Original paper

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The effect of type D personality on quality of life, fatigue severity, and cardiovascular risk in patients with rheumatoid arthritis

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Abstract

Introduction: The tendency to experience negative emotions, to supress self-expression and distressed personality patern are a features of type D personality (TDP) We aimed to evaluate the impact of TDP on cardiovascular disease (CVD), interstitial lung disease (ILD), disease activity, and general health in patients with rheumatoid arthritis (RA).

Material and methods: This cross-sectional study included 125 patients with RA. Sociodemographic data, laboratory parameters, disease activation parameters, and ILD involvement were recorded. We assessed the presence of TDP with a total of 14 items of the TDP scale, the Framingham Risk Score (FRS) indicating the 10-year CVD risk as low, moderate, and high, fatigue severity with the fatigue severity score, and general health assessment with the 12-Item Short-Form Health Survey (SF-12).

Results: Type D personality was not associated with lung involvement, cardiovascular risk (CVR), or disease activity. Patients with TDP reported significantly lower physical (d = 0.47, p = 0.012) and mental (d = 1.07, p < 0.001) health-related quality of life (SF-12 scores). Multiple linear regression analysis results indicated that negative affectivity was a significant predictor of SF-12 mental scores (B = –0.87, SE = 0.25, β = –0.72, p < 0.001) and explained 36.6% of the variance (R^2 = 0.366). The FRS was significantly elevated in RA patients with lung disease (8.0 vs. 2.0, d = 0.88, p < 0.001), and a higher proportion of these patients fell into the moderate and high CVR categories (compared to those without lung disease (d = 0.15, p < 0.001).

Conclusions: Neither lung involvement nor disease activity in RA patients is influenced by TDP trait. Patients with RA who have interstitial lung involvement have more chance of developing CVD. Type D personality, particularly negative affect, decreases overall health without affecting disease activity.

Key words: type D personality, interstitial lung disease, rheumatoid arthritis, quality of life.

Introduction

Rheumatoid arthritis (RA) is a chronic, systemic inflammatory disease of unclear cause, with both articular and extraarticular symptoms [1]. Interstitial lung disease (ILD) is a significant extra-articular manifestation that impacts mortality and morbidity in individuals who have RA [2]. Another important factor affecting morbidity in RA patients is the increased incidence of cardiovascular disease (CVD) secondary to inflammation [3]. Conventional risk factors such as diabetes mellitus (DM), hypertension, smoking, obesity, medication, and active disease increase the risk of CVD compared to the general population. Patients with RA have a twofold increased risk of myocardial infarction and up to a 50% elevated cardiovascular mortality risk compared to the general population [2].

Stress and psychological variables are thought to trigger several autoimmune diseases, such as RA [4]. The importance of psychological factors in both disease development and disease management is known. Type D personality (TDP) is characterised by a tendency to experience negative emotions (negative affectivity) and to suppress self-expression in social situations (social inhibition), representing a distressed personality pattern associated with chronic stress and poor health outcomes [5]. The presence of TDP has also been shown to increase the risk of CVD such as myocardial infarction and result in poor prognosis [6]. Type D personality can manifest its

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effects on CVD through behavioural, psychological, and biological aspects. Behavioural factors such as exercise, adherence to medication, and dietary habits may be impacted. Those with TDP are more likely to experience anxiety and despair. Biologically, TDP is associated with higher cortisol secretion. In addition, proinflammatory cytokines are thought to cause endothelial cell dysfunction and atherosclerotic plaque development [7]. Based on this, we wanted to investigate the effect of TDP on cardiovascular risk (CVR) and interstitial lung involvement in RA patients.

Quality of life (QoL) is considered an important treatment outcome in RA patients [8]. Quality of life does not always correlate with disease activity. Individual differences, such as psychological factors, may account for this. We also aimed to analyse the effect of TDP on disease management and general QoL. There are scarce data on this topic. Our objective in this study was to explore the effect of TDP on CVR, interstitial lung involvement, disease activity, and overall QoL in RA patients.

Material and methods

Between August 2024 and October 2024, this cross-sectional, single-centre study was conducted at our university. Patients diagnosed with RA according to the 2010 European Alliance of Associations for Rheumatology/American College of Rheumatology RA classification criteria were included in the study [9]. The exclusion criteria included individuals under 18 years of age, and those with current infections, malignancies, and psychiatric disorders. Patients were categorised into 2 groups as those with and without RA lung involvement. Patients in the RA lung involvement group had verified ILD using high-resolution computed tomography (HRCT) due to respiratory complaints.

Socio-demographic parameters (age, sex, education level, smoking history), clinical factors (serology, type of interstitial lung involvement, severity, disease activity), and comorbidities were all documented. Rheumatoid arthritis disease activity was evaluated with the Disease Activity Score for 28 joints (DAS28), Simplified Disease Activity Index (SDAI), and Clinical Disease Activity Index (CDAI) [10]. Laboratory parameters involved rheumatoid factor, anti-cyclic citrullinated peptide (anti-CCP), C-reactive protein (CRP) (mg/dl), fasting blood glucose (mg/dl), triglycerides (mg/dl), high-density lipoprotein cholesterol (mg/dl), low-density lipoprotein cholesterol (mg/dl), and total cholesterol (mg/dl) levels. The Framingham Risk Score (FRS) was computed to evaluate the 10-year CVD risk for the patients [11]. For the evaluation of TDP, fatigue, and QoL, the Type D Scale-14 (DS14), the Fatigue Severity Scale, and the 12-Item Short-Form Health Survey (SF-12) QoL scale were used, respectively [5, 12–14].

Disease Activity Score for 28 joints ≤ 2.6 was categorised as remission, 2.6–3.2 as low disease activity, ≥ 3.2–5.1 as moderate disease activity, and ≥ 5.1 as high disease activity [15].

Type D personality consists of 2 scales: social inhibition and negative affectivity. To indicate social inhibition or negative affect, a score of ≥ 10 is necessary in the relevant category. Type D personality requires a score of ≥ 10 in each category.

The 12-Item Short-Form Health Survey was scored mentally and physically [13, 14].

The Fatigue Severity Scale has 9 items that assess the intensity of fatigue symptoms experienced by respondents over the preceding week. The total score is determined by calculating the arithmetic mean. A score of 2.8 or above typically signifies weariness. A score of > 6.1 was considered as chronic fatigue syndrome.

Patients with ILD were classified into 2 categories: limited (less than 20% involvement) or diffuse (more than 20% involvement), based on HRCT results. Patterns of lung involvement were classified as organising pneumonia, usual interstitial pneumonia, and nonspecific interstitial pneumonia; patients who did not fit into these groups were classified as undefined [16].

Statistical analyses

A priori sample size estimation was not performed. Instead, a consecutive sampling approach was adopted, whereby all eligible patients who were under regular follow-up in our clinic and had complete medical records in the hospital system during the predefined study period, and who consented to participate, were included in the analysis. Following data collection, *post hoc* power analysis was conducted using G*Power software (version 3.1.9.7; Institute for Experimental Psychology, Heinrich Heine University Düsseldorf, Germany). The *F*-test family was selected, and the "Linear multiple regression: Fixed model, R^2 deviation from zero" procedure was used. Observed power values were calculated based on the obtained effect size (f^2) values derived from the regression models. Effect sizes (f^2) were calculated using the following formula: $f^2 = R^2/(1 - R^2)$, where R^2 represents the coefficient of determination obtained from the regression model.

All statistical analyses were conducted using SPSS version 27.0 (IBM Corp., Armonk, NY). Descriptive statistics were expressed as mean ± standard deviation, median and interquartile range, or frequency and percentage, depending on the nature and distribution of the variables. Normality was assessed using the Kolmogorov-Smirnov test. Independent sample *t*-tests

or Mann-Whitney *U* tests were used for between-group comparisons of continuous variables, while Pearson's χ^2 or Fisher's exact tests were applied for categorical data as appropriate.

To investigate the association between personality traits (i.e. negative affectivity and DS14 total score) and clinical outcomes (including SF-12 mental and physical health scores, fatigue severity, and FRS) univariate and multivariate linear regression analyses were performed. The parameters for which a significant difference was found in both the binary comparisons for negative affectivity and TDP (DS14 total score) were included in the regression analyses. In the univariate and multivariate regression models, adjustments were made for age, gender, and medication status. Gender and medication were entered as dummy variables. Prior to model estimation, the assumptions of linear regression were systematically assessed. Linearity between independent and dependent variables was verified through partial regression plots. Normality of residuals was evaluated using normal probability plots and the Shapiro-Wilk test for regression residuals. Homoscedasticity (equal variance of residuals) was assessed via scatterplots of standardised residuals versus predicted values. Independence of errors was verified using the Durbin-Watson statistic. Multicollinearity was evaluated using both the Variance Inflation Factor (VIF) and tolerance values; VIF values below 10 and tolerance values above 0.1 were considered acceptable. No violations of these assumptions were detected. Model fit was assessed using the coefficient of determination (R^2), and observed power was calculated for a multivariate regression model.

A p-value < 0.05 was considered statistically significant for all analyses.

Bioethical standards

The Local Ethics Committee of Cukurova University, Adana, Türkiye accepted the study protocol (approval date: 26 July 2024, no. 146/60). Prior to initiating the study, each participant provided written informed consent. This research complied with the criteria of the Declaration of Helsinki.

Results

Patients with RA and lung involvement were substantially older than those without lung disease (65.3 ±9.0 vs. 54.0 ±11.3 years, d = 1.05, p < 0.001), with a smaller percentage of females in the lung disease group (60.0% vs. 81.1%, d = 2.86, p = 0.021). The lung disease group exhibited a considerably greater smoking history, quantified in pack-years (d = 0.31, p = 0.030). Additionally, CVD was more prevalent among patients with lung disease (20.0%) compared to those without (5.6%, p = 0.014). Inflammatory markers differed between the groups, with patients with lung involvement showing significantly higher CRP levels (d = 0.59, p = 0.004) and erythrocyte sedimentation rate (ESR) (d = 0.67, p = 0.001). Notably, the FRS was markedly increased in RA patients with lung disease (8.0 vs. 2.0, d = 0.88, p < 0.001), and a higher proportion of these patients fell into the moderate and high CVR categories (compared to those without lung disease (d = 0.15, p < 0.001; Table I).

In the comparative analysis of RA patients with and without TDP, females were significantly more prevalent in the type D group (90.5% vs. 59.7%, d = 0.11, p < 0.001). Smoking exposure was also higher in the non-type D group (d = 0.39, p = 0.009). Patients with TDP reported significantly lower physical (d = 0.47, p = 0.012) and mental (d = 1.07, p < 0.001) health-related QoL (SF-12 scores). Additionally, fatigue severity was higher in the type D group (d = 0.76, p < 0.001), with a greater proportion experiencing fatigue (92.1% vs. 66.1%, d = 0.10, p = 0.001) and chronic fatigue (38.1% vs. 11.3%, d = 0.10, p < 0.001; Table II).

In the subgroup analysis of patients with and without social inhibition, no significant differences were found in disease activity or lung involvement patterns. However, negative affectivity was significantly associated with worse mental health outcomes (SF-12 mental score, p < 0.001) and higher fatigue severity (p < 0.001). Patients with negative affectivity were also more likely to experience chronic fatigue (33.8% vs. 11.8%, p = 0.005). Gender distribution also differed, with a higher proportion of females in the negative affectivity group (86.5% vs. 58.8%, p = 0.001; Table III).

In the univariate regression analyses, negative affectivity significantly predicted SF-12 mental/physical subscales and fatigue severity. It was negatively associated with SF-12 mental (β = –0.612, p < 0.001, R^2 = 0.369) and physical scores (β = –0.184, p < 0.05, R^2 = 0.026) and positively associated with fatigue severity (β = 0.435, p < 0.001, R^2 = 0.183). No significant association was found between negative affectivity and FRS.

According to the multivariate linear regression analysis, negative affectivity was found to be a significant independent predictor only for SF-12 mental component scores (β = –0.727, p < 0.001), indicating that higher levels of negative affect were associated with poorer mental health-related QoL. This model accounted for approximately 36.6% of the variance in SF-12 mental scores (R^2 = 0.366) and demonstrated high statistical power (100%), supporting the adequacy of the sample size for detecting meaningful associations. Type D Scale-14 total scores did not significantly predict any of the outcome variables in the multivariate models (Table IV).

Table I. Comparative analysis of sociodemographic, laboratory, and other study parameters between rheumatoid arthritis patients with and without lung disease

Variable	RA without lung disease (*n* = 90)	RA with lung disease (*n* = 35)	Effect size (Cohen's *d*)	*p*
Sex, female [*n* (%)]	73 (81.1)	21 (60.0)	2.86	0.021
Age [years][a]	54.0 ±11.3	65.3 ±9.0	1.05	< 0.001
BMI [kg/m^2][a]	28.4 ±6.0	27.4 ±3.7	NA	0.382
Education level [*n* (%)]				
Illiterate	18 (20.0)	8 (22.9)	NA	0.272
Primary and/or secondary	48 (53.3)	23 (65.7)		
High school	12 (13.3)	3 (8.6)		
University+	12 (13.3)	1 (2.9)		
Smoking exposure – packets per year (*n*)[b]	0.0 (0.0)	0.0 (2.0)	0.31	0.030
Disease duration [years][b]	10.0 (9.0)	10.0 (10.0)	NA	0.916
Lung involvement severity [*n* (%)]				
Limited	NA	15 (42.9)	NA	NA
Diffuse	NA	19 (54.3)		
Lung involvement pattern [*n* (%)]				
NSIP	NA	11 (31.4)	NA	NA
UIP	NA	16 (45.7)		
Organised pneumonia	NA	1 (2.9)		
Undescribed	NA	6 (17.1)		
Comorbidities [*n* (%)]				
Coronary artery disease	5 (5.6)	7 (20.0)	2.40	0.014
Hypertension	33 (36.7)	19 (54.3)	NA	0.073
Diabetes mellitus	8 (8.9)	2 (5.7)	NA	0.557
Additional disease	37 (41.1)	21 (60.0)	NA	0.057
DAS28-CRP[b]	2.18 (2.00)	2.07 (1.72)	NA	0.998
SDAI	3.2 (12.5)	5.6 (18.6)	NA	0.727
CDAI[b]	2.5 (12.0)	4.5 (18.0)	NA	0.976
CCP[b]	38.0 (244.1)	125.0 (726.0)	0.39	0.031
RF[b]	24.5 (124.8)	48.0 (159.0)	NA	0.146
Serology [*n* (%)]				
Positive	53 (58.9)	29 (82.9)	0.23	0.012
Negative	37 (41.1)	6 (17.1)		
Clinical variables				
Systolic blood pressure [mmHg][b]	125.0 (28.0)	130.0 (20.0)	0.43	0.018
Diastolic blood pressure [mmHg][b]	80.0 (11.5)	80.0 (15.0)	NA	0.303
Total cholesterol[b]	184.5 (49.5)	175.0 (39.5)	NA	0.272
Triglycerides[b]	124.0 (96.0)	103.5 (74.5)	NA	0.261
HDL-C[a]	51.3 ±13.0	52.9 ±14.8	NA	0.551
LDL-C[b]	104.0 (36.0)	101.5 (41.8)	NA	0.622
Fasting blood glucose[b]	93.0 (28.0)	91.0 (22.0)	NA	0.272
ESR[b]	15.0 (18.0)	28.0 (23.2)	0.67	0.001
CRP[b]	4.9 (7.3)	9.8 (14.3)	0.59	0.004

Table I. Cont.

Variable	RA without lung disease (n = 90)	RA with lung disease (n = 35)	Effect size (Cohen's d)	p
Medication [n (%)]				
DMARD	62 (68.9)	13 (37.1)	NA	< 0.001
Anti-TNF + DMARD	10 (11.1)	2 (5.7)		
Abatacept	2 (2.2)	3 (8.6)		
Tocilizumab	7 (7.8)	3 (8.6)		
Rituximab	5 (5.6)	3 (8.6)		
MMF/AZA	0 (0.0)	10 (28.6)		
Others	4 (4.4)	1 (2.9)		
SF12				
Physical[b]	35.2 (17.6)	33.6 (17.7)	NA	0.942
Mental[a]	43.3 ±12.2	43.4 ±12.8	NA	0.980
Fatigue score[b]	4.6 (3.1)	5.2 (2.6)	NA	0.268
Fatigue (+)[b]	67 (74.4)	28 (80.0)	NA	0.589
Chronic fatigue (+)[b]	22 (24.4)	9 (25.7)	NA	0.969
FRS	2.0 (4.0)	8.0 (12.0)	0.88	< 0.001
Risk level [n (%)]				
Low	75 (83.3)	18 (51.4)	0.15	< 0.001
Moderate	6 (6.7)	11 (31.4)		
High	7 (7.8)	6 (17.1)		
Social inhibition score[b]	12.0 (7.0)	11.5 (5.5)	NA	0.179
Social inhibition (+) [n (%)]	68 (75.6)	25 (71.4)	NA	0.841
Negative affectivity score[b]	15.0 (21.0)	9.5 (18.3)	NA	0.279
Negative affectivity (+) [n (%)]	57 (63.3)	17 (48.6)	NA	0.216
TDP (+) [n (%)]	47 (52.2)	16 (45.7)	NA	0.643

[a]*Represents mean ± standard deviation.*
[b]*Represents median (interquartile range).*
anti-CCP – anti-cyclic citrullinated peptide, AZA – azathioprine, BMI – body mass index, CDAI – Clinical Disease Activity Index, CRP – C-reactive protein, DAS28 – Disease Activity Score for 28 joints, DMARD – disease modifying anti-rheumatic drug, ESR – erythrocyte sedimentation rate, FRS – Framingham Risk Score, HDL-C – high-density lipoprotein cholesterol, LDL-C – low-density lipoprotein cholesterol, MMF – mycophenolate mofetil, NA – not available, NSIP – nonspecific interstitial pneumonia, RA – rheumatoid arthritis, RF – rheumatoid factor, SDAI – Simplified Disease Activity Index, SF12 – 12-Item Short-Form Health Survey, TDP – type D personality, TNF – tumour necrosis factor, UIP – usual interstitial pneumonia.

Discussion

Our group of patients with RA-ILD were older, had a higher proportion of men, smoked more, and had higher frequencies of anti-CCP antibodies, all of which were consistent with previous data [17]. Although disease activity assessed by DAS28 was comparable between patients with and without ILD, ESR and CRP levels were significantly higher in the ILD group. This finding suggests that systemic inflammation in RA extends beyond articular involvement. Elevated acute-phase reactants may reflect subclinical extra-articular inflammation, particularly related to pulmonary involvement, rather than joint activity alone [18, 19]. In addition, our study discovered that TDP has no effect on disease activity, lung involvement, or FRS score, but it does have a negative impact on QoL, fatigue score, and chronic fatigue. Stress has been shown to have immunologically mediated effects on rheumatic diseases [20]. We also wanted to look at the rate of ILD in this patient group, considering that personality traits may affect patients' ability to cope with stress and the course of the disease. The results of our study showed that TDP trait had no effect on either smoking rate or interstitial lung involvement.

Cardiovascular disease is a commonly recognised comorbidity in both chronic obstructive pulmonary disease and ILD. Research indicates that the incidence of CVD is elevated in patients with idiopathic pulmonary

Table II. Comparative analysis of sociodemographic and disease-related parameters of the patient population with and without type D personality

Variable	RA with type D (*n* = 63)	RA without type D (*n* = 62)	Effect size (Cohen's *d*)	*p*
Sex, female [*n* (%)]	57 (90.5)	37 (59.7)	0.11	**< 0.001**
Age [years][a]	55.7 ±12.5	58.5 ±11.3	NA	0.833
BMI [kg/m^2][a]	27.9 ±5.5	28.1 ±5.4	NA	0.844
Smoking exposure – packets per year (*n*)[b]	0.0 (0.0)	0.0 (20.0)	0.39	**0.009**
Disease duration [years][b]	10.0 (9.0)	10.0 (10.0)	NA	0.985
Lung involvement severity [*n* (%)]				
Limited	7 (11.1)	8 (12.9)	NA	0.898
Diffuse	8 (12.7)	10 (16.1)		
Lung involvement pattern [*n* (%)]				
NSIP	7 (11.1)	4 (6.5)	NA	0.229
UIP	7 (11.1)	8 (12.9)		
Organised pneumonia	0 (0.0)	1 (1.6)		
Undescribed	1 (1.6)	5 (8.1)		
Comorbidities [*n* (%)]				
Coronary artery disease	6 (9.5)	6 (9.7)	NA	0.976
Hypertension	27 (42.9)	22 (35.5)		0.393
Diabetes mellitus	6 (9.5)	3 (4.8)		0.311
Additional disease	31 (42.9)	24 (38.7)		0.229
DAS28-CRP[b]	2.2 (2.0)	2.1 (1.9)		0.875
DAS28 category [*n* (%)]				
Remission	36 (57.1)	36 (58.1)	NA	0.133
Low disease activity	2 (3.2)	5 (8.1)		
Moderate disease activity	22 (34.9)	15 (24.2)		
Severe disease activity	0 (0.0)	3 (4.8)		
Serology [*n* (%)]				
Positive	39 (61.3)	39 (62.9)	NA	0.900
Negative	21 (33.3)	20 (32.3)		
SF12				
Physical[b]	31.7 (14.7)	39.7 (18.1)	0.47	**0.012**
Mental[a]	37.5 ±11.2	49.2 ±10.6	1.07	**< 0.001**
Fatigue score[b]	5.7 (2.4)	3.9 (3.4)	0.76	**< 0.001**
Fatigue (+) [*n* (%)]	58 (92.1)	42 (66.1)	0.10	**0.001**
Chronic fatigue (+) [*n* (%)]	23 (38.1)	7 (11.3)	0.10	**< 0.001**

[a]*Represents mean ± standard deviation.*
[b]*Represents median (interquartile range).*
BMI – body mass index, DAS28 – Disease Activity Score for 28 joints, NSIP – nonspecific interstitial pneumonia, RA – rheumatoid arthritis, SF12 – 12-Item Short-Form Health Survey, UIP – usual interstitial pneumonia.

fibrosis, with ischaemic heart disease being the primary cause of mortality [21]. Patel et al. [22] revealed that coronary artery calcification was frequent in patients with ILD and was connected to cardiovascular events in their study. In this study, the FRS score of patients with RA-ILD exceeded that of the non-ILD group. Similar to the literature, our investigation found that the group with lung involvement had a higher risk of CVD. Although this result is not the purpose of our study, we think it is information that contributes to the literature.

Table III. Comparative analysis of sociodemographic and disease-related parameters of the patient population with and without social inhibition

Variable	RA-social inhibition (+) (*n* = 93)	RA-social inhibition (–) (*n* = 32)	*p*	RA-negative effectivity (+) (*n* = 74)	RA-negative effectivity (–) (*n* = 51)	*p*
Sex, female [*n* (%)]	70 (75.3)	24 (75.0)	0.741	64 (86.5)	30 (58.8)	**0.001**
Age [years][a]	56.6 ±11.9	58.3 ±12.5	0.505	55.4 ±12.6	59.5 ±10.8	0.064
BMI [kg/m^2][a]	27.9 ±5.8	28.3 ±4.3	0.733	28.2 ±5.4	27.8 ±5.6	0.749
Education level [*n* (%)]						
Illiterate	21 (22.6)	4 (12.5)	0.633	20 (27.0)	6 (11.8)	0.139
Primary and/or secondary	51 (54.8)	20 (62.5)		40 (54.1)	31 (60.8)	
High school	11 (11.8)	4 (12.5)		6 (8.1)	9 (17.7)	
University[+]	10 (10.8)	4 (12.5)		8 (10.8)	5 (9.8)	
Smoking exposure – packets per year (*n*)[b]	0.0 (8.0)	0.0 (11.3)	0.662	0.0 (0.0)	0.0 (20.0)	0.053
Disease duration [years][b]	10.0 (10.5)	9.5 (12.5)	0.599	10.0 (10.5)	10.0 (11.0)	0.165
Lung involvement severity [*n* (%)]						
Limited	13 (14.0)	2 (6.3)	0.101	8 (10.8)	7 (13.7)	0.611
Diffuse	11 (11.8)	7 (21.9)		8 (10.8)	10 (19.6)	
Lung involvement pattern [*n* (%)]						
NSIP	9 (9.7)	2 (6.3)	0.748	8 (10.8)	3 (5.9)	0.113
UIP	10 (10.8)	5 (15.6)		7 (9.5)	8 (15.7)	
Organised pneumonia	1 (1.1)	0 (0.0)		0 (0.0)	1 (2.0)	
Undescribed	4 (4.3)	2 (6.3)		1 (1.4)	5 (9.8)	
Comorbidities [*n* (%)]						
Coronary artery disease	12 (12.9)	0 (0.0)	0.034	6 (8.1)	6 (11.8)	0.512
Hypertension	38 (40.9)	11 (34.4)	0.562	30 (40.5)	19 (37.3)	0.656
Diabetes mellitus	7 (7.5)	2 (6.3)	0.830	7 (9.5)	2 (3.9)	0.229
Additional disease	44 (47.3)	11 (34.4)	0.225	34 (46.0)	21 (41.2)	0.538
DAS28-CRP[b]	2.0 (1.9)	2.6 (2.1)	0.081	2.4 (1.9)	2.1 (1.9)	0.331
Serology [*n* (%)]						
Positive	57 (61.3)	21 (65.6)	0.554	46 (62.2)	32 (62.7)	0.963
Negative	32 (34.4)	9 (28.1)		24 (32.4)	17 (33.3)	
SF12						
Physicial[b]	33.4 (17.6)	37.9 (16.9)	0.276	31.4 (13.8)	42.7 (19.4)	0.010
Mental[a]	42.6 ±13.0	45.4 ±10.0	0.229	37.5 ±10.9	51.5 ±9.4	< 0.001
Fatigue score[b]	5.0 (3.2)	4.3 (2.7)	0.062	5.5 (2.4)	3.6 (3.5)	< 0.001
Fatigue (+) [*n* (%)]	76 (81.7)	24 (75.0)	0.679	69 (93.2)	31 (60.8)	< 0.001
Chronic fatigue (+) [*n* (%)]	29 (31.2)	2 (6.3)	0.006	25 (33.8)	6 (11.8)	0.005

[a]*Represents mean ± standard deviation.*
[b]*Represents median (interquartile range).*
BMI – body mass index, CRP – C-reactive protein, DAS28 – Disease Activity Score for 28 joints, NSIP – nonspecific interstitial pneumonia, RA – rheumatoid arthritis, SF12 – 12-Item Short-Form Health Survey, UIP – usual interstitial pneumonia.

Our analysis revealed no significant difference in disease activity between the groups with and without TDP. However, the QoL was greatly reduced, and the severity of fatigue was significantly increased. To our knowledge, there has been relatively little research on TDP in rheumatological diseases [23–25]. In a study of RA patients, Klaassen et al. [26] revealed that TDP was not associated with disease activity, but rather with lower

Table IV. Multiple linear regression analysis adjusted for age, gender, and medication was performed to identify the effects of negative affectivity and total Type D Scale-14 (DS14) scores on 12-Item Short-Form Health Survey (SF-12) scores, fatigue, and Framingham Risk Score (FRS)

Variables	SF-12 mental		SF-12 physical		Fatigue score		FRS	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Univariate regression analyses								
Negative affectivity score	–0.73** (0.09)	–0.612	–0.19* (0.10)	–0.184	0.08** (0.02)	0.435	0.01 (0.04)	0.018
DS-14 total score	–0.53** (0.07)	–0.560	–0.14 (0.08)	–0.169	0.06 (0.01)	0.427	0.01 (0.03)	0.019
Multivariate regression analyses								
Negative affectivity score	–0.87 (0.25)**	–0.727	–0.22 (0.28)	–0.210	0.06 (0.05)	0.296	0.00 (0.10)	0.007
DS-14 total score	0.12 (0.20)	0.123	0.02 (0.22)	0.028	0.02 (0.04)	0.149	0.00 (0.08)	0.012

**p < 0.05, **p < 0.001.*
SE – standard error.

overall life satisfaction. The findings of this study support the conclusions of Klaassen et al. [26]. In opposition to this study, İnal et al. [23] discovered that the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) score, an indicator of disease activity in patients with ankylosing spondylitis, was elevated in those with TDP. These contrasting findings might be explained by the fact that BASDAI is a more subjective metric whereas DAS28 includes objective evaluations like CRP.

One of the important causes of mobility and mortality in RA is CVD. Although CVD is common and affects the course of the disease in patients with RA, there is no ideal scoring system for the assessment of CVR [27].

The relationship between cardiovascular events and TDP has been the primary focus of previous research [28]. Type D personality has been shown to be an independent factor increasing the incidence of cardiovascular events [29]. In our investigation, RA patients presenting TDP features were not identified as having an elevated risk for CVD or ILD. Although CVR in RA patients may be associated with inflammation and lung involvement, there is no evidence that personality type and psychological factors are effective [30]. However, it should be noted that smoking exposure was higher among non-type D individuals. Since smoking is a well-established CVR factor, this imbalance might have attenuated or masked potential differences in CVR between the 2 personality groups. Future studies should control for smoking history when evaluating the independent effect of TDP on cardiovascular outcomes. Besides conventional risk factors, disease activity and inflammation are more significant determinants of CVD. Consequently, TDP may serve as an insignificant risk factor for cardiovascular issues in individuals with RA. The effect of stress and TDP on acute cardiac events cannot be ignored, but we think that it is a subordinate risk factor for CVD. The effect of the presence of TDP on CVD is mostly associated with poor prognosis. Our study did not include a prognosis. Although it does not appear to be a contributing factor to the development of cardiac diseases, prospective studies should be done to assess its impact on CVD prognosis.

Previous studies have shown that 80% of RA patients have fatigue, but to our current knowledge there is no study investigating the effect of personality type on fatigue [31]. A study conducted in Korean society has shown that depression and stress trigger physical and mental fatigue [32]. This indirectly shows the effect of personality traits on fatigue. In our study, we observed that 76% of RA patients had fatigue. In addition, it was observed that both fatigue severity and chronic fatigue were more common in type D patients. The presence of chronic fatigue in patients is an entity that affects disease management, resistance to treatment, and general well-being [33]. All these show the importance of personality type in coping with the disease and in the treatment phase.

Horwood et al. [34] discovered that TDP was more common in chronic conditions like RA and type 2 DM than in healthy individuals. It was additionally found that negative affect has a greater impact on overall health, and that as negative affect grows, so does the reporting of psychological symptoms. Indeed, in our research, negative affect was shown to be a key predictor of overall health.

Study limitations

The research possesses certain limitations. One restriction is that the surveys employed may have been affected by their inherent subjectivity. Nevertheless, validated questionnaires were employed. The lack of prospective, longitudinal studies is another limitation for assessing the impact of personality type on disease. Another limitation is the lack of combined scores with ultrasound to assess CVR. Another weakness of the study is the lack of a healthy control group. Previous research

has shown that TDP disorder is more prevalent in RA patients compared to healthy individuals. Therefore, this study focused on the situations affected by TDP disorder in the patient group. Despite these limitations, the present study has several strengths.

Conclusions

It is the first to simultaneously assess TDP, disease activity, interstitial lung involvement, CVR, fatigue, and QoL in patients with RA. This multidimensional approach provides a comprehensive understanding of the psychosocial and systemic aspects of RA. Additionally, the use of validated questionnaires and objective risk scores enhances the reliability of the findings. These results may help clinicians integrate psychological assessment into the holistic management of RA.

Because TDP is associated with decreased well-being and life satisfaction, it is recommended that clinicians routinely administer the simple, short, easy-to-use DS-14. Providing the necessary psychological support is thought to contribute to the management and QoL of patients.

Disclosures

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Data availability: The data that support the findings of this study are available on request from the corresponding author (G.V.).

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