58%). Education level distribution slightly varied between

participants from the USA and Portugal, with the former reporting having, for the most part, greater education level than the latter. Indeed, 57% of USA participants had completed at least a Bachelor's degree *versus* 44% of Portuguese participants. The family net income per poverty threshold also varied between participants of the two countries. As much as 49% of the participants from the USA subsample reported a family net income more than five times above the poverty threshold relative to the year 2018, versus only 22% of Portuguese participants.

The most frequently (non-mutually exclusive) reported chronic pain conditions were low back pain (overall sample: n=417, 74%; USA: n=219, 80%; Portugal: n=198, 69%; $\chi^2[1]=9.66$, p=.002), osteoarthritis (overall sample: n=253, 45%; USA: n=132, 48%; Portugal: n=121, 42%; $\chi^2[1]=2.27$, p=.132), and migraine (overall sample: n=131, 23%; USA: n=72, 26%; Portugal: n=59, 21%; $\chi^2[1]=2.71$, p=.099). As summarized in Table 2, the overall sample (as well as the USA and Portugal subsamples) is characterized by moderate levels of pain severity and pain interference, with USA participants reporting slightly greater pain interference as compared to their Portuguese counterparts ($t[559]=-2.16$, p=.03, d=-0.18). General physical function and psychological function, in the overall sample, were, on average, 50.21 (SD=23.62) and 61.43 (SD=20.98), respectively, with USA participants reporting better psychological function than Portuguese participants ($t_{Welch}[521.52]=-2.74$, p=.01, d=-0.23).

[Insert Table 2]

Assumptions Testing

The study variables' skewness and kurtosis ranged from -0.67 to 0.50 (USA: -0.50 and 1.11; Portugal: -0.78 and 0.54), and from -1.03 to -0.14 (USA: -1.17 and 0.37; Portugal: -1.03 and -0.06), respectively, indicating an absence of severe deviation from the normal distribution. Levene's test suggested that heterogeneity of variances is present for the measures of age, psychological function, the pain coping response of relaxation, and medication and solicitude beliefs. The assumptions of residuals' homoscedasticity, of normality of residuals' distribution, of independence of residuals ($1.88<DW<2.19$), and absence of multicollinearity ($1.01<VIF<1.56$) were met.

Pain-related beliefs and pain coping responses: USA *versus* Portugal comparisons

The frequency of use of guarding (t[559]=-3.36, p=.001, d=-0.28), resting (t[599]=-2.41, p=.02, d=-0.20), and exercising/stretching (t[599]=-4.77, p<.001, d=-0.40) to cope with pain were higher among individuals from the USA as compared to their Portuguese counterparts. On the other hand, the frequency of use of relaxation (t_{Welch}[521.52]=2.10, p=.04, d=0.18), support seeking in response to pain (t[599]=3.04, p=.003, d=0.26), and the degree of agreement with pain-related beliefs of harm (t[599]=2.65, p=.01, d=0.22), medication use (t_{Welch}[521.52]=5.80, p<.001, d=0.49), solicitude (t_{Welch}[521.52]=7.74, p<.001, d=0.65), and medical cure (t[599]=4.96, p<.001, d=0.42) were lower among USA participants as compared to Portuguese participants. Finally, the frequency of use of asking for assistance, task persistence, and coping self-statements to cope with pain, as well as the degree of agreement with pain-related beliefs of disability, pain control, and emotion were not statistically significantly different between the USA and Portugal subsamples.

Univariate associations between the study variables

Partial correlation coefficients between study variables, both for the overall sample and for the USA and Portugal subsamples, are summarized in Table 3. The direction and statistical significance of the associations were similar across the two subsamples, except for the associations between: (1) pain interference and pain coping response of task persistence ($Z_{observed}$=-2.22, p=.026), and pain control beliefs ($Z_{observed}$=1.99, p=.047); and (2) general physical function and pain coping responses of guarding ($Z_{observed}$=-3.22, p=.001), as well as disability ($Z_{observed}$=-3.49, p<.001), and emotion beliefs ($Z_{observed}$=3.63, p<.001). For the most part, pain coping responses of guarding (.21<|r|<.64), resting (.15<|r|<.38), asking for assistance (.17<|r|<.46), relaxation (.03<|r|<.20), and support seeking (.09<|r|<.24), as well as the belief that pain indicates that physical damage is occurring (.22<|r|<.40), that pain medication intake is an appropriate pain treatment (.03<|r|<.29), that others should be solicitous in response to pain behavior (.05<|r|<.30), that one is disabled by pain (.35<|r|<.79), and that emotions influence pain (.01<|r|<.29), are associated with greater pain and worse physical and psychological function. On the other hand, the pain coping responses of

task persistence (.16<|*r*|<.41) and exercise/stretch (.003<|*r*|<.16), and the belief that one is able to control his/her pain (.24<|*r*|<.48) are associated with lower pain and better physical and psychological function.

[Insert Table 3]

OLS Multiple Linear Regression-based Trajectory Analyses Predicting Pain Severity

The results of the OLS multiple linear regression-based trajectory analyses predicting pain severity and the moderation tests of country of origin are summarized in Table 4. As can be seen, variables entered in Step 1 accounted for 4% (for coping self-statements) to 23% (for disability beliefs) of the variance of pain severity. Most pain coping responses and pain-related beliefs were positively and significantly associated with pain severity. However, the pain coping responses of exercising/stretching (β=.01, p=.937), coping self-statements (β=.09, p=.111), and task persistence (β=-.24, p<.001), as well as solicitude (β=.06, p=.360), medical cure (β=-.01, p=.849), emotion (β=.01, p=.810), and pain control (β=-.25, p<.001) beliefs, were either not significantly associated, or were negatively associated, with pain severity. No statistically significant moderation effect of country of origin emerged in these analyses.

[Insert Table 4]

OLS Multiple Linear Regression-based Trajectory Analyses Predicting Pain Interference

As shown in Table 4, the variables entered in Step 1 accounted for 6% (for support-seeking coping response) to 43% (for disability beliefs) of the variance of pain interference. Most pain coping responses and pain-related beliefs considered were positively and significantly associated with pain interference. However, the pain coping response of task persistence (β=-.38, p<.001), and pain control (β=-.32, p<.001) beliefs were negatively associated with pain interference, while the pain coping responses of exercise/stretch (β=-.11, p=.076) and coping self-statements (β=.10, p=.09), as well as medical cure beliefs (β=.05, p=.389) were not significantly associated with pain interference.

Statistically significant small effect size moderation effects of country of origin were found for three (20%) out of 15 OLS regression analyses predicting pain interference. Interaction effects were found for the task persistence coping response (ΔR^2=.01, p=.032, f^2=0.01), as well as for disability (ΔR^2=.01, p=.022, f^2=0.01) and pain control (ΔR^2=.01, p=.021, f^2=0.01) beliefs. The conditional effects of the significant interaction effects are depicted in Figure 1. These show that pain control and disability beliefs are stronger predictors of pain interference in the Portuguese subsample than in the USA subsample, while task persistence coping response is a stronger predictor of pain interference in the USA subsample as compared to the Portuguese subsample. However, all moderation effects found had small effect sizes.

OLS Multiple Linear Regression-based Trajectory Analyses Predicting General Physical Function

Table 5 presents the results of the OLS multiple linear regression-based trajectory analyses predicting general physical function and testing the moderation effects of country of origin. As can be seen, variables entered in Step 1 accounted for 12% (for coping self-statements and medical cure beliefs) to 58% (for disability beliefs) of the variance of general physical function. The pain coping responses and pain-related beliefs that were negatively and significantly associated with general physical function (β ranging from -.73 [p<.001] and -.16 [p=.003]) were guarding, resting, asking for assistance, and support-seeking coping responses, as well as harm, medication, and disability beliefs. On the other hand, the pain coping responses of relaxation, task persistence, and exercise/stretch, as well as solicitude and pain control beliefs, were positively significantly associated with general physical function (β ranging from .05 [p=.047] and .40 [p<.001]). Coping self-statements, as well as medical cure and emotion beliefs were not significantly associated with general physical function.

[Insert Table 5]

Statistically significant small effect size moderation effects of country of origin were found for two (13%) out of 15 OLS regression analyses predicting general physical function. Interaction

effects were found for guarding responses (ΔR^2=.01, p=.019, f^2=0.01) and for emotion beliefs (ΔR^2=.02, p<.001, f^2=0.02). The conditional effects of the significant interaction effects are depicted in Figure 2, and suggest that emotion beliefs are a relevant predictor of general physical function in the Portuguese subsample, but not in the USA subsample, while guarding is a stronger predictor of general physical function in the USA subsample than in the Portuguese subsample.

OLS Multiple Linear Regression-based Trajectory Analyses Predicting Psychological Function

As can be seen in Table 5, the variables entered in Step 1 accounted for 5% (for coping self-statements and relaxation coping response) to 17% (for disability beliefs) of the variance of psychological function. Most pain coping responses and pain-related beliefs were negatively and significantly associated with psychological function (β ranging from -.26 [p<.001] and -.15 [p=.019]), including guarding, resting, asking for assistance, and support-seeking responses, as well as harm, solicitude, disability, and emotion beliefs. Only task persistence (β=.27, p<.001) responses and pain control (β=.24, p<.001) beliefs were positively significantly associated with psychological function; relaxation, exercise/stretch, coping self-statements, and medication and medical cure beliefs were not significantly associated with psychological function.

A statistically significant small effect size moderation effect of country of origin was found for one out of 15 OLS regression analyses predicting psychological function. The association between medication beliefs and psychological function was moderated by participants' country of origin (ΔR^2=.007, p=.04, f^2=0.007). The conditional effects of the significant interaction effects are depicted in Figure 3 and indicate that while medication beliefs are only very weakly associated with psychological function in the USA subsample, these believes are associated with worse psychological function in the Portuguese subsample.

Discussion

This is the first study to directly test the moderating effects of country of origin on the associations between psychological factors and pain and function in samples from different

countries. It also examined the similarities and differences in the endorsement of beliefs and coping responses in two samples of individuals with chronic pain from two countries. Participants from both countries reported many similarities in terms of the endorsement of pain-related beliefs and pain coping responses, and also in terms of the direction and strength of the associations between the study variables. For example, very similar levels of endorsement of the beliefs that pain causes disability, that one can control pain, and that emotions impact pain, and of pain coping responses of asking for assistance, task persistence, and coping self-statements emerged. This is consistent with findings of Ferreira-Valente et al. [23], which compared coping data obtained from individuals with chronic pain from these countries (albeit from two different studies).

The number of significant moderation effects was small (only 10% of the moderation analyses). This suggests that there are many more between-country similarities than differences in the directions and strengths of the associations between the study variables. Across both countries, the factors most closely associated with pain and function are beliefs regarding disability, harm, and pain control, and guarding and task persistence coping responses [15,22,24,25,35,40,44]. Disability beliefs, harm beliefs, and guarding appear to be maladaptive in individuals from both countries, whereas control beliefs and task persistence coping appear to be adaptive. If these findings replicate in future studies, only minor cultural adaptations might be needed when customizing psychosocial pain treatments originally developed in one of these countries for use in the other.

However, consistent with the results of Sharma et al.'s systematic review [48], between-country differences in the endorsement of 60% of the pain-related beliefs and coping responses emerged. Portuguese participants were more likely to endorse the beliefs that pain is a sign of harm, that there exists a medical cure for pain, that medications are appropriate for managing chronic pain, and that others should be solicitous when one experiences pain. Portuguese participants also used relaxation and support seeking in response to pain more often than the USA participants. Consistent with previous findings [23], participants from the USA reported using more guarding and resting (two passive coping responses) and the active coping response of exercise/stretch.

These between-country differences may be attributed to between-country historical, ideological/political, and socioeconomic differences, which are associated with disparities in healthcare systems, pain treatments available, and access to specialty healthcare [41,42,48]. For example, the Portuguese health system has a universal tax-financed national health service, special health insurance schemes for certain professional groups, and voluntary health insurance options [41,49]. The proportion of GDP allocated to the total health expenditure is lower in Portugal. Unlike the USA, most health expenditure in Portugal is covered by government financing schemes [41]. The entire population is covered for basic healthcare services [41,49]. Nonetheless, important health inequalities remain [41,49], and waiting times for health services tend to be longer in Portugal than the average of the Organization for Economic Co-operation and Development (OECD) countries [42]. Thus, differences between Portugal and the USA may exist in the access to timely and adequate healthcare for one's pain condition and for paid sick leave. Thus, Portuguese patients may use fewer passive pain coping responses. Also, individuals with lower income may not be able to afford unpaid sick leave or paid domestic help with household chores. Resting and guarding responses might be less viable for Portuguese individuals relative to those from higher average income countries like the USA. Furthermore, the universal healthcare services coverage in Portugal may foster greater confidence in the available (predominantly biomedical) healthcare. This may encourage the belief that biomedical interventions are appropriate for managing pain among Portuguese individuals.

Another possible reason for the between-country differences observed might be related to culture-related differences [23,48]. The Hofstede's model of national cultures [32,33] distinguishes the USA and Portugal's cultures mostly via their levels of individualism, tolerance for uncertainty, indulgence/restraint-orientation, and attitudes towards power inequalities. USA nationals tend to be individualist and indulgent. They also tend to have low levels of emotional expressiveness, to be more willing to consider different views, and to not live by universally accepted rules. The emphasis on equal rights encourages an informal, direct, and participative communication among

individuals from different hierarchical positions in the USA. On the other hand, Portugal is a collectivist and restraint-oriented country. Portuguese individuals tend to be loyal and strongly committed to the in-group (e.g., family). They tend to be pessimistic and to limit gratification to comply with social rules, norms, and codes of beliefs and behavior. Hierarchical distance is expected; those higher up in the hierarchy are given more privileges and access to information [32,33]. Given these cultural differences, the observed greater agreement with solicitude and medical cure beliefs, a greater use of support seeking, and lesser use of resting and wellness-focused strategies (e.g., exercising and stretching) in the Portuguese participants is not surprising.

As noted previously, only a few small effect size moderation effects for country of origin were identified. Those that did emerge were related to beliefs about disability, pain control, appropriateness of medications for pain management, and the impact of emotions on pain. Moderation effects were also identified for guarding and task persistence coping responses. Thus, there may be more between-person than between-country differences in the role that psychological factors play in pain and its impact. To culturally customize psychosocial pain treatments originally developed in the USA into the Portuguese context, and *vice versa*, only minor cross-cultural adjustments of these treatments might be needed. That said, the study findings also suggest that it might be worthwhile for clinicians to consider contextual and culture-related specificities when tailoring treatment to any one individual [7,23,25,32,33,48]. Clinicians who wish to be sensitive to cultural issues when treating individuals with chronic pain from Portugal might: (1) strongly discourage the endorsement of disability, medication, and emotion beliefs, and (2) strongly encourage pain control beliefs. Conversely, for those clinicians who would like to be culturally sensitive when treating USA individuals with chronic pain, it might be more important to: (1) strongly discourage guarding responses, and (2) strongly encourage task persistence.

This study has several limitations that should be considered when interpreting the results. First, the study used convenience samples, which do not necessarily represent the population of individuals with chronic pain in both countries. Exclusion of individuals with missing data may

have also limited the representativeness of the study samples. Second, some demographic and socioeconomic between-sample differences were found. These could potentially partially explain the between-sample differences found in beliefs and coping. Therefore, additional research with other representative and balanced samples is needed to determine the reliability and generalizability of these findings. Third, a portion of the study sample was recruited during the COVID-19 pandemic. This may have influenced how the participants dealt with their pain, and some of the between-sample differences may be partially associated with between-country differences in how the two countries' authorities addressed the pandemic. Fourth, a large number of analyses were conducted in this exploratory study, which increased the probability of Type I errors. Further research to determine the reliability of the findings is warranted. Fifth, the use of a cross-sectional design precludes the ability to draw causal inferences. Longitudinal and experimental studies are needed to be able to make causal conclusions. Finally, borderline internal consistency of some measures of beliefs and coping may have blurred some between-sample differences in the domains assessed by these measures. Research using larger samples sizes that could help to mitigate the impact of borderline measure reliability would be useful.

Conclusions

Despite the study's limitations, the findings provide important new evidence regarding the potential role of the country of origin in influencing pain-related beliefs and pain coping responses. It is the first study to directly examine the moderating role of the country of origin on the associations between psychological domains and pain and function. The results suggest the need to target disability, pain control, and harm beliefs, and guarding and task persistence responses, in pain treatments in the USA and in Portugal. If the findings regarding the moderating effects of country of origin are replicated, the findings suggest that only a few changes might be needed when adapting a treatment developed in one country to another. Such adaptations might include the need to strongly discourage disability, medication, and emotion beliefs, while strongly encouraging pain control beliefs, in adults with chronic pain from Portugal. For those individuals from the USA, it

would appear to be more important to encourage task persistence and discourage guarding responses to pain. Additional research is needed to determine the reliability of these findings in other samples from these (and other) countries.

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Authors' Contributions

AFV is the principal investigator, obtained funding, conceived the study idea, and together with JPR and MJ developed the design of the study. JC contributed to the review of the study design. AFV and JC acquired the data. AFV performed the data analysis, and together with MP wrote the first draft of the manuscript. SS, SB, JPR and MP contributed to the interpretation of data analysis results. SS, JC, SB and JPR critically revised the manuscript. All authors approved the final version and are accountable for all aspects of this work.

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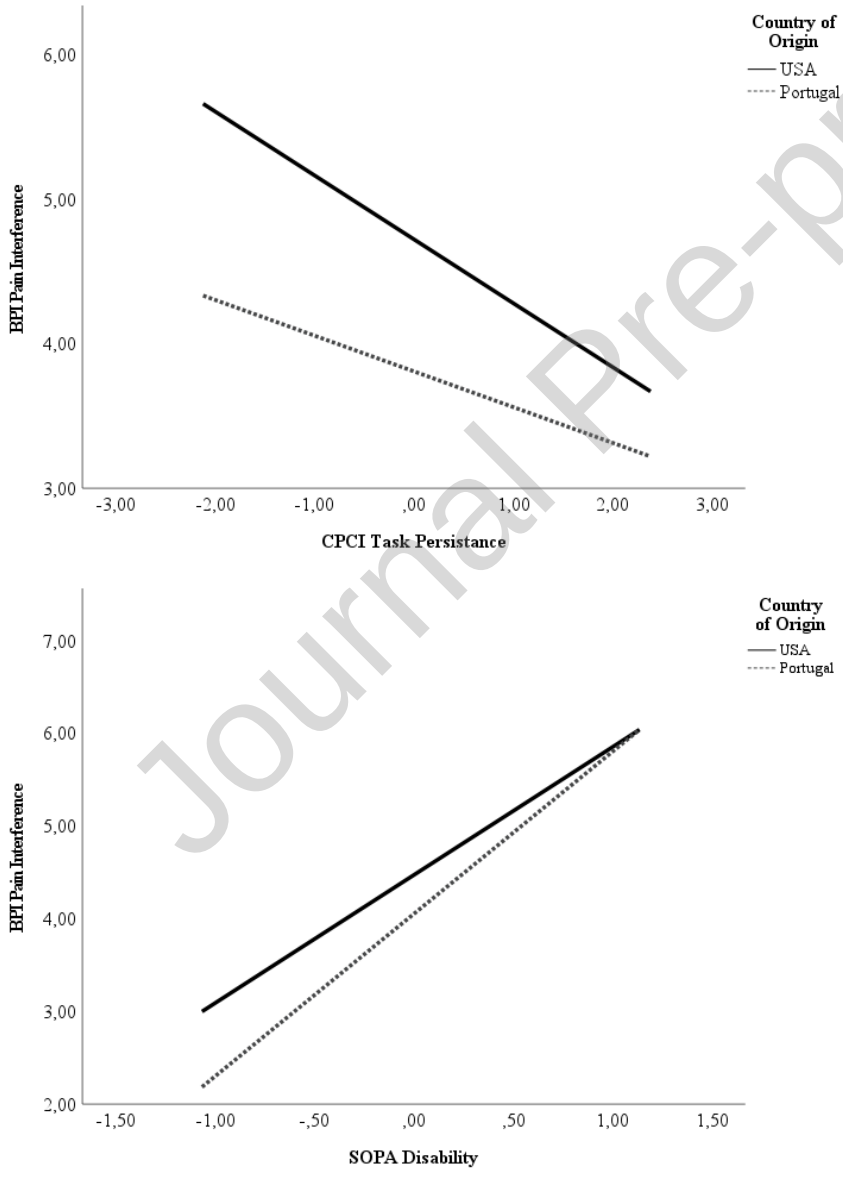
Figures Legends

Figure 1.



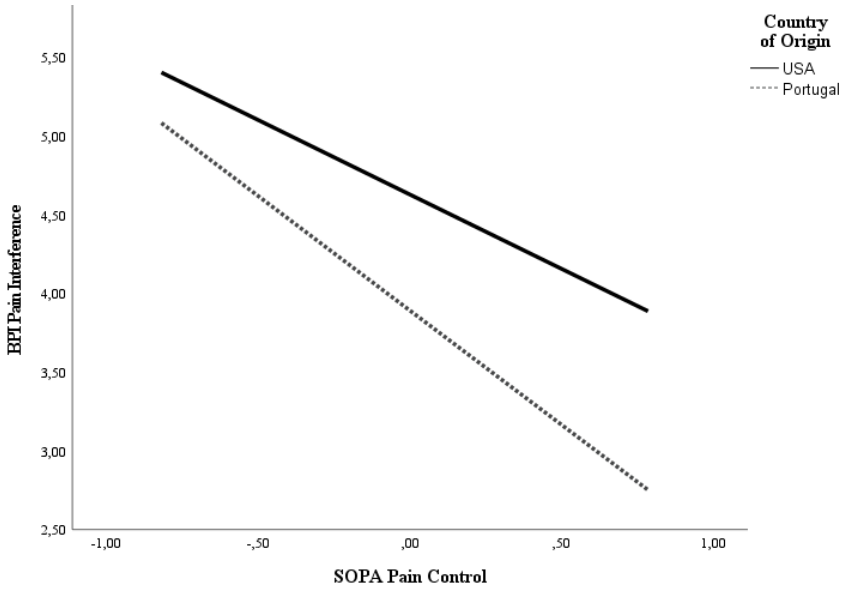
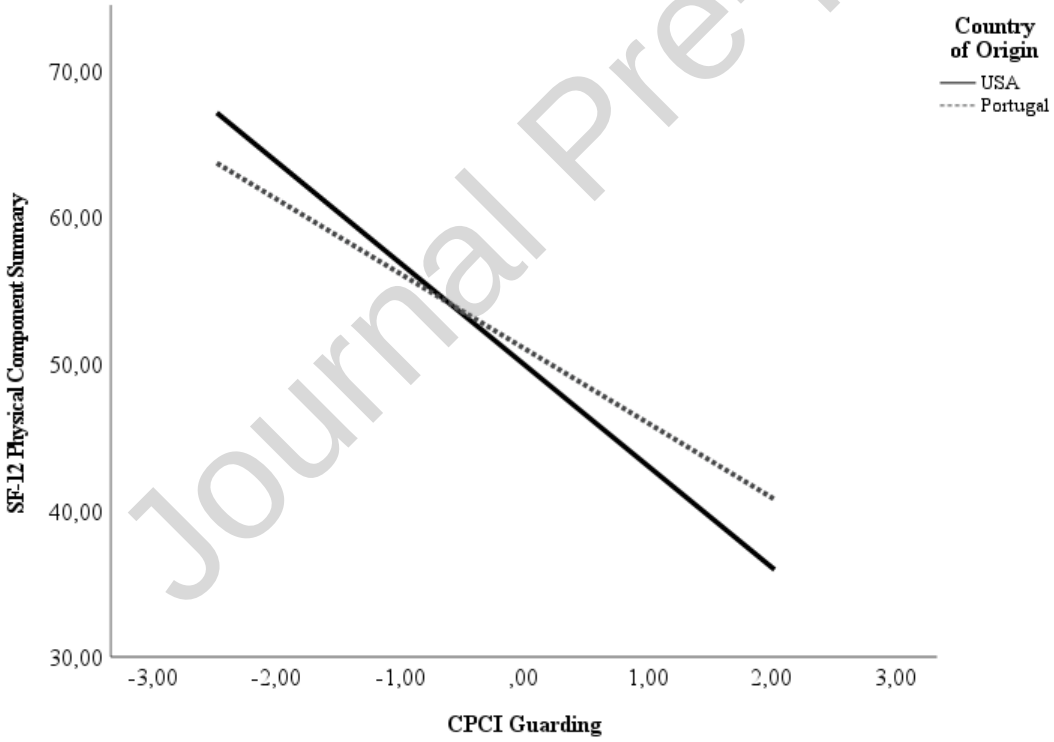


Fig 1. Conditional effects of significant interactions predicting pain interference.

Figure 2.



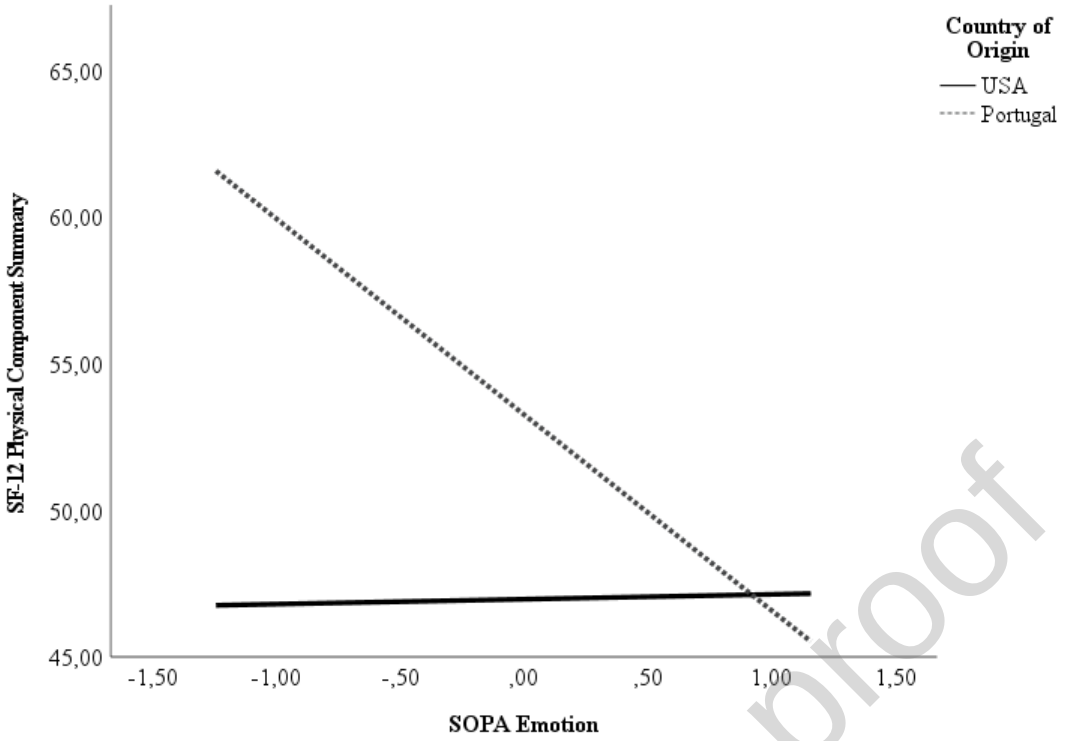


Fig 2. Conditional effects of significant interactions predicting general physical function.

Figure 3.

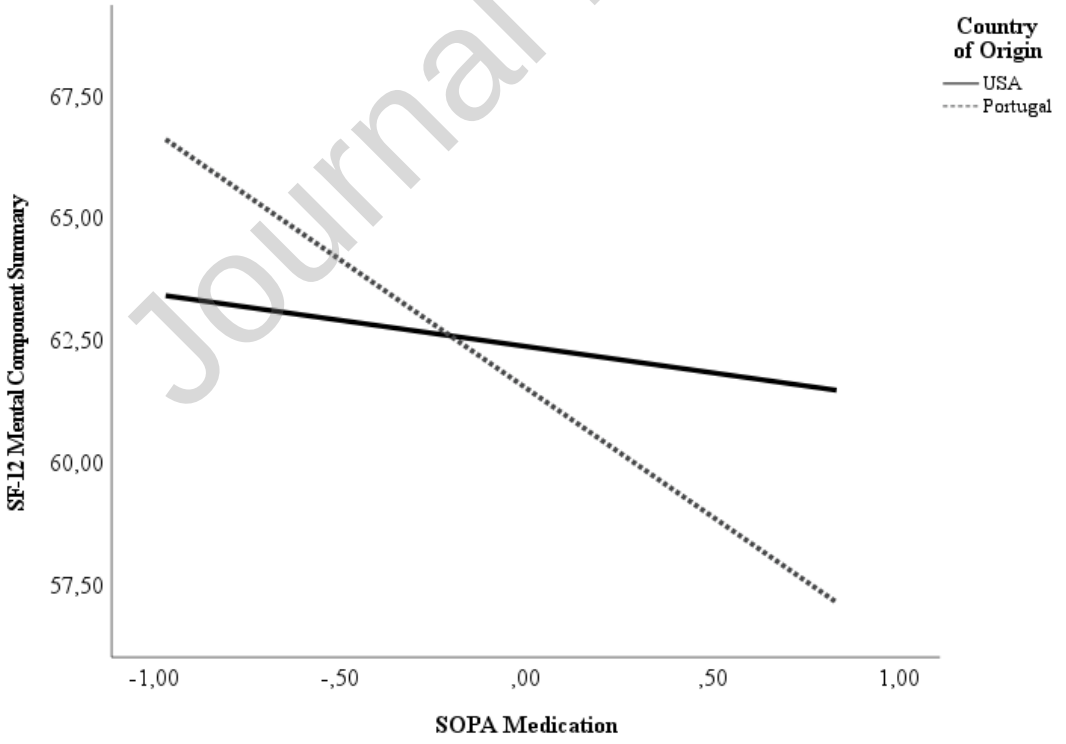


Fig 3. Conditional effects of significant interactions predicting pain interference, and general physical and psychological function.

Table 1.Sociodemographic characteristics

	Overall Sample (*N*=561)					USA Subsample (*N*=273)					Portugal Subsample (*N*=288)					*Hypothesis test*		
	%	*M*(*Me*)	*SD*	*Sk*	*Ku*	*%*	*M*(*Me*)	*SD*	*Sk*	*Ku*	*%*	*M*(*Me*)	*SD*	*Sk*	*Ku*	χ^2/U	*t*	*p-value*
Sex (women)	69					61					76					**14.67**		**<.001**
Age (in years)		54.34	16.45	-.173	-.735		54.60	14.66	-.209	-.645		54.10	17.99	-.138	-.894		-.358*	.721
Education level		(4)					(5)					(3)				**19760.50**†		**<.001**
No schooling (0)	2					-					5							
Primary school (1)	11					-					20							
Lower secondary school (2)	7					-					14							
Upper secondary school (3)	21					14					27							
Post-secondary education (4)	14					28					-							
Bachelor's or equivalente (5)	32					39					26							
Master's or equivalente (6)	11					17					7							
Doctoral or equivalente (7)	2					2					1							
Marital status																**12.84**		**.005**
Single	19					22					16							
Married/Domestic Partnership	58					57					58							
Separated/ Divorced	15					17					14							
Widowed	8					**4**					**12**							
Family net income/Poverty threshold	(*n*=449)	(4)				(*n*=261)	(4)				(*n*=188)	(3)				**17886.50**†		**<.001**
Less than 1x the poverty threshold (1)	7					7					7							
Between 1x and 2x above the poverty	14					11					19							

threshold (2)			
Between 2x and 3.5x above the poverty threshold (3)	21	15	30
Between 3.5x and 5x above the poverty threshold (4)	20	18	22
More than 5x above the poverty threshold (5)	38	49	22

Note: Education level is defined according to the International Standard Classification of Education 2011 (ISCED-11); Family net income/Poverty threshold, approximately, relative to the year 2018 (Portugal: €6.014; USA: $12.140); χ^2 – Chi-square test; $U/^{\dagger}$ – Mann-Whitney *U* test; *t* – Independent samples *t*-test; *Independent samples *t*-test with Welch correction; **bold text** indicates statistical significance.

Table 2.Descriptive statistics and subsamples comparisons

Variable [score range]	Overall Sample (*N*=561)				USA Subsample (*N*=273)				Portugal Subsample (*N*=288)				*t*-test		
	M	*SD*	*Sk*	*Ku*	*M*	*SD*	*Sk*	*Ku*	*M*	*SD*	*Sk*	*Ku*	*t*	*p*	*Cohen's d*
Criterion variables															
BPI - Pain Severity [0-10]	4.31	1.80	0.25	-0.36	4.20	1.82	0.33	-0.35	4.42	1.77	0.19	-0.32	1.45	.148	0.12
BPI - Pain Interference [0-10]	4.25	2.41	0.21	-0.74	4.48	2.27	0.11	-0.77	4.04	2.52	0.33	-0.69	**2.16**	**.031**	**-0.18**
SF-12 PCS	50.21	23.62	-0.22	-0.77	50.81	23.14	-0.22	-0.70	49.64	24.09	-0.21	-0.83	-0.59	.559	-0.05
SF-12 MCS	61.43	20.98	-0.46	-0.32	63.89	17.14	-0.19	-0.79	59.09	23.86	-0.41	-0.64	**-2.74***	**.006**	**-0.23**
Pain coping responses															
CPCI Guarding [0-7]	3.48	2.06	-0.03	-0.93	3.78	2.07	-0.18	-0.94	3.20	2.01	0.11	-0.81	**-3.36**	**.001**	**-0.28**

CPCI Resting [0-7]	3.92	1.95	-0.17	-0.70	4.13	1.95	-0.23	-0.59	3.73	1.94	-0.12	-0.79	**-2.41**	**.016**	**-0.20**
CPCI Asking for Assistance [0-7]	2.57	2.23	0.50	-0.94	2.39	2.23	0.63	-0.79	2.74	2.23	0.38	-1.03	1.86	.064	0.16
CPCI Relaxation [0-7]	3.80	2.16	-0.18	-1.01	3.60	2.27	-0.06	-1.17	3.98	2.04	-0.26	-0.80	**2.10***	**.036**	**0.18**
CPCI Task Persistence [0-7]	4.11	2.09	-0.36	-0.86	4.17	2.04	-0.42	-0.79	4.06	2.14	-0.31	-0.91	-0.641	.522	-0.05
CPCI Exercise/Stretch [0-7]	3.65	2.12	-0.05	-0.96	4.08	2.08	-0.28	-0.86	3.24	2.08	0.17	-0.85	**-4.77**	**<.001**	**-0.40**
CPCI Seeking [0-7]	2.13	2.14	0.79	-0.48	1.85	1.98	1.11	-0.37	2.39	2.25	0.54	-0.93	**3.04**	**.003**	**0.26**
CPCI Coping Self-Statements [0-7]	3.91	2.23	-0.31	-1.00	3.78	2.26	-0.20	-1.04	4.03	2.19	-0.41	-0.92	1.32	.188	0.11
Pain-related beliefs															
SOPA Harm [0-4]	1.74	0.84	0.26	-0.26	1.64	0.82	0.39	0.06	1.83	0.85	0.15	-0.45	**2.65**	**.008**	**0.22**
SOPA Medication [0-4]	2.76	0.89	-0.67	-0.14	2.54	0.93	-0.50	-0.34	2.97	0.79	-0.78	-0.06	**5.80***	**<.001**	**0.49**
SOPA Solicitude [0-4]	1.62	1.12	0.27	-0.93	1.26	0.95	0.58	-0.35	1.96	1.17	-0.13	-1.01	**7.74***	**<.001**	**0.65**
SOPA Disability [0-4]	1.67	0.97	0.41	-0.60	1.72	1.04	0.40	-0.78	1.62	0.91	0.38	-0.46	-1.14*	.255	-0.10
SOPA Pain Control [0-4]	2.02	0.81	-0.09	-0.58	1.99	0.83	0.02	-0.65	2.04	0.80	-0.20	-0.47	0.70	.483	0.06
SOPA Medical Cure [0-4]	1.58	0.84	0.14	-0.58	1.41	0.85	0.43	-0.120	1.75	0.80	-0.10	-0.65	**4.96**	**<.001**	**0.42**
SOPA Emotion [0-4]	1.86	1.10	0.10	-0.33	1.89	1.19	0.21	-0.09	1.82	1.02	-0.11	-0.94	-0.70*	.488	-0.06

Note: BPI – Brief Pain Inventory; SF-12 PCS - Medical Outcomes Study 12-Item Short Form Health Survey Physical Component Summary; SF-12 MCS - Medical Outcomes Study 12-Item Short Form Health Survey Mental Component Summary; CPCI – 2-item *per* scale Chronic Pain Coping Inventory; SOPA – 35-items Survey of Pain Attitudes; *Independent samples *t*-test with Welch correction; **bold text** indicates statistical significance.

Table 3.Partial correlation coefficients (controlling for sex and socioeconomic status).

	Overall sample				USA subsample				Portugal subsample			
	BPI - Pain Severity	BPI - Pain interference	SF-12 PCS	SF-12 MCS	BPI - Pain Severity	BPI - Pain interference	SF-12 PCS	SF-12 MCS	BPI - Pain Severity	BPI - Pain interference	SF-12 PCS	SF-12 MCS
Pain coping responses												
CPCI Guarding	**.30****	**.46*****	**-.55****	**-.24****	**.29****	**.44*****	**-.64****	**-.21****	**.30****	**.44*****	**-.45****	**-.29****
CPCI Resting	**.19****	**.33*****	**-.33****	**-.23****	**.22****	**.35*****	**-.38****	**-.26****	**.15***	**.27*****	**-.27****	**-.23****
CPCI Asking for Assistance	**.30****	**.42*****	**-.42****	**-.18****	**.27****	**.38*****	**-.45****	**-.21****	**.34****	**.46*****	**-.40****	**-.17****
CPCI Relaxation	**.18****	**.17*****	**-.11****	-.04	**.20****	**.19****	**-.12***	-.03	**.16****	**.18****	-.11	-.04
CPCI Task Persistence	**-.19****	**-.30*****	**.36****	**.24****	**-.22****	**-.39*****	**.41****	**.31****	**-.16****	**-.22*****	**.32****	**.20****
CPCI Exercise/Stretch	-.01	**-.09***	**.14****	**.09***	.003	-.11	**.16****	.10	-.04	**-.13***	**.16****	.08
CPCI Seeking	**.16****	**.16*****	**-.18****	**-.12****	**.18****	**.24*****	**-.24****	**-.16****	**.14***	**.13***	**-.15***	-.09
CPCI Coping Self-Statements	.07	.05	.03	.05	.10	**.12***	-.03	-.001	.04	-.01	.07	.09
Pain-related beliefs												
SOPA Harm	**.28****	**.28*****	**-.37****	**-.23****	**.31****	**.34*****	**-.40****	**-.25****	**.25****	**.25*****	**-.37****	**-.22****
SOPA Medication	**.15****	**.13****	**-.20****	**-.12****	**.15***	.12	**-.14***	-.03	**.15***	**.20****	**-.29****	**-.18****
SOPA Solicitude	**.11***	**.17*****	**-.18****	**-.28****	.05	**.21****	**-.14***	**-.24****	**.18****	**.23*****	**-.28****	**-.30****
SOPA Disability	**.43****	**.63*****	**-.73****	**-.34****	**.42****	**.60*****	**-.79****	**-.35****	**.43****	**.62*****	**-.65****	**-.35****
SOPA Pain Control	**-.29****	**-.42*****	**.41****	**.30****	**-.24****	**-.34*****	**.36****	**.30****	**-.34****	**-.48*****	**.44****	**.32****
SOPA Medical Cure	-.03	-.02	.03	**-.12****	-.01	.07	-.06	-.08	-.02	.004	.04	**-.15***

SOPA Emotion	.06	**.20*****	**-.15*****	**-.29*****	.02	**.17****	.01	**-.34*****	.09	**.22*****	**-.29*****	**-.27*****

Note: BPI – Brief Pain Inventory; SF-12 PCS - Medical Outcomes Study 12-Item Short Form Health Survey Physical Component Summary; SF-12 MCS - Medical Outcomes Study 12-Item Short Form Health Survey Mental Component Summary; CPCI – 2-item *per* scale Chronic Pain Coping Inventory; SOPA – 35-items Survey of Pain Attitudes; *p<.05; **p<.01; ***p<.001; **bold text** indicates statistical significance.

Table 4. OLS Multiple Linear Regression-based Trajectory Analyses Predicting Pain Intensity and Pain Interference.

	BPI Pain Severity				BPI Pain Interference			
	R^2 (p-value; f^2)	ΔR^2 (p-value; f^2)	β	p-value	R^2 (p-value; f^2)	ΔR^2 (p-value; f^2)	β	p-value
CPCI Guarding	.14 (<.001; 0.14)	<.001 (.944; <.001)			.25 (<.001; 0.33)	.001 (.539; 0.001)		
Guarding			.30	<.001			.41	<.001
Country			.01	.740			-.11	.009
Interaction			-.01	.944			.05	.539
CPCI Resting	.09 (<.001; 0.10)	.002 (.259; 0.002)			.16 (<.001; 0.19)	.001 (.492; 0.001)		
Resting			.23	<.001			.33	<.001
Country			-.02	.654			-.15	<.001
Interaction			-.11	.259			-.06	.492
CPCI Asking for Assistance	.15 (<.001; 0.18)	.001 (.524; 0.001)			.24 (<.001; 0.32)	.003 (.112; 0.003)		
Asking for Assistance			.27	<.001			.36	<.001
Country			-.05	.258			-.20	<.001
Interaction			.48	.524			.11	.112
CPCI Relaxation	.09 (<.001; 0.10)	<.001 (.802; <0.001)			.10 (<.001; 0.11)	<.001 (.694; <0.001)		
Relaxation			.19	.001			.17	.003
Country			-.07	.14			-.22	<.001
Interaction			-.02	.802			.04	.694
CPCI Task Persistence	.10 (<.001; 0.11)	.002 (.377; 0.002)			.16 (<.001; 0.19)	**.01 (.032; 0.01)**		

Task Persistence			-.24	<.001			-.38	<.001
Country			-.04	.377			-.19	<.001
Interaction			.12	.244			**.21**	**.032**
CPCI Exercise/Stretch	.06 (.001; 0.06)	<.001 (.746; <0.001)			.08 (<.001; 0.09)	<.001 (.742; 0.001)		
Exercise/Stretch			.01	.937			-.11	.076
Country			-.06	.236			-.23	<.001
Interaction			-.03	.746			-.03	.742
CPCI Seeking	.09 (<.001; 0.10)	.002 (.327; 0.002)			.06 (<.001; 0.06)	.004 (.119; 0.004)		
Seeking			.20	.001			.24	<.001
Country			-.06	.180			-.22	<.001
Interaction			-.08	.327			-.12	.119
CPCI Coping Self-statements	.04 (<.001; 0.04)	<.001 (.944; <0.001)			.07 (.090; 0.08)	.002 (.224; 0.002)		
Coping Self-statements			.09	.111			.10	.09
Country			-.05	.247			-.21	<.001
Interaction			-.06	.545			-.11	.224
SOPA Harm	.37 (<.001; 0.59)	.002 (.263; 0.002)			.15 (<.001; 0.18)	.002 (.265; 0.002)		
Harm			.32	<.001			.33	<.001
Country			-.07	.12			-.22	<.001
Interaction			-.12	.263			-.12	.265
SOPA Medication	.08 (<.001; 0.09)	<.001 (.980; 0.001)			.09 (<.001; 0.10)	.002 (.302; 0.002)		
Medication			.16	.005			.13	.018
Country			-.08	.099			-.23	<.001
Interaction			.00	.980			.16	.302
SOPA Solicitude	.08 (<.001; 0.09)	.002 (.271; 0.002)			.11 (<.001; 0.12)	<.001 (.842; <0.001)		
Solicitude			.06	.360			.22	.002
Country			-.07	.120			-.25	<.001
Interaction			.11	.271			.02	.842
SOPA Disability	.23 (<.001; 0.30)	.001 (.506; 0.001)			.43 (<.001; 0.75)	**.01 (.022; 0.01)**		
Disability			.41	<.001			.56	<.001
Country			.03	.455			-.09	.017
Interaction			.05	.506			**.16**	**.022**
SOPA Pain Control	.14 (<.001; 0.16)	.001 (.335; 0.001)			.23 (<.001; 0.30)	**.01 (.021; 0.01)**		
Pain Control			-.25	<.001			-.32	<.001
Country			-.01	.746			-.15	<.001

Interaction			-.11	.335			**-.25**	**.021**
SOPA Medical Cure	.25 (.001; 0.33)	<.001 (.885; 0.001)			.07 (<.001; 0.08)	.001 (.522; 0.001)		
Medical Cure			-.01	.849			.05	.389
Country			-.05	.315			-.21	<.001
Interaction			-.02	.885			-.07	.522
SOPA Emotion	.06 (<.001; 0.06)	.002 (.314; 0.002)			.11 (<.001; .12)	.003 (.174; 0.003)		
Emotion			.01	.810			.14	.011
Country			-.05	.287			-.19	<.001
Interaction			.09	.314			.12	.174

Note: BPI – Brief Pain Inventory; CPCI – 2-item *per* scale Chronic Pain Coping Inventory; SOPA – 35-items Survey of Pain Attitudes; *Independent samples *t*-test with Welch correction; **bold text** indicates statistical significance.

Table 5. OLS Multiple Linear Regression-based Trajectory Analyses Predicting Physical and Psychological Function.

	SF-12 PCS				SF-12 MCS			
	R^2 (*p-value*; f^2)	ΔR^2 (*p-value*; f^2)	β	*p-value*	R^2 (*p-value*; f^2)	ΔR^2 (*p-value*; f^2)	β	*p-value*
CPCI Guarding	.38 (<.001; 0.61)	**.01 (.019; 0.01)**			.12 (<.001; 0.15)	.01 (.072; 0.01)		
Guarding			-.60	<.001			-.18	.001
Country			.02	.542			-.09	.040
Interaction			**.17**	**.019**			-.15	.072
CPCI Resting	.46 (<.001; 0.85)	.003 (.151; 0.003)			.11 (<.001; 0.12)	<.001 (.593; 0.001)		
Resting			-.36	<.001			-.22	<.001
Country			.09	.042			-.08	.084
Interaction			.13	.151			-.05	.593
CPCI Asking for Assistance	.27 (<.001; 0.37)	<.001 (.583; <0.001)			.06 (<.001; 0.06)	<.001 (.910; <0.001)		
Asking for Assistance			-.42	<.001			-.18	.003
Country			.14	.001			-.04	.420
Interaction			.04	.583			-.01	.910
CPCI Relaxation	.13 (<.001; 0.15)	<.001 (.854; <0.001)			.05 (<.001; 0.05)	<.001 (.835; <0.001)		

Relaxation			.05	.047			-.03	.616
Country			.04	.001			-.03	.482
Interaction			.09	.854			-.02	.835
CPCI Task Persistence	.22 (<.001; 0.28)	.003 (.119; 0.003)			.11 (<.001; 0.12)	<.001 (.560; <0.001)		
Task Persistence			.40	<.001			.27	<.001
Country			.12	.005			-.05	.245
Interaction			-.14	.119			-.06	.560
CPCI Exercise/Stretch	.14 (<.001; 0.16)	<.001 (.838; <0.001)			.06 (<.001; 0.06)	<.001 (.954; <0.001)		
Exercise/Stretch			.17	.004			.09	.132
Country			.17	<.001			-.02	.665
Interaction			-.02	.838			-.01	.954
CPCI Seeking	.15 (<.001; 0.18)	.004 (.093; 0.004)			.07 (<.001; 0.09)	.001 (.500; 0.001)		
Seeking			-.26	<.001			-.15	.019
Country			.15	.001			-.03	.527
Interaction			.13	.093			.05	.500
CPCI Coping Self-statements	.12 (<.001; 0.14)	.002 (.303; 0.002)			.05 (<.001; 0.05)	.003 (.198; 0.003)		
Coping Self-statements			-.02	.733			<.001	.996
Country			.14	.002			-.04	.423
Interaction			.09	.303			.12	.198
SOPA Harm	.25 (<.001; 0.33)	.001 (.412; 0.001)			.10 (<.001; 0.11)	<.001 (.752; 0.001)		
Harm			-.40	<.001			-.21	<.001
Country			.16	<.001			-.02	.602
Interaction			.08	.412			-.03	.752
SOPA Medication	.16 (<.001; 0.19)	.004 (.085; 0.004)			.07 (<.001; 0.08)	**.007 (.04; 0.007)**		
Medication			-.16	.003			-.05	.422
Country			.17	<.001			-.02	.662
Interaction			-.25	.085			**-.32**	**.040**
SOPA Solicitude	.16 (<.001; 0.19)	.002 (.202; 0.002)			.13 (<.001; 0.15)	.002 (.278; 0.002)		
Solicitude			.07	.022			-.23	.001
Country			.04	<.001			.02	.643
Interaction			.10	.202			-.11	.278
SOPA Disability	.58 (<.001; 1.38)	<.001 (.631; <0.001)			.17 (<.001; .20)	.004 (.092; 0.004)		
Disability			-.73	<.001			-.30	<.001
Country			.01	.862			-.11	.017

Interaction			.03	.631			-.14	.092
SOPA Pain Control	.26 (<.001; 0.35)	.002 (.287; 0.002)			.15 (<.001; 0.18)	.004 (.120; 0.004)		
Pain Control			.35	<.001			.24	<.001
Country			.09	.30			-.08	.084
Interaction			.11	.287			.18	.120
SOPA Medical Cure	.12 (<.001; 0.14)	.002 (.277; 0.002)			.07 (<.001; 0.08)	.003 (.154; 0.003)		
Medical Cure			-.04	.435			-.06	.338
Country			.14	.002			-.01	.877
Interaction			.11	.277			-.15	.154
SOPA Emotion	.16 (<.001; 0.19)	**.02 (<.001; 0.02)**			.14 (<.001; 0.16)	.001 (.397; 0.001)		
Emotion			.01	.888			-.26	<.001
Country			.13	.002			-.06	.207
Interaction			**-.34**	**<.001**			-.07	.397

Note: SF-12 PCS - Medical Outcomes Study 12-Item Short Form Health Survey Physical Component Summary; SF-12 MCS - Medical Outcomes Study 12-Item Short Form Health Survey Mental Component Summary; CPCI – 2-item *per* scale Chronic Pain Coping Inventory; SOPA – 35-items Survey of Pain Attitudes; *Independent samples *t*-test with Welch correction; **bold text** indicates statistical significance.

Highlights

- Country moderates the link between only a few beliefs and coping responses and pain and function.
- Task persistence and guarding are stronger predictors of pain and function in adults from the USA.
- Pain control, disability, emotion, and medication beliefs are more important in Portuguese adults.
- Only few adjustments are needed for adapting psychosocial treatments from one country to another.
- Culturally customizing psychosocial pain treatments might contribute to improve their efficacy.