Adverse effects of the COVID-19 pandemic on fibromyalgia patients in Germany: a longitudinal investigation including pre-pandemic data of pain and health-related outcomes

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Abstract

Objective

The COVID-19 pandemic, along with the associated restrictions and changes, has had a far-reaching impact on the mental health and well-being of people around the world. The most serious impact can arguably be observed in vulnerable populations, such as chronic pain patients. Using a pre-test/post-test design with pre-pandemic comparative data, the present study sought to investigate how the pandemic impacted chronic pain and well-being in individuals with fibromyalgia (FM) (N = 109).

Methods

We assessed longitudinal changes of various clinical parameters, such as pain severity, disability, FM impact, depressive mood and several items assessing the individual experience of the pandemic as well as self-perceived changes of pain, anxiety, depression and physical activity levels.

Results

Results suggested a significant self-perceived worsening of pain, depressive mood, anxiety as well as reduced physical activity due to the pandemic. Interestingly, these self-perceived changes were not reflected in longitudinal increases of test values (T1-T2). Pain severity at T1 was the strongest predictor of pain severity at T2, while COVID-related outcomes showed no critical importance, with COVID-related fear being the only significant predictor of T2 pain. The general perceived negative impact of the pandemic was the only predictor of self-perceived worsening of pain. Finally, patients with less severe pre-pandemic pain symptoms displayed greater longitudinal worsening of pain.

Conclusion

These findings emphasise the importance of addressing the specific needs of chronic pain suffers during a pandemic.

Key words

COVID-19, pandemic, psychosocial factors, fibromyalgia, chronic pain

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Introduction

Since its onset in early spring 2020, the COVID-19 (SARS CoV-2) pandemic has had a far-reaching and fundamental impact on the lives of people around the world. Apart from the apparent health-related concerns and fears, current research progressively focusses on less obvious adverse consequences of the pandemic and the associated restrictions on public life. In that respect, recent studies have stressed the impact on mental health and well-being, particularly involving increased levels of depression, anxiety, and affective distress (1, 2). Although these and other adverse consequences can be observed in the general population, certain vulnerable groups as chronic pain patients have been shown to experience particularly severe adverse effects (3-8). It is also worth noting that chronic pain is most prevalent in older populations with comorbid illness (9), a group of people who is at the same time particularly at risk from a severe COVID infection. Correspondingly, Zanetti *et al*. (6) found an increased COVID-19 mortality in patients with rheumatic diseases. Apart from the universal pandemic-related impact on various facets of physical and psychological well-being, chronic pain patients seem to experience a considerable worsening of their pain symptoms. In that respect, recent studies have found significant self-reported increases of pain severity and pain-related suffering due to the pandemic (4, 5, 10-13).

In order to explore the precise way, in which chronic pain patients are impacted by the restrictions and psychosocial burdens associated to the COVID-19 pandemic, we conducted a postal questionnaire survey throughout the first half of 2022, assessing a wide variety of sociodemographic, clinical and psychometric variables. As stated above, the vast majority of previous studies have assessed perceived changes and did not provide conclusive comparisons of current ratings with pre-pandemic data. In contrast, we had the special opportunity to compare our data with an earlier examination of the same FM patients that was carried out by our research group towards the end of 2019. In this way, we were able to relate the self-perceived changes of pain, anxiety and well-being levels to longitudinal comparisons of pre-pandemic and current ratings.

We expected FM patients to report distinct self-perceived increases of pain severity, depressive symptoms and anxiety levels as well as decreased physical activity levels, compared to an average pre-pandemic week (5). Considering a partial result on a subsample of 85 chronic pain patients by Fallon *et al*. (5), we assumed that such self-perceived pain increases might not necessarily be reflected in a longitudinal pre-post increase of pain severity ratings. Such findings would point to a pronounced pain experience on a psychological level (presumably related to psychological distress), rather than an actual increase in physical pain.

Materials and methods

Participants and procedure

A total of 109 individuals with FM (aged 55.13±8.12 years, range 27 to 71 years), mainly recruited through social media support groups, completed a paper and pencil survey that was sent to them by post. Participation was voluntary and participants were not compensated for their participation. FM diagnoses were obtained by medical professionals and disorders fulfilled the criteria postulated by Wolfe *et al*. (14) (Table I).

Pre-pandemic data was obtained as part of an earlier study with FM patients conducted in our research department. This initial data collection at T1 took place between May 2019 and early 2020, immediately prior to the outbreak of the pandemic. Only subjects whose questionnaires had been completed by February 2020 at the latest were included to ensure that COVID had not yet had a decisive influence on our T1 data. The present investigation T2 was announced as a follow-up survey, incorporating a number of new questions related to the COVID-19 pandemic. As with the initial examination T1, participants received the test documents with a stamped return envelope by post. All questionnaires were completed between March 15, 2022 and July 15,

Table I. Longitudinal demographic, psychometric and clinical characteristics of FM patients (n=109).

	T1			T2			*t*-test	
	M	*SD*	Range	*M*	*SD*	Range	*t*-value (df)	*p*
Age (years)	51.94	8.54	24-68	55.13	8.12	27-71		
Pain duration in years	17.45	13.42	1-52	20.07	13.04	3-55		
CES-D	23.52	7.07	8-43	23.93	6.39	11-39	-0.71 (107)	.48
FIQ								
Physical functioning	1.5	0.48	0.1-2.6	1.44	0.54	0-2.7	1.47 (107)	.144
Total	60.47	15.49	16.55-88.76	58.38	13.67	10.3-82.51	1.31 (76)	.195
FSQ								
Symptom Severity Score	9.65	1.97	2-12	9.54	2.12	1-12	0.78 (106)	.439
Widespread Pain Index	11.81	4.45	3-19	10.83	4.71	0-19	2.43 (106)	**.017***
PRSS								
Catastrophising	2.42	1.08	0-4.44	2.28	1.17	0-4.56	1.65 (108)	.102
Coping	3.08	0.82	0.13-4.75	3.07	0.81	1-4.63	0.15 (108)	.883
CPG								
Pain intensity	71.96	11.74	40-100	71.94	13.88	26.67-100	0.02 (108)	.99
Disability score	65.93	18.52	0-96.67	65.03	18.58	6.67-100	0.63 (108)	.53
Chronic pain grade	3.31	0.79	1-4	3.26	0.91	0-4	0.79 (107)	.433
MPI								
Pain severity	4.04	0.99	1-5.67	4.09	1	0.67-6	-0.75 (108)	.455
Interference	4.26	1.12	0.5-6	4.14	1.11	0.7-6	1.83 (108)	.127
Life control	3.18	1.27	0-6	3.07	1.29	0-6	0.94 (108)	.351
Affective distress	3.62	1.32	0.33-6	3.47	1.3	0-6	1.11 (108)	.269
Social support	3.44	1.66	0-6	3.24	1.64	0-6	1.47 (105)	.145
Punishing responses	1.42	1.61	0-6	1.36	1.63	0-6	0.38 (102)	.707
Solicitous responses	3.21	1.59	0-6	3.25	1.62	0-6	-0.44 (102)	.66
Distracting responses	2.74	1.39	0-6	2.68	1.57	0-6	0.43 (102)	.667
Social activities	2.31	0.99	0.75-5.88	2.09	0.95	0.38-4.5	3.07 (107)	**.003***
General activity level	7.56	2.43	2.65-12.33	7.2	2.51	2.18-12.18	2.04 (107)	**.044***

T1: initial examination; T2: recent examination; *M*: mean; *SD*: standard deviation; df: degrees of freedom; CES-D: Centre for Epidemiologic Studies Depression Scale; FIQ: Fibromyalgia impact questionnaire; FSQ: Fibromyalgia Survey Questionnaire; PRSS: Pain-related Self Statements Scale; CPG: Chronic Pain Grade Scale; MPI: West Haven-Yale Multidimensional Pain Inventory.
*Significant change ($p<.05$).

2022. Out of the initial 208 FM patients that participated at T1, we were able to recruit 150 persons for our follow-up investigation, ultimately received 128 submissions of which 109 could be included since the first survey was fully completed by February 2020. On participant was excluded due to pronounced changes to her pain symptoms during her current pregnancy.

The study was approved by the ethics review board of the Medical Faculty, Ruhr University Bochum. All participants gave written informed consent to participate in the study.

Diagnostic and clinical assessment

At both measurement time points, participants completed two universal multidimensional tools for pain assessment: The West Haven-Yale Multidimensional Pain Inventory (MPI) (15) (German version: Flor *et al*.) (16) and the Chronic Pain Grade Scale (CPG) (17), as well as two FM-specific diagnostic tools: The Fibromyalgia Survey Questionnaire (FSQ) (18) and the Fibromyalgia Impact Questionnaire (FIQ-G) (German version: Offenbaecher *et al*.) (19). The Pain-related Self Statements Scale PRSS (German version: FSS, Flor *et al*.) (20) was used to measure situation-specific aspects of cognitive coping with pain. Depressive and associated symptoms were assessed using the Centre for Epidemiologic Studies Depression Scale (CES-D (21); German version: ADS) (Table I). At T2, we additionally assessed the pain-catastrophising scale (PCS) (22) as well as a number of COVID-related single items, and widely used tools including the Fear of COVID questionnaire (FCV) (23) and the COVID stress scales (CSS) (24) (Table II).

The COVID-related single items we introduced can be seen in Supplementary Table S1 and were partially adapted from Fallon *et al*. (5) Here we utilised a 10cm visual analogue scale (VAS) to capture individual experiences during the pandemic (*i.e*. perceived stress related to lockdown conditions) as well as self-perceived changes of pain, well-being, anxiety and physical activity levels relative to an average pre-pandemic week.

In principle, all employed tools can be subdivided into four categories: 1) sociodemographic information (*i.e*. age, education, employment status); 2) clinical variables (*i.e*. pain, anxiety and depression symptoms); 3) individual experience of the pandemic (*i.e*. lockdown conditions, home office, financial problems, COVID-related deaths of close persons); 4) self-perceived changes due to the pandemic (*i.e*. pain, anxiety, depression, physical activity). For a summary of the utilised diagnostic and clinical tools as well as the group values we obtained, see Tables I and II.

Table II. Demographic, psychometric and clinical characteristics of FM patients at T2 (n=109).

	M	*SD*	Range
PCS			
Helplessness	11.02	5.98	0-23
Magnification	4.41	2.8	0-12
Rumination	7.12	4.32	0-16
Total PCS	22.55	11.74	0-51
FCV	14.03	8.67	7-46
CSS			
Danger of Contamination	11.95	11.4	0-47
Trauma	2.43	4.11	0-18
Control	2.39	2.93	0-15
Total Score	16.77	16.27	0-72

M: mean; *SD*: standard deviation; PCS: Pain Catastrophising Scale; FCV: Fear of COVID questionnaire; CSS: COVID stress scales.

Data analysis

All data were analysed using the SPSS software package (v. 26.0 for Windows, SPSS Inc., Chicago, IL, USA). Test values (MPI, CPG, FSQ, FIQ, PRSS, CES) were compared between measurement points T1 and T2 using paired sample *t*-tests to record longitudinal changes in clinical parameters. As we noticed that participants differed considerably regarding these longitudinal changes, participants with longitudinal worsening of pain and those with no change or even improvement of pain were analysed separately and comparisons of the above-named T1 and T2 test values were recalculated to examine each subgroup in more detail.

Afterwards, in all participants two stepwise regression analyses with a forward selection approach and T2 pain severity ratings as the dependent variable were calculated, controlling for participant age and reports of other illness during the last two weeks. First, pre-pandemic (T1) test scores (MPI, CPG, PRSS, FSQ, FIQ, CES-D) were used as independent variables. The second analysis used COVID-related single items (Supplementary Table S1) as well as FCV and CSS subscales as independent variables.

In the next step, self-perceived changes of pain, well-being, anxiety and physical activity levels were tested for statistical significance using univariate *t*-tests. Furthermore, correlations of the above-mentioned self-perceived changes with pain catastrophising scores (PCS) were tested for significance ($p<.05$). In a further step, we used stepwise regression to investigate whether self-perceived changes in depression, anxiety and physical activity levels would predict self-perceived increases of pain severity, again controlling for participant age and reports of other illness during the last two weeks.

To test whether self-perceived pain worsening due to the pandemic aligned with real changes in pain severity ratings, we examined the relationship of the two parameters more closely and correlated self-perceived changes of pain intensity with the observed change of MPI pain severity ratings (T2-T1).

Results

Characteristic experiences of FM patients related to the COVID-19 pandemic

69% of patients stated they were part of a high-risk group (most commonly obesity, high blood pressure, asthma). In addition, 54% reported that close family members were part of a high-risk group. During the course of the pandemic, 52% of patients had experienced phases in which they had isolated themselves almost completely from the outside world. 15% reported someone in their close social circle had died from COVID-19. Overall, FM patients reported a strong negative self-perceived impact of the pandemic using a VAS (0–100) (M = 47.88±31.07; $t(107) = 16.01$, $p<0.001$). Current pain in FM patients was assessed in an additive item for the average pain intensity throughout the last week at T2. Here, participants reported a mean pain intensity of 70.42±16.65.

94.5% of patients had access to an outdoor area during the pandemic (garden: 70%, balcony: 33%, terrace: 15%), which was associated with a significant self-perceived positive impact on general well-being (M=68.8±41.77; $t(101) =16.63$, $p<.001$).

FM display no significant T1-T2 worsening of pain

In our initial examination at T1, FM patients reported longstanding disease with a mean pain duration of 17.45 years (SD = 13.42; range 1 to 52 years). In addition, we recorded high scores of pain severity (MPI: 4.04±0.99; CPG: 71.96±11.74), FM impact (FIQ: 60.47±15.49) and depressive symptoms (CES-D: 23.52±7.07) (Table I).

In relation to the pre-pandemic test values, our follow-up examination T2 revealed no significant longitudinal worsening of pain severity (MPI: $t(108)= -0.75$, $p=0.455$; CPG: $t(108) = 0.02$, $p=0.99$), FM impact ($t(76) = 1.31$, $p=0.195$) or depressive symptoms ($t(107) = -0.71$, $p=0.48$). However, we observed significant decreases regarding social activities (MPI; $t(107) = 3.07$, $p=0.003$) and the general activity level (MPI; $t(107) =2.04$, $p=0.044$) as well as decreases regarding FSQ widespread pain index ($t(106) =2.43$, $p=0.017$).

Interestingly, although no significant change in pain ratings could be detected, self-perceived change of pain intensity was significantly correlated with the observed change of MPI pain severity ratings (T2-T1) ($r=0.25$, $p=0.009$).

Differences between patients with longitudinal worsening of pain vs. no change or improvement of pain

As part of the descriptive evaluation of our sample, we observed that 57 participants displayed no longitudinal worsening of pain, while 52 participants did. For this reason, we divided our sample into two groups: Those who showed longitudinal worsening of pain severity (MPI) from T1 to T2 and those who showed improvement or no change of pain severity. FDR-corrected two-sample *t*-tests ($p<.05$) revealed a

variety of differences between our two subsamples. Unsurprisingly, patients showing a T1-T2 worsening of pain severity also demonstrated a significantly greater worsening of interference/disability (MPI: $p_{(FDR)}$ <.001; CPG: $p_{(FDR)}$ =0.005). Beyond that, we observed greater decreases of life control (MPI) ($p_{(FDR)}$ =0.02) as well as greater increases of FM impact (FIQ) ($p_{(FDR)}$ =0.022) and affective distress (MPI) ($p_{(FDR)}$ =0.032).

However, at T1 patients with T1-T2 pain worsening displayed lower pain severity (MPI) ($p_{(FDR)}$ =0.018), lower affective distress (MPI) ($p_{(FDR)}$ =0.022) and higher levels of life control (MPI) ($p_{(FDR)}$ =0.041), compared to the remaining participants with no longitudinal pain worsening.

Pain severity at T1 is the only test value collected at T1 that predicts T2 pain severity

We ran a stepwise regression analysis with T2 pain severity ratings as the dependent variable. Pre-pandemic (T1) test scores (MPI, CPG, PRSS, FSQ, FIQ, CES-D) were used as independent variables. Introducing age and reports of other illness during the past two weeks as confound variables in a first step, the model did not reach statistical significance (F (2, 102) =0.433; p=0.65), explaining only 0.8% of the variance. The second model included MPI pain severity at T1 as a predictor and explained 50% (corrected: 48%) of the variance (an additional 49%). The third and final model included CPG pain severity at T1 as an additional predictor, explaining 52% (corrected: 50%) of the variance. In this final model, pain severity at T1 was a highly significant predictor (MPI: β=0.545; p<0.001; CPG: β=0.224; p=0.022) of pain severity at T2 (Table III).

Individual experiences during the COVID-19 pandemic do not predict longitudinal pain severity at T2

In another stepwise regression analysis, COVID-related single items (Supplementary Table S1) as well as FCV and CSS subscales assessed at T2 were used as independent variables. Again, age and reports of comorbid illness were used as confound variables. In this case, the only significant predictor was the total FCV score (β=0.248; p=0.011). The total variance explained by this model was 7 % (corrected: 4%) (Table IV).

Table III. Multiple regression model 1 of pain severity at T2 with T1 test values.

	R	R^2	Adj. R^2	B	SE	β	t	p
Step 1	.092	.008	-.011					
Age				.011	.012	.09	.907	.366
Other illness				.047	.197	.024	.24	.811
Step 2	.705	.497	.482					
Age				.006	.009	.048	.683	.496
Other illness				.045	.141	.022	.317	.752
MPI pain severity				.708	.071	.7	9.9	**<.001***
Step 3	.723	.523	.504					
Age				.004	.009	.035	.502	.616
Other illness				.03	.138	.015	.218	.828
MPI pain severity				.551	.097	.545	5.68	**<.001***
CPG pain severity				.019	.008	.224	2.33	**.022***

Step 1 covers the inclusion of confound variables prior to the predictor analysis.
R^2: variance explained by the model; Adj. R^2: corrected variance estimate; B: unstandardised regression coefficient; SE: standard error; β: standardised regression coefficient; t: estimated coefficient; p: significance value.
*Significant change (p<0.05).

Table IV. Multiple regression model 2 of pain severity at T2 with COVID-related items.

	R	R^2	Adj. R^2	B	SE	β	t	p
Step 1	.092	.008	-.011					
Age				.011	.012	.09	.912	.364
Other illness				.047	.196	.024	.241	.81
Step 2	.263	.069	.042					
Age				.008	.012	.062	.646	.52
Other illness				.035	.191	.018	.185	.854
FCV Score				.029	.011	.248	2.58	**.011***

Step 1 covers the inclusion of confound variables prior to the predictor analysis.
R^2: variance explained by the model; Adj. R^2: corrected variance estimate; B: unstandardised regression coefficient; SE: standard error; β: standardised regression coefficient; t: estimated coefficient; p: significance value.
*Significant change (p<0.05).

Self-perceived effects of the COVID-19 pandemic on FM patients

Using univariate t-tests on the differential VAS ratings of the current status relative to an average pre-pandemic week, FM patients reported statistically significant self-perceived increases in pain (mean change: 25.07±34.12; t(107)=7.64, p<0.001), depressive symptoms (mean change: 16.52±30.71; t(106)=5.57, p<0.001) and anxiety (mean change: 12.69±28.35; t(107) = 4.65, p<0.001) as well as decreased levels of physical activity (mean change: -8.93±43.26; t(106) = -2.13, p=0.035) (Fig. 1). 53% of patients reported self-perceived worsening of pain, while 46% reported no symptom change due to the pandemic. Interestingly, we found self-perceived increases of pain intensity to be positively correlated with pain catastrophising scores (PCS) (r =0.208, p=0.032). Beyond that, PCS scores were also positively related to perceived increases in depressed mood (r=0.317, p=0.001).

Self-perceived changes in depressive mood and physical activity predict a self-perceived worsening of pain

As a first step of our subsequent regression analysis, age and comorbid illness were entered into the model. This model did not reach statistical significance (F (2, 103) = 2.34; p=0.101). In Step 2 of the analysis, perceived changes of depressed mood were entered. The total variance explained by the model was 24% (corrected: 21%) (F (3, 102)

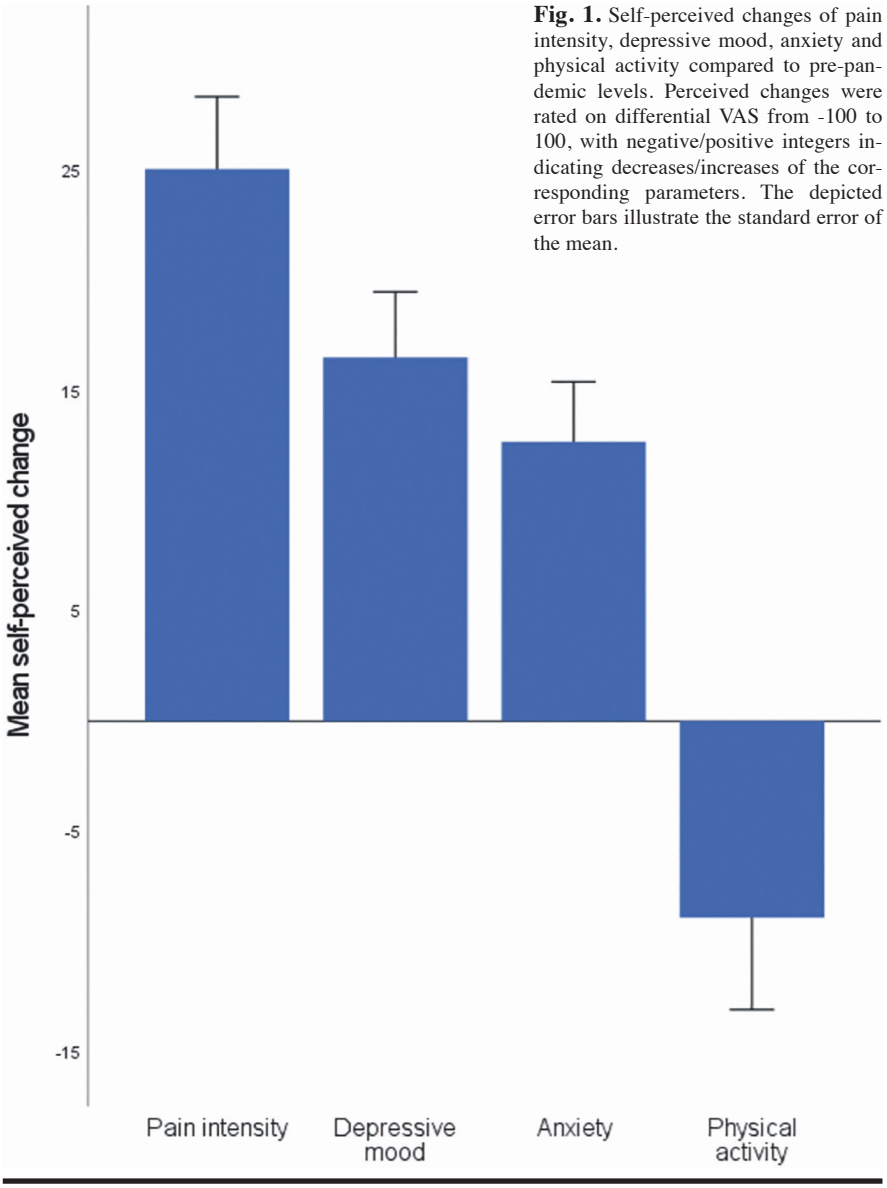

Fig. 1. Self-perceived changes of pain intensity, depressive mood, anxiety and physical activity compared to pre-pandemic levels. Perceived changes were rated on differential VAS from -100 to 100, with negative/positive integers indicating decreases/increases of the corresponding parameters. The depicted error bars illustrate the standard error of the mean.

=10.51; $p<0.001$). For the final model, self-perceived changes of the physical activity level were introduced, explaining an additional 5% of variance (29%: corrected: 26%) (F (4, 101)= 10.1; $p<0.001$). Self-perceived changes of anxiety levels did not qualify as a significant predictor. The sequence of analysis steps is illustrated in Table V.

The perceived overall negative impact of the COVID-19 pandemic predicts self-perceived worsening of pain

Using self-perceived changes of pain severity as the dependent variable in another stepwise regression model, we examined the influence of COVID-related outcomes (single items and questionnaires). After entering age and comorbid illness as covariates, the only significant predictor of the final model was the general perceived negative impact of the pandemic (β=0.325; p=0.001). This model provided a total of 15% (corrected: 12%) variance explained (Table VI).

Discussion

It is well known that catastrophes and crises, such as the COVID-19 pandemic, have extensive negative consequences on people's physical and psychological well-being. Only recently it has been argued that the COVID-19 crisis should be understood as a new type of global mass trauma (25). This might particularly apply to vulnerable populations like chronic pain patients. The primary aim of our investigation was to explore how the pandemic impacted FM patients, primarily in terms of pain severity, psychological well-being and physical activity levels. To this end, self-perceived changes were compared to actual measured longitudinal changes of the corresponding test parameters. In general, a large portion of patients reported vast adverse consequences related to the pandemic and the associated lockdown periods. These self-perceived effects were not reflected in our longitudinal T1-T2 test comparisons. However, after subdividing our sample, patients with a T1-T2 worsening of pain displayed significantly greater worsening of pain interference/disability, FM impact, affective distress and life control. Intriguingly, this particularly applied to patients who had less severe symptoms at T1.

Overall impact of the pandemic on FM patients

A majority of FM patients reported comorbid illness (obesity, high blood pressure, asthma) relevant for the risk assessment of a COVID-19 infection. The high proportion of particularly vulnerable high-risk patients within our sample (69%) emphasises the special relevance of our research questions for chronic pain populations. On average, FM patients displayed moderate levels of COVID-related fear and distress (FCV, CSS). Unsurprisingly, participants however perceived a considerable negative overall impact of the pandemic. This is accompanied by the finding that a majority of patients reported phases of complete isolation throughout the course of the pandemic. Interestingly, one of the only parameters showing significant longitudinal worsening in our sample was the social activity level (MPI). This seems entirely plausible considering the widespread restrictions on social life associated with the pandemic. More generally speaking, the COVID-19 pandemic along with its associated restrictions and lockdowns have had a substantial negative impact on the social lives of people around the world. In this context, it is important to note that previ-

Table V. Stepwise multiple regression model 3 of self-reported increases in pain severity with self-perceived changes.

	R	R^2	Adj. R^2	B	SE	β	*t*	*p*
Step 1	.209	.044	.025					
Age				.138	.405	.033	.341	.734
Other illness				14.09	6.55	.207	2.15	**.034***
Step 2	.486	.236	.214					
Age				-.346	.376	-.082	-.918	.361
Other illness				5.11	6.15	.075	.831	.408
Depression (SPC)				.523	.103	.471	5.07	**<.001***
Step 3	.535	.286	.258					
Age				-.234	.368	-.056	-.636	.526
Other illness				4.91	5.97	.072	.822	.413
Depression (SPC)				.473	.102	.426	4.63	**<.001***
Physical activity (SPC)				-.18	.068	-.228	-2.65	**.009***

Step 1 covers the inclusion of confound variables prior to the predictor analysis.
R^2: variance explained by the model; Adj. R^2: corrected variance estimate; B: unstandardised regression coefficient; SE: standard error; β: standardised regression coefficient; *t*: estimated coefficient; *p*: significance value.
*Significant change ($p<0.05$).

Table VI. Stepwise multiple regression model of 4 self-reported increases in pain severity with COVID-related items.

	R	R^2	Adj. R^2	B	SE	β	*t*	*p*
Step 1	.209	.044	.025					
Age				.138	.405	.033	.341	.734
Other illness				14.09	6.55	.207	2.15	**.034***
Step 2	.381	.145	.12					
Age				.05	.386	.012	.129	.897
Other illness				10.01	6.33	.147	1.58	.117
FCV Score				.357	.102	.325	3.49	**.001***

Step 1 covers the inclusion of confound variables prior to the predictor analysis.
R^2: variance explained by the model; Adj. R^2: corrected variance estimate; B: unstandardised regression coefficient; SE: standard error; β: standardised regression coefficient; *t*: estimated coefficient; *p*: significance value.
*Significant change ($p<0.05$).

ous investigations have underlined the vital importance of social conditions including social connection in shaping the painful experience (10, 26).

Longitudinal effects of the pandemic on pain and other clinical measures in FM patients

The results described above suggest that patients with FM experienced no measurable longitudinal worsening of pain severity due to the pandemic, confirming the indications found in a subgroup analysis by Fallon *et al*. (5). Beyond that, we also found no significant longitudinal changes in parameters like depressive mood, FM impact, life control or interference/disability scores.

After subdividing the sample for our subsequent analyses based on the presence of longitudinal worsening of pain, we found a number of striking group differences. Patients with a T1-T2 worsening of pain demonstrated significantly greater worsening of pain interference/disability, FM impact and affective distress. In addition, this subgroup of patients also showed greater decreases of life control from T1 to T2. This illustrates the far-reaching adverse effects associated to an increase of pain severity.

Intriguingly, patients who displayed a T1-T2 worsening of pain were less severely affected at T1, showing lower pain severity, lower affective distress as well as higher levels of life control. This finding can most likely not be attributed to a roof effect, since the mean and the individual maximum pain intensity at T1 are far from the upper end of the MPI scale. It therefor appears that patients who had severe symptoms before the pandemic remained largely unaffected, while it was mainly patients with less severe pre-pandemic illness who experienced a significant worsening. This finding could be of particular importance for the planning and development of preventive measures.

Multiple regression analyses revealed that the strongest predictors of pain severity at T2 were pre-pandemic pain severity scores assessed at T1 (50% of variance explained). Testing only for COVID-related single items and tools, the only significant predictor was the FCV score, leading to a total 7% of variance explained. None of the other COVID-related variables showed a relevant impact on the longitudinal changes in pain severity. In view of this, the impression arises that pandemic-related factors had no considerable influence on the longitudinal change in pain levels.

Self-perceived vs longitudinal T1-T2 changes of pain severity

In contrast to the longitudinal data reported above, participants did report significant self-perceived increases of pain due to the pandemic, confirming previous findings by Fallon *et al*. (5) and other investigations (4, 10-13). In our study, more than half of the sample reported a worsening of their pain symptoms. Comparable investigations with chronic pain patients reported similar proportions (*e.g*. 39% (11), 65% (10)).

Although FM patients perceived a pandemic-related worsening of pain, MPI pain severity scores did not change from T1 to T2. This might indicate that self-perceived increases of pain reflect a behavioural correlate of psychological distress rather than a measurable longitudinal change of physical pain intensity. Since patients displayed no measurable T1-T2 increase of pain severity, while reporting a self-perceived worsening of pain, it seems most useful to target psychological factors that might modulate the painful experience. Our findings emphasise the importance of addressing the specific needs and issues of chronic pain sufferers during a pandemic. For a significant proportion of those affected, pain symptoms as well as general physical and mental

health can worsen substantially. Self-perceived worsening of symptoms and well-being affect an even larger proportion of patients (5, 12, 27). Thus, it seems inevitable to create specific treatment offers or to adapt current concepts adequately to the adversely changed circumstances. Cognitive behavioural therapy has been shown to provide good results in highly catastrophising chronic pain patients (28). In this realm, the reachability of patients poses a special challenge, since chronic pain sufferers have been shown to be particularly withdrawn and socially isolated. However, recent progress regarding remote technological approaches could be an adequate solution to this issue (29-31).

Conclusion

The present study investigated the impact of the COVID-19 pandemic on FM patients in terms of pain severity, psychological well-being and physical activity. A large portion of patients reported vast adverse consequences related to the pandemic and the associated lock-down periods. These self-perceived effects were not reflected in longitudinal test parameters. This might indicate that a self-perceived increase in pain may reflect a consequence of psychological distress rather than a measurable longitudinal change of physical pain intensity. For this reason, future treatment offers should focus on psychological determinants like pain catastrophising, which is known to play an important role in pain perception. Moreover, we were able to gain insights into the most important target group of such interventions, as the present results indicate that patients with less severe pre-pandemic pain symptoms at T1 appeared to be more affected by the effects of the pandemic.

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