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Psychological Well-Being, Body Image, and Interoception – Differences Between Women With Rheumatologic Diseases and Healthy Women[1]

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Abstract

Objective: The aim of the study was to explore differences between women with rheumatologic diseases (RD) and healthy women (HC) in terms of psychological functioning, body image, and interoception.

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Method: The study included 86 women (43 RD, 43 HC). Psychological health was assessed using the *Four-Dimensional Symptom Questionnaire* (4DSQ) (Czachowski et al., 2012). Body image satisfaction was measured with the *Body Esteem Scale for Adolescents and Adults* (BESAA) (Słowińska, 2019). Subjective aspects of interoceptive awareness were evaluated using the *Multidimensional Assessment of Interoceptive Awareness* (MAIA) (Brytek-Matera & Kozieł, 2015).

Results: Compared to the HC, women with RD showed higher levels of depression, distress, anxiety, and somatization as measured by the 4DSQ. Moreover, in the BESAA, the RD group reported greater dissatisfaction with their body appearance and body weight than the HC group. Regarding subjective interoception, women with RD scored higher on the MAIA subscales *Noticing* and *Not-Worrying* but lower on the *Trusting* subscale compared to healthy participants.

Conclusions: The findings provide significant evidence of reduced psychological well-being among women with rheumatologic diseases. The results highlight the need for interventions aimed at improving psychological well-being and supporting the integration of bodily experiences and interoceptive processes in this population.

Keywords: rheumatologic diseases, psychological well-being, body image, interoception

Rheumatologic diseases (RD) are a group of conditions involving inflammatory or degenerative processes within the musculoskeletal system and connective tissue, which may sometimes manifest in internal organs (Clunie et al., 2018). In terms of etiology, RD can be divided into inflammatory autoimmune diseases, degenerative diseases, joint diseases associated with metabolic disorders (e.g., gout, osteoporosis), and autoinflammatory diseases (e.g., Still's disease) (Calle & Gómez-Puerta, 2018; Decker et al., 1983). The subgroup of inflammatory autoimmune diseases includes, among others, connective tissue diseases such as systemic lupus erythematosus (SLE), rheumatoid arthritis (RA), and spondyloarthropathies, including for example psoriatic arthritis (PsA) (Brand et al., 2012).

Clinical observations indicate that various types of pain are a constant symptom in individuals with RD. It is estimated that up to 70% of patients with RA report pain of moderate or severe intensity (Grygus & Nogas, 2023). From a physiological perspective, chronic pain leads to various types of changes – first functional, then structural (neuroplastic) – in the central nervous system. In individuals with chronic pain, the so-called mechanism of central sensitization is well known; as a consequence, there is a persistent lowering of the pain threshold (hyperalgesia), and patients may perceive stimuli that healthy individuals experience as neutral as painful (Mezhov et al., 2021).

The consequences of experiencing chronic pain include changes in the cognitive, emotional and social domains. Empirical data show that chronic pain significantly affects memory and concentration, which considerably hinders occupational and social functioning in individuals with RD (Berryman et al., 2013). In psychology, the concept of total pain, introduced by Cicely Saunders (1964), has long been known. It primarily refers to patients receiving palliative care, yet it appears applicable to individuals suffering from chronic diseases, including

RD. This concept treats pain as a multidimensional experience – physical, psychological, social, and even philosophical (existential) (Saunders, 1964, 2001). In chronic diseases, this is reflected in the way that somatic pain is intertwined with psychological suffering (anxiety, depression), social problems (job loss, social isolation), and prompts patients to ask existential questions (Why me? How am I supposed to live with this disease from now on?).

This description is also confirmed in relation to individuals with RD. Statistics indicate that, compared to healthy individuals, this group of patients is much more likely to experience significantly elevated distress, depression, and anxiety disorders (Dehghan et al., 2023; González-Parra & Daudén, 2019; Matcham et al., 2013). Studies have shown that chronic stress in patients with RD leads to depletion of psychological resources, chronic fatigue (up to 80% of patients with RA and 67–90% of patients with SLE report such symptoms), reduced motivation, greater helplessness, and a sense of loss of meaning in life, that is, to so-called psychological burnout (Dey et al., 2021; Hsiao et al., 2024; Sharpe et al., 2023). Patients with RD more frequently use various avoidance and over-control strategies, which may indicate poor stress-coping abilities (Sturgeon et al., 2016). Empirical evidence shows that individuals with RA or SLE are much more likely to experience loss of social roles, withdrawal from professional life, and reduced satisfaction with social and interpersonal relationships (Evers et al., 2003). Loss of, or limitations in, occupational and social functioning often become factors that secondarily exacerbate depression and reduce the sense of meaning in life (Katz & Yelin, 2001; Żołnierczyk-Zreda et al., 2020).

Clinical practice also clearly shows that RD are frequently accompanied by various deformities and uncontrolled weight gain (Lee & Werth, 2017). These may result from the disease process itself or from side effects of its treatment (Lutf & Hammoudeh, 2012). Such factors often lead individuals with RD to perceive their own bodies differently (Geller et al., 2024; Rodrigues et al., 2021). Body image encompasses not only the perception of outward appearance but also the emotional and cognitive attitude toward it (Cash & Pruzinsky, 2004). In chronic conditions such as RD, one's own body may be experienced as "disabled" and, moreover, as a source of suffering and threat, which in turn can affect the patient's identity and self-esteem (Jorge et al., 2010). It is also known that in chronically ill individuals a distorted body image frequently gives rise to a sense of stigmatization, which may lead to withdrawal from social life, avoidance of physical activity and interpersonal contact, and thus to additional social consequences of the disease (Cano-García et al., 2021). The literature describes the phenomenon of "body-image discrepancy", that is, a mismatch between the image of an ideal body and reality (Hernández-López et al., 2021). In individuals who experience such a discrepancy, it can lead to chronic psychological tension, reduced quality of life, and difficulties in emotion regulation (Momeñe et al., 2023; Rivière et al., 2018).

The phenomena and processes described above also appear to occur in individuals with RD and are reflected in statistics and research findings in this population. It has been shown that as many as 84.6% of individuals with SLE report higher levels of body dissatisfaction due to skin changes, hair loss, and treatment side effects (e.g., weight gain) (Chen et al., 2022; Mostafa et al., 2023). Furthermore, up to 53%

of individuals with PsA perceive themselves as unattractive, withdraw from social life, and reduce their physical activity (Rosińska et al., 2017). In individuals with SLE and PsA, the severity of disease symptoms is also associated with a deterioration in body image, increased depression, and heightened anxiety related to these issues (Chen et al., 2022; Mostafa et al., 2023; Nazik et al., 2017; Rosińska et al., 2017).

Pain perception, a disturbed body image, and subjectively experienced emotional state (mood) are inseparably linked to interoception, that is, the process of receiving, interpreting, and responding to information from within the body (internal organs) (Henningsen et al., 2018; Horsburgh et al., 2024). Interoception encompasses not only the accuracy of reading visceral signals (e.g., the correctness of detecting one's own heartbeats), but also subjective sensitivity (the tendency to notice and evaluate bodily sensations) and metacognitive awareness (confidence in one's evaluations of interoceptive sensations) (Garfinkel et al., 2015). The key brain regions responsible for interoception include structures such as the insular cortex and the anterior cingulate cortex (ACC). The function of these structures is to integrate visceral signals with emotional evaluation and subsequently to control the organism's homeostasis (Critchley & Garfinkel, 2017).

The latest hypotheses on interoceptive processing, such as predictive coding theory, assume that the brain continuously predicts the state of the organism and compares these predictions with actual signals from the viscera. Chronic pain is thought to result from erroneous predictions and a mismatch between the "expected" afferent signals and those actually received through the senses (Barrett & Simmons, 2015; Henningsen et al., 2018). High sensitivity to bodily sensations, combined with low trust in the body and a negative body image, fosters misinterpretation of interoceptive signals and exacerbation of somatic symptoms (Jia & Jackson, 2016; McAndrew et al., 2019). Lowered mood (depression) and anxiety further disrupt interoceptive accuracy, sensitivity, and metacognitive awareness (Clemente et al., 2024; Critchley et al., 2023; Eggart et al., 2019). Research suggests that the influence of affective factors on interoceptive processes is most likely related to dysfunction within the insula–ACC circuit, that is, the system responsible for "predicting" bodily states and weighting prediction error (Barrett & Simmons, 2015; Critchley & Harrison, 2013). In practice, dysfunction within this circuit translates into a specific symptom profile: heightened subjective sensitivity to interoceptive bodily signals in the absence of objective accuracy in reading them, reduced trust in these signals, and increased worry about bodily sensations. This pattern is consistent with meta-analyses of studies in patients with chronic pain (Horsburgh et al., 2024; Oliveira et al., 2024) and has also been reported in research on individuals with RD (Duschek et al., 2017; Jia & Jackson, 2016; Valenzuela-Moguillansky et al., 2017). Such a mechanism also appears to explain why interventions targeting the regulation of attention to the body and modification of beliefs about symptoms (e.g., mindfulness-based or interoceptive regulation trainings) may reduce suffering despite incomplete remission of somatic complaints (Khalsa et al., 2018).

To the best of our knowledge, the current body of literature contains relatively few studies on psychological functioning, and in particular interoceptive

processing, in individuals with RD. Moreover, some interoception studies in patients with RD have produced inconsistent results. For example, research on patients with fibromyalgia has shown that they report higher levels of subjectively assessed awareness of bodily sensations, while at the same time exhibiting reduced interoceptive accuracy measured with objective methods (Das & Choy, 2023; Duschek et al., 2017; Staud, 2011). Other studies have demonstrated that individuals with fibromyalgia also show increased vigilance toward bodily experiences and are more prone to avoid unpleasant sensations than healthy individuals (Schmitz et al., 2021). As mentioned above, the topic of interoception in people with RD calls for more in-depth exploration.

In light of the foregoing, the aim of this study was to assess psychological state, perception, and sensations arising from within the body in individuals with rheumatologic diseases. We included only women in the study. The exclusive focus on a female population was motivated by the markedly higher prevalence of RD, particularly those of autoimmune origin, in women (Desai & Brinton, 2019). There is evidence that this gender disparity in incidence is partly due to increased immune system reactivity in women (Hewagama et al., 2009). This may have a genetic basis related to mutations located on sex chromosomes (X), which would determine the higher susceptibility to rheumatologic diseases among women (Kanaan et al., 2016; Wang et al., 2022). It is also possible that, in addition to biological factors, psychological factors play an important role in the overrepresentation of women with RD. Women tend to report higher levels of dissatisfaction with their appearance and to attribute greater importance to it compared to men (Quittkat et al., 2019). This may also affect their relationship with their own bodies and their psychological functioning, though, like the other factors mentioned above, this association clearly requires further investigation.

In this study we adopted several assumptions. First, we expected that women with RD would exhibit substantially higher levels of depressive and anxiety symptoms (worry and/or somatization) than healthy women. Second, we anticipated that women with RD would have a less positive perception of their own bodies and altered interoception. More specifically, in comparison with the control group, they were expected to show lower trust in their bodies while simultaneously paying more attention to bodily sensations, experiencing heightened body-related worry, and having greater difficulty disengaging from unpleasant bodily sensations.

Method

Participants

A total of 86 women took part in the study (M = 33.94 years, SD = 9.39). Rheumatologic diseases had been diagnosed in 43 women [M = 32.47, SD = 7.27 (RD group)]. An equal number of women (N = 43, M = 35.51, SD = 11) formed the control group (CG). These were women in good health, without any chronic complaints. Age ($\chi 2 = 743.5$, $p = .118$), level of education ($\chi 2 = 2.64$, $p = .45$), place of

residence ($\chi 2 = 5.31$, $p = .257$), and employment status ($\chi 2 = 8.327$, $p = .08$) did not significantly differ between the groups.

In the clinical group, the mean duration of disease was approximately 6 years ($M = 6.84$ years, $SD = 6.57$; range: 1–27 years). The mean symptom severity in the sample of women with RD was $M = 5.37$, $SD = 2.69$ (range: 0–10). Nine women reported a comorbid condition. Thirty-seven women reported regular medication use. Detailed information on the clinical group is presented in appendix 1.

Before participating in the study, all participants provided written informed consent that was conscious and voluntary. The study was conducted as part of a project approved by the Bioethics Committee of the Nicolaus Copernicus University – Ludwik Rydygier Collegium Medicum in Bydgoszcz (approval no. KB475/2021 dated 14.09.2021).

Measures

To assess mental health, we used the *Four-Dimensional Symptom Questionnaire* (4DSQ; Terluin et al., 2004) in the Polish adaptation by Czachowski et al. (2012). The 4DSQ measures the intensity of four factors: distress, depression, anxiety, and somatization. The instrument consists of 50 items, which are rated on a 5-point scale from 1 (*symptom not present at all*) to 5 (*very frequent/constant presence of the symptom*). In the present study, Cronbach's alpha coefficients were as follows: *Somatization* $\alpha = .91$, *Distress* $\alpha = .94$, *Anxiety* $\alpha = .91$, *Depression* $\alpha = .94$.

Body image was assessed using the *Body Esteem Scale for Adolescents and Adults* (BESAA; Mendelson et al., 2001) in the Polish adaptation by Słowińska (2019). This tool comprises three scales: *Appearance*, *Weight*, and *Attribution* (evaluation of appearance attributed to others). It contains 23 items rated on a 5-point scale (1 = *never*, 5 = *always*). In the present study, Cronbach's alpha was $\alpha = .95$ for *Appearance*, $\alpha = .94$ for *Weight*, and $\alpha = .61$ for *Attribution*.

Interoception was measured with the *Multidimensional Assessment of Interoceptive Awareness* (MAIA; Mehling et al., 2012) in the Polish adaptation by Brytek-Matera and Koziel (2015). The questionnaire consists of 32 items forming 8 subscales: *Noticing*, *Not Distracting*, *Not Worrying*, *Attention Regulation*, *Emotional Awareness*, *Self-Regulation*, *Body Listening*, and *Trusting*. Responses are given on a 6-point scale (0 = *does not apply to me at all*, 5 = *applies to me very much*). Scores on the *Not Worrying* scale should be interpreted in reverse. Cronbach's alpha coefficients in the present study were: *Noticing* $\alpha = .79$, *Attention Regulation* $\alpha = .87$, *Emotional Awareness* $\alpha = .81$, *Self-Regulation* $\alpha = .89$, *Body Listening* $\alpha = .87$, *Trusting* $\alpha = .90$, *Not Distracting* $\alpha = .64$, *Not Worrying* $\alpha = .23$.

Procedure

The study had a questionnaire-based design and was conducted online using the *Qualtrics* platform. Prior to the main study, all participants completed

a screening questionnaire. Its purpose was to assign women to the appropriate group (clinical vs control), and to collect sociodemographic data and information on symptoms in the clinical group. After completing the screening, participants filled in all the questionnaires described in the Measures section in random order. The entire procedure took approximately 30 minutes.

Statistical Analysis

The study was conducted using an ex post facto design. Data analyses were performed with IBM SPSS Statistics, version 27.0. For variables with normal distributions, we used Student's t-test for independent samples. For between-group comparisons (RD vs CG) of variables that deviated from normality, we applied the Mann–Whitney U test.

Results

The statistical analysis revealed significant differences on all 4DSQ subscales: *Distress* ($U = 414$, $p < .001$), *Depression* ($U = 404.5$, $p < .001$), *Anxiety* ($U = 294$, $p < .001$), and *Somatization* ($U = 124$, $p < .001$). On all subscales, the RD group obtained higher scores than the control group. Descriptive statistics and mean scores for each 4DSQ subscale in both groups, as well as the significant between-group differences, are presented in Tables 1 (p. 123–124) and 2 (p. 124) and Figure 1 (p. 125).

Table 1

Descriptive Statistics for the Scores of Individual Subscales of the Questionnaires Used in the Study Obtained in the Group of Women With Rheumatologic Disease (RD)

Variable	*M*	*SD*	*ME*	*Skew*	*Kurt*	*Min.*	*Max.*	*SW*
4DSQ Distress	15.77	9.21	16	0.28	–0.99	2	32	.95*
4DSQ Depression	4.37	4.40	3	0.65	–1.11	0	12	.84***
4DSQ Anxiety	8	6.09	7	0.8	0.3	0	24	.93*
4DSQ Somatization	15.51	7.08	16	0.09	–0.74	2	31	.98
MAIA Not Distracting	1.07	1.09	1.33	–0.48	–0.49	–1	3.33	.98
MAIA Not Worrying	1.54	1.33	1.33	0.55	–0.50	–0.33	4.67	.95
MAIA Noticing	4.58	0.95	4.5	–0.55	0.21	2	6	.95
MAIA Attention Regulation	3.5	1.10	3.43	–0.03	–0.25	1.29	5.71	.98
MAIA Emotional Awareness	4.62	0.97	4.8	–0.98	1.43	1.40	6	.93*
MAIA Self Regulation	3.10	1.28	3	0.43	–0.43	1	6	.97

Continuation of Table 1

Variable	*M*	*SD*	*ME*	*Skew*	*Kurt*	*Min.*	*Max.*	*SW*
MAIA Body Listening	3.10	1.27	3	0.15	–1.04	1	5.33	.95*
MAIA Trusting	3.38	1.47	3.33	0.01	–0.84	1	6	.95
BESAA Appearance	27.84	9.89	27	0.12	–0.73	10	49	.97
BESAA Attribution	14.72	3.49	15	0.07	0.14	6	23	.98
BESAA Weight	22.12	9.01	20	0.2	–1.32	8	37	.93*

Note. M – mean; *ME* – median; *SD* – standard deviation; *Skew* – skewness; *Kurt.* – kurtosis; *Min. and Max.* – minimum and maximum values of the distribution; *SW* – Shapiro–Wilk test statistic; *BESAA Appearance* – Self-evaluation of appearance; *BESAA Attribution* – Perceived evaluation of appearance; *BESAA Weight* – Self-evaluation of weight.
* $p < .05$; ** $p < .01$; *** $p < .001$

Table 2

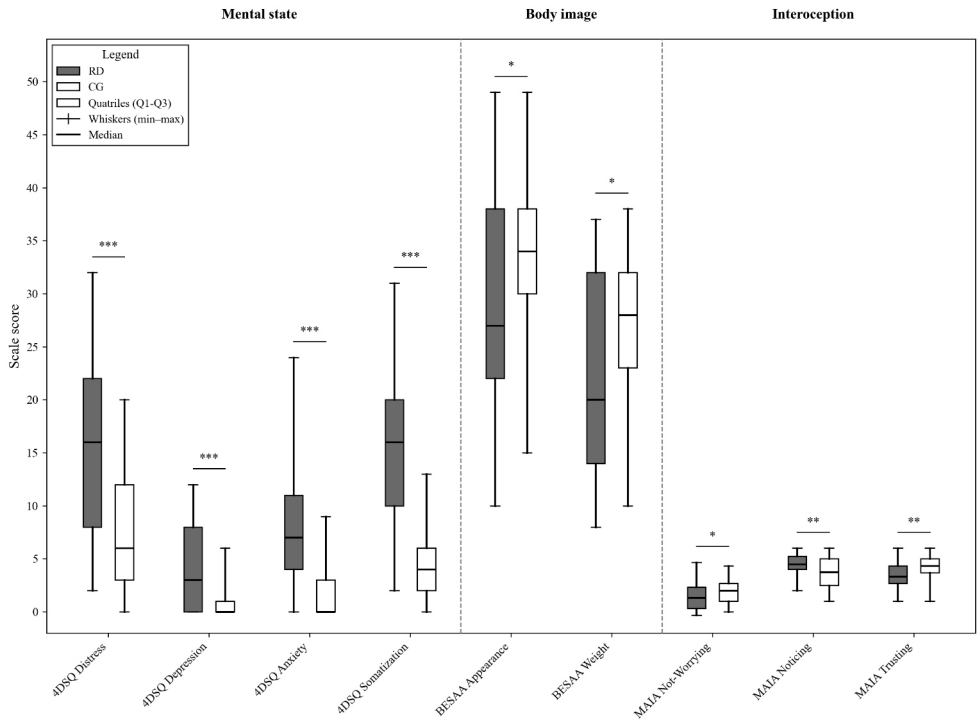
Descriptive Statistics for the Scores of Individual Subscales of the Questionnaires Used in the Study Obtained in the Control Group (CG)

Variable	*M*	*SD*	*ME*	*Skew*	*Kurt*	*Min.*	*Max.*	*SW*
4DSQ Distress	7.19	5.1	6	0.48	–0.61	0	20	.94*
4DSQ Depression	0.7	1.42	0	2.44	5.6	0	6	.57***
4DSQ Anxiety	1.63	2.28	0	1.5	1.76	0	9	.75***
4DSQ Somatization	4.21	3.2	4	0.80	0.51	0	13	.93**
MAIA Not Distracting	1.45	1.14	1.33	0.09	–0.19	1	4	.97
MAIA Not Worrying	1.99	1.05	2	0.24	–0.32	0	4.33	.98
MAIA Noticing	3.69	1.4	3.75	–0.25	–0.99	1	6	.96
MAIA Attention Regulation	3.8	1.08	3.86	–0.26	–0.17	1	5.86	.99
MAIA Emotional Awareness	4.47	1.04	4.6	–0.78	1.53	1	6	.94*
MAIA Self Regulation	3.4	1.25	3	0.19	–0.77	1	6	.97
MAIA Body Listening	3.4	1.29	3.67	–0.31	–0.93	1	5.33	.94*
MAIA Trusting	4.28	1.18	4.33	–0.72	0.17	1	6	.94*
BESAA Appearance	34.09	7.22	34	–0.08	–0.14	15	49	.98
BESAA Attribution	15.33	3.01	15	0.71	0.69	11	24	.95*
BESAA Weight	26.72	6.95	28	–0.49	–0.21	10	38	.97

Note. M – mean; *ME* – median; *SD* – standard deviation; *Skew* – skewness; *Kurt.* – kurtosis; *Min. and Max.* – minimum and maximum values of the distribution; *SW* – Shapiro–Wilk test statistic; *BESAA Appearance* – Self-evaluation of appearance; *BESAA Attribution* – Perceived evaluation of appearance; *BESAA Weight* – Self-evaluation of weight.
*$p < .05$; ** $p < .01$; *** $p < .001$

Figure 1

Statistically Significant Between-Group Differences (RD vs CG) in the Subscales of Questionnaires Assessing Mental State, Body Perception, and Various Aspects of Interoception



Note. RD – rheumatologic diseases; CG – control group; * $p < .05$; ** $p < .01$; *** $p < .001$; BESAA *Appearance – Self-evaluation of appearance*; BESAA *Weight – Self-evaluation of weight*.

For the BESAA, the groups differed significantly on the *Appearance* subscale [t (84) = 3.35, p = .014, d = –0.72] and on the *Weight* subscale (U = 650.5, p = .018) (Figure 1). As shown by the mean scores (Tables 1, p. 123–124 and 2, p. 124), women with RD scored lower on these scales compared to women in the control group. In contrast, the groups did not differ significantly on the BESAA *Attribution* subscale (U = 838, p = .452).

In terms of interoception, the study groups differed significantly in means in the following subscales: on the MAIA subscales *Noticing* [t (84) = 3.45, p = .003, d = 0.74], *Not Worrying* [t (84) = –1.74, p = .046, d = –0.38], and *Trusting* (U = 591.5, p = .004) (Figure 1). On the *Noticing* and *Not Worrying* subscales, the RD group obtained higher scores than the control group, whereas the opposite pattern was observed for the *Trusting* subscale, where women with RD scored lower than controls (Tables 1, p. 123–124 and 2, p. 124). Differences between the groups on the remaining MAIA subscales were not statistically significant: *Emotional Awareness* (U = 833.5, p = .43), *Self-Regulation* [t (84) = –1.09,

p = .898], *Body Listening* (U = 806, p = .304), *Not-Distracting* [t (84) = –1.58, p = .662], and *Attention Regulation* [t (84) = –1.29, p = .86].

Discussion

One of the aims of the present study was to examine whether individuals with RD differ from healthy controls in selected psychological domains. The results showed that women with RD reported significantly greater severity of depressive symptoms, distress, anxiety, and somatization compared to the control group (see Tables 1, p. 123–124 and 2, p. 124, Figure 1, p. 125). These findings are consistent with previous studies demonstrating that individuals with RD display higher levels of depression and anxiety than healthy individuals (Neto et al., 2025). Plach et al. (2004) suggested that deteriorations in mental health in people with RD may be primarily related to disease-related symptoms such as pain and reduced psychophysical functioning. Such symptoms, which are typical of rheumatologic conditions, are likely to affect mood and increase vulnerability to depression (Köhler et al., 2014; Mac Giollabhui et al., 2021). The mood changes, anxiety, and heightened somatization observed in our participants may also have a strictly biological basis. Specifically, the inflammatory hypothesis of depression proposes that chronic inflammatory overactivity of the immune system contributes to low mood via the effects of pro-inflammatory mediators on the central nervous system (Schiepers et al., 2005). Initially, this process evokes sickness behavior (low energy, somatic complaints, desire to lie down) (Dantzer, 2001), and when neuroinflammation becomes chronic it leads to mood and behavioral changes typical of depression (Dantzer et al., 2008). It is therefore plausible that the psychological state of the women with RD in this study also reflected such processes.

In the *Introduction*, we also described the mechanism of central sensitization – a physiological state characterized by increased excitability of nociceptive centers and pathways, manifesting as hyperalgesia or allodynia, which has been well documented across different chronic pain conditions (Mezhov et al., 2021) and highlighted as an important etiological factor in RD in some studies (Mesci et al., 2024). It is possible that this mechanism contributed to more intense somatic complaints in the RD group, and that it was associated with elevated anxiety and distress in these patients.

An important result of this study was that women with rheumatologic diseases, in addition to higher levels of anxiety, low mood, distress, and somatic symptoms, also reported lower satisfaction with their bodies compared to healthy women. Scores on the BESAA *Appearance* subscale were significantly lower in the RD group than in controls (see Tables 1, p. 123–124 and 2, p. 124, Figure 1, p. 125). We also observed lower satisfaction with body weight among women in the clinical group compared to the control group (BESAA *Weight* subscale). These differences may be driven by the consequences of the disease and its treatment (Lutf & Hammoudeh, 2012). Visible symptoms – body deformities,

skin changes, and/or adverse effects of glucocorticoid therapy (e.g., increased body weight, "moon face") – are likely to undermine self-esteem, intensify shame and feelings of stigmatization, and promote social withdrawal (Cheah et al., 2020).

Interestingly, the groups did not differ in perceived reactions of others to their appearance (BESAA *Attribution* subscale) (see Tables 1, p. 123–124 and 2, p. 124, Figure 1, p. 125). These findings are not fully consistent with previous reports; for example, Plach et al. (2004) observed that patients with RA reported pronounced feelings of shame in social situations due to visible bodily changes. One possible explanation for the lack of differences in the present study is that not all participants had visible bodily changes. Another likely explanation is that the women in our sample may have experienced high levels of social support, which could have shaped their perception of acceptance of the disease by others (Kostova et al., 2014). In any case, the present results point to the need for more fine-grained analyses that take into account specific symptoms characteristic of particular rheumatologic conditions.

A further aim of this study was to examine interoceptive processing in women with RD. Analysis of MAIA scores showed that women with RD differed from controls in their sensitivity to bodily experiences (*Noticing* subscale) (Mehling et al., 2012). The second dimension that differentiated the groups was worry in response to pain and discomfort (*Not-Worrying* subscale), which was more pronounced in the RD group than in the control group (Figure 1, p. 125). Taken together, these two dimensions suggest that the clinical group was more vigilant and more negatively oriented toward their bodily sensations than the control group (Tables 1, p. 123–124 and 2, p. 124). Such heightened sensitivity and negative valuation of bodily signals is described as interoceptive hypervigilance (Labrenz et al., 2020). Other studies indicate that this phenomenon is frequently observed in patients with chronic pain (Horsburgh et al., 2024) and in individuals with anxiety disorders (Pang et al., 2019). Increased interoceptive vigilance may represent an adaptive mechanism in situations of chronic uncertainty, for example in conditions with an unpredictable course, which is often the case in RD (McAndrew et al., 2019). These findings are in line with reports of heightened vigilance and a tendency toward anxious-defensive interpretations of emotional situations in patients with RA (Basińska, 2002).

The observed hypervigilance also fits well within the disturbed predictive coding framework described in the *Introduction*. Dysfunction of the insula–ACC circuit may lead to overweighting of predictions regarding visceral signals (hypervigilance) combined with low objective accuracy in reading these signals (Barrett & Simmons, 2015; Critchley & Harrison, 2013; Horsburgh et al., 2024; Paulus & Stein, 2010). The latter dimension, however, is not assessed by any of the MAIA subscales (Mehling et al., 2012) and thus was not examined in this study.

Another interoceptive dimension that differentiated the RD group was trust in bodily signals. In women with RD, trust was markedly lower than in controls (MAIA *Trusting* subscale; Tables 1, p. 123–124 and 2, p. 124). This effect may reflect the impact of difficult disease-related experiences or the consequences of a sudden and unpredictable course of illness, which may undermine a sense of bodily stability and safety (Grassi et al., 1998).

When considered together, the interoceptive differences (MAIA – higher *Noticing and Not-Worrying*, lower *Trusting*) appear consistent with the results obtained on the 4DSQ (psychological functioning and somatic symptom severity) and BESAA (attitudes toward the body; lower satisfaction with appearance and weight). As several review papers indicate, excessive monitoring of bodily sensations (high interoceptive sensitivity) combined with low accuracy in decoding these signals promotes distress and symptom escalation and constitutes a typical pattern in many studies on pain and interoception (Henningsen et al., 2018; Horsburgh et al., 2024; Van Den Bergh et al., 2017; Wolters et al., 2022). In practice, this constellation may help explain the co-occurrence of high somatization and anxiety with limited bodily trust observed in the women with RD in this study.

The specific pattern of scores across all questionnaires in the clinical group may also form the basis for a hypothetical causal model in RD. In this model, the onset of rheumatologic disease and associated inflammation would be linked to intensified pain, whose chronic nature would drive central sensitization and the emergence of avoidance mechanisms and pain-related fear. In parallel, neuroplastic changes in the brain would alter functional relationships within the insula–ACC circuit, resulting in hypervigilance (elevated MAIA *Noticing* scores), reduced trust in bodily signals (lower MAIA *Trusting* scores), and excessive worry about symptoms (lower MAIA *Not-Worrying* scores). These processes would contribute to distress, increase somatization, and lead to anxiety and depressed mood (elevated 4DSQ scores), as well as lower self-esteem (reduced BESAA *Appearance* and *Weight* scores), as observed in the women in our study, and likely to increased social withdrawal.

This chain of associations appears plausible and aligns with well-established theoretical models describing disorders with symptom profiles similar to those seen in RD. One example is the fear-avoidance model (FAM), which explains the cognitive-behavioral mechanisms that develop in the context of chronic pain perception (Vlaeyen & Linton, 2000). The model posits that interpreting pain as threatening intensifies fear, increases hypervigilance to bodily signals, and leads to avoidance of physical activity, which, via feedback loops, maintains pain, lowers mood, and amplifies distress. The MAIA and 4DSQ profiles observed in the women with RD in our study appear to fit this theoretical framework well.

The proposed causal chain (RD model) can also be related to the Common Sense Model (CSM) of self-regulation formulated by Leventhal et al. (2016). According to this model, negative illness representations (e.g., perceived severe consequences, low controllability, chronic course) give rise to specific coping strategies and defense mechanisms (including avoidance). Negative beliefs about the illness also generate negative emotions and reduce self-esteem (as reflected, for example, in lower BESAA *Appearance* and *Weight* scores). This mechanism further strengthens distress (4DSQ *Distress*) and contributes to social withdrawal, effects that were particularly apparent in our sample with regard to the former dimension.

It must be emphasized, however, that the hypothetical causal model proposed here, although grounded in existing theories, requires further empirical

verification. Nevertheless, formulating such theoretical hypotheses appears meaningful, as the precise psycho-physiological mechanisms linking organic diseases to mental health outcomes remain poorly understood. A better understanding of these mechanisms may prove highly valuable in clinical practice, for instance in developing effective interventions for individuals suffering not only from rheumatologic diseases but also from other conditions.

Limitations

Despite yielding some interesting findings, the present study has several limitations. First, the sample size was relatively small. Another important factor that may have influenced the results is the high heterogeneity of the clinical group. Although all rheumatologic diseases belong to the same broad category and often share similar physiological mechanisms, they are characterized by diverse somatic symptoms and different patterns of involvement across organ systems. Moreover, while psychological functioning tends to be impaired across the population of patients with rheumatologic conditions, the literature also suggests substantial differences between specific diagnostic subgroups, which further increases heterogeneity (Zabłocka-Żytka & Wiśniewski, 2021). Future research on individuals with RD should therefore involve larger samples and, importantly, include more homogeneous subgroups, possibly restricted to single diagnostic entities.

Another limitation concerns the online format of the study. This may have introduced selection bias, for example by limiting participation to individuals with adequate access to technological equipment and a stable internet connection.

In future research, it will be important to examine disease-specific symptoms in more detail and to consider disease duration. As women constitute the majority of patients with RD, future studies should nevertheless also include men, in order to identify potential sex-related differences. Additionally, in the context of interoception, it would be valuable to combine self-report measures with objective indices, such as brain potentials time-locked to cardiac activity (Heart-Evoked Potentials, HEP). Such multimethod approaches could yield more robust findings and provide a stronger basis for future research on the interrelations between bodily processes and patients' mental states.

Conclusion

The findings of this study indicate that women with rheumatologic diseases experience not only impairments in various aspects of psychological well-being but also reduced self-esteem related to their body image and subjectively experienced interoceptive sensations. It therefore appears justified that specialist care for this patient group, in addition to somatic treatment, should place substantial emphasis on improving psychological functioning. A comprehensive approach to

patients' needs is in line with the biopsychosocial model (Engel, 1977). There is evidence that patients with rheumatologic conditions often perceive the level of psychological support and understanding of appearance-related difficulties from their physicians as insufficient (Hale et al., 2015). Consequently, efforts to better integrate different domains of patient support are crucial for improving care quality. In addition to rheumatologic or orthopedic treatment, interventions aimed at improving the relationship with the body may be particularly beneficial and could positively influence disease course; one promising approach is body-focused mindfulness-based therapy, which has been shown to enhance psychological well-being (Zhou et al., 2020).

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Appendix 1

Information on Comorbidities and Medications in the Group of Women with Rheumatologic Diseases (RD)

	CDT	**SpA**	**OA**	**gout**	**OP**	**FM**	**Total**
N	25	9	4	2	1	2	43
Comorbidities							
Thyroid disorders	5					1	6
Gynecological disorders	1			1		1	3
Nephrological disorders	1				1		2
Gastroenterological disorders					1		1
Cardiological disorders				1			1
Hypertension	2	1					3
Asthma	2				1		3
Anxiety disorders	3						3
Depression		1					1
Depressive–anxiety disorders	2						2
Medications (chronic use)							
Immunosuppressive	16	5	1				21
Thyroid medications	6		1			1	8
Antidiabetic	1			1			2
Painkillers	2		1	1			4
Nephrological	1						1
Psychiatric	8	1	1	1	1	2	14
Cardiological	8	2		1		1	12
Gastroenterological	2			1			3
Gynecological	3	2					5

Note. CTD – connective tissue diseases (e.g., systemic lupus erythematosus, rheumatoid arthritis); SpA – spondyloarthropathies (e.g., psoriatic arthritis, ankylosing spondylitis); OA – osteoarthritis; gout – gouty arthritis; OP – osteoporosis; FM – fibromyalgia; *N* – number of participants.