

ORIGINAL ARTICLE

The Relationship Between Rheumatoid Factor Seropositivity and Impulsivity in Rheumatoid Arthritis and the Potential Clinical Effects of Impulsivity

Romatoid Artritte Romatoid Faktör Seropozitifliği ile Dürtüsellik Arasındaki İlişki ve Dürtüsellik Potansiyel Klinik Etkileri

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ABSTRACT

Background: Impulsivity is the propensity to make judgments and take action without sufficient planning or foreseeing consequences. Impulsivity is one of the main symptoms of several mental disorders. Studies supporting the association between inflammation and impulsivity are increasing in number. This study aimed to assess the association between impulsivity, inflammation and rheumatoid factor (RF) in rheumatoid arthritis, a systemic inflammatory disease.**Methods:** Thirty rheumatoid arthritis patients with RF+ and 22 rheumatoid arthritis patients with RF- were enrolled in this study. Impulsivity was measured with the Barratt Impulsiveness Scale (BIS). The Morisky Medication Adherence Scale (MMAS), and Intuitive Eating Scale-2 (IES-2) was applied to assess the potential clinical effects of impulsivity. In addition, Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), Health Assessment Questionnaire (HAQ), and Disease Activity Score-28 (DAS-28) were used to evaluate the individuals' clinical features. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were used as inflammation biomarkers.**Results:** In this study, patients with RF+ had higher BIS total scores than those with RF- ($p = .039$). In addition, smoking rates, which may be associated with impulsive behavior, were higher in the RF+ group than in the RF- group ($p = .033$). Moreover, there was a significant positive correlation between the attentional impulsivity dimension of BIS and CRP levels in the RF+ group ($p = .023$). Regarding MMAS, BAI, BDI, and IES-2, there was no significant difference between RF+ and RF- groups.**Conclusions:** These results indicate that RF seropositivity in rheumatoid arthritis is associated with impulsivity. The high impulsivity detected in RF+ patients may be the reason why risky behaviors such as smoking are seen more frequently in this group. Moreover, it has also been shown that increased attentional impulsivity in RF+ group is associated with inflammation. Further studies evaluating the effect of inflammatory processes on impulsivity in RF+ patients are needed.**Keywords:** Rheumatoid arthritis, Rheumatoid factor, Inflammation, Impulsivity, Medication adherence, Eating, Anxiety, Depression

ÖZ

Amaç: Dürtüsellik, yeterli planlama yapmadan veya sonuçlarını öngörmeden yargıda bulunma ve harekete geçme eğilimidir. Dürtüsellik, farklı ruhsal bozuklukların temel belirtilerinden biridir. Enflamasyon ve dürtüsellik arasındaki ilişkiyi destekleyen çalışmaların sayısı giderek artmaktadır. Bu çalışmada sistemik inflamatuvar bir hastalık olan romatoid artritte dürtüsellik, inflamasyon ve romatoid faktör (RF) arasındaki ilişkinin değerlendirilmesi amaçlanmıştır.**Materyal-Metot:** Bu çalışmaya RF+ olan 30 romatoid artrit hastası ve RF- olan 22 romatoid artrit hastası dahil edilmiştir. Dürtüsellik Barratt Dürtüsellik Ölçeği (BDÖ) kullanılarak ölçülmüştür. Dürtüsellik potansiyel klinik etkilerini değerlendirmek için Morisky Tedavi Uyum Ölçeği (MTUÖ) ve Sezgisel Yeme Ölçeği-2 (SYÖ-2) uygulanmıştır. Ayrıca, bireylerin klinik özelliklerini değerlendirmek için Beck Depresyon Ölçeği (BDÖ), Beck Anksiyete Ölçeği (BAÖ), Sağlık Değerlendirme Anketi (SDA) ve Hastalık Aktivite Skoru-28 (HAS-28) kullanılmıştır. Eritrosit sedimentasyon hızı ve C-reaktif protein (CRP) inflamasyon biyobelirteçleri olarak kullanılmıştır.**Bulgular:** Bu çalışmada, RF+ olan hastaların toplam BDÖ skorları RF- olanlara göre daha yüksek olarak saptandı ($p = .039$). Ayrıca, dürtüsel davranışla ilişkili olabilecek sigara içme oranları RF+ olan grupta daha yüksekti ($p = .033$). Ayrıca, RF+ grubunda BIS dikkat dürtüsellik boyutu ile CRP seviyeleri arasında anlamlı bir pozitif korelasyon vardı ($p = .023$). MTU, BAÖ, BDÖ ve SYÖ-2 toplam puanları açısından RF+ ve RF- grupları arasında anlamlı bir fark bulunmadı.**Sonuç:** Bu sonuçlar romatoid artritte romatoid faktör seropozitifliğinin dürtüsellik ile ilişkili olduğunu göstermektedir. RF+ hastalarda saptanan yüksek dürtüsellik, sigara kullanımı gibi riskli davranışların bu grupta daha sık görülmesinin sebebi olabilir. Ayrıca, RF+ grubunda artmış dikkat dürtüsellik inflamasyon ile ilişkili olduğu da gösterilmiştir. RF+ hastalarda inflamatuvar süreçlerin dürtüsellik üzerindeki etkisini değerlendiren ileri çalışmalara ihtiyaç vardır.**Anahtar Kelimeler:** Romatoid artrit, Romatoid faktör, İnflamasyon, Dürtüsellik, Tedavi uyumu, Yeme, anksiyete, Depresyon

Introduction

Rheumatoid arthritis is among the most frequent been an increased interest in central neurological inflammatory and autoimmune diseases (1). manifestations of rheumatoid arthritis (3). Circulating Inflammatory activation in rheumatoid arthritis leads immune complexes can trigger inflammation in the to many extra-articular manifestations (2). There has central nervous system and lead to neuropsychiatric

symptoms. Extra-articular involvement of rheumatoid arthritis may be associated with generalized or focal seizure, fever, headaches, frontal syndrome, delirium, depression, anxiety, psychomotor retardation, and dementia (2, 3). It has been reported that central involvement and seropositivity may be related (4). Furthermore, the rheumatoid factor (RF) has been shown in the cerebrospinal fluid in the central nervous system involvement of rheumatoid arthritis (5, 6).

Antibodies such as anti-citrullinated protein antibodies (ACPA) and RF are high in rheumatoid arthritis. Rheumatoid factor is first discovered in rheumatoid arthritis, and higher amounts of RF in the blood may indicate inflammation in rheumatoid arthritis. RF positivity was found to be 50-80% in rheumatoid arthritis (7). It has been stated that rheumatoid arthritis has two possible subtypes in terms of RF status (RF + and RF -) (8). Both subgroups have been shown to differ in terms of psychological symptoms and the clinical course of the disorder. The RF- subtype was related to higher emotional expression, more extended periods of depression, and a longer diagnostic delay than the RF+ subtype (8). In agreement with these findings, Ho et al. (2011) reported that high RF levels were a significant predictor of depression severity (9). Furthermore, it has been shown that rheumatoid arthritis patients with RF positive have more frequent cognitive impairments, sleep difficulties, and are more risky in terms of alcohol consumption and smoking (10, 11). This shows that RF in rheumatoid arthritis can affect the course of the disease.

Inflammation is associated with mental disorders such as schizophrenia, depression, and bipolar disorder, as well as risky behaviors such as suicide attempts (12, 13). These studies suggest its association with common pathogenesis involving various mental disorders. However, there is no definite opinion regarding the role of inflammation in the etiology of mental disorders. Thomas et al. (2021) showed that peripheral inflammation might cause structural changes in corticolimbic white matter pathways (14). Corticolimbic functions are significantly associated with impulsivity and persistent psychiatric symptoms that characterize many mental disorders (15, 16). Moreover, it has been known for a long time that streptococcal infection is related to autoimmune neuropsychiatric disorders in which impulse control is mainly impaired (such as attention-deficit/hyperactivity disorder, obsessive-compulsive disorder or tic disorder) (17). Studies that support the association of inflammation with impulsivity

are increasing (18-20).

"Impulsivity is the tendency to act prematurely without foresight" (21). The Diagnostic and Statistical Manual of Mental Disorders defines impulsivity as one of the main symptoms of several mental disorders (22). Increased impulsivity is associated with a disordered eating attitude (23), decreased compliance to treatment (24), and quality of life (25). Impulsivity can lead to unhealthy behaviors such as smoking, drinking alcohol. Therefore, inflammation in rheumatoid arthritis may be related to impulsivity and, consequently, a poor diet, poor adherence to medical treatment, and a worse prognosis.

Although it has long been reported that rheumatoid arthritis patients may have impulse control problems (26), there have not been enough studies in this field. Nevertheless, it has been reported that substance use disorders (27), self-harm (28), and suicide attempts (29) are common in rheumatoid arthritis patients. All these findings indicate that rheumatoid arthritis patients may have impulse control problems. Therefore, studies evaluating impulsivity in rheumatoid arthritis patients are needed.

This study aimed to examine the impulsive features with self-report scales in RF + and RF- rheumatoid arthritis patients and evaluate the relationship between impulsivity and inflammation. Researching the potential role of impulsivity in the psychopathology of rheumatoid arthritis may shed light on the disease's prognosis.

Material and Method

This study was conducted as a single-center cross sectional study at Uşak Training and Research Hospital Rheumatology Outpatient Clinic between May 2022 - September 2022. The procedure was approved by the Uşak University Medical Ethics Committee for Clinical Studies (82-82-06).

Participants

A total of fifty-two patients with rheumatoid arthritis were included. For the purposes of this study, two groups were formed according to their RF status: the patients with RF + and RF -. The inclusion criteria were: rheumatoid arthritis diagnosis according to 2010 ACR diagnosis criteria (30), and 18 to 70 years of age and , being able to speak, read, and write in Turkish . The exclusion criteria were as follows: having a rheumatologic disease other than rheumatoid arthritis and fibromyalgia syndrome, previous psychiatric

admission or psychotropic use, having a physical or neurological illness that prevents participants from completing the self-report scales.

Measures

We documented the sociodemographic features as sex, age, occupation, academic level, clinical characteristics, rheumatoid arthritis-related features, and blood test results (erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) as inflammation biomarker and RF, a common autoantibody, for grouping participants). Blood was collected for standard hematological testing in the morning, before the meal. A rheumatologist examined the joints and calculated the participants Disease Activity Score-28 (DAS-28) to measure the severity of rheumatoid arthritis disease activity (31). The DAS-28 score was determined considering the number of swollen and painful joints, patient global health score, and ESR values. Higher scores suggest a higher disease activity level.

Self-report inventory scales were given to all participants:

Barratt Impulsiveness Scale

We used Barratt Impulsiveness Scale (BIS) to assess all participants' impulsivity severity (32). BIS is a 30-item self-report scale with 0 to 90 total potential scores. Higher scores suggest a more impulsive personality construct. Güleç et al. (2008) conducted the Turkish translation's validity and reliability (33).

Beck Anxiety Inventory

We used Beck Anxiety Inventory (BAI) to assess all participants' anxiety symptom severity (34). BAI is a self-report scale with 21 items. Higher scores suggest more severe anxiety symptoms. Ulusoy et al. (1998) evaluated the Turkish translation's validity and reliability (35).

Beck Depression Inventory

We used Beck Depression Inventory (BDI) to assess all participants' levels of depression symptoms (36). BDI is a self-report scale with 21 items. Higher scores suggest more severe depressive symptoms. Hisli et al. (1988) conducted the Turkish translation's validity and reliability (37).

Morisky Medication Adherence Scale

Morisky Medication Adherence Scale (MMAS) was used to measure medication adherence and was developed by Morisky et al. (2008) (38). It is an 8-item

self-report scale with 0 to 8 total potential scores. Higher scores suggest a higher level of medication adherence. Aşilar et al. (2014) conducted the Turkish translation's validity and reliability (39).

Intuitive Eating Scale-2

Intuitive Eating Scale-2 (IES-2) was used to assess the adaptive eating habits of the participants (40). It is a five-point Likert-type self-report scale consisting of 23 items. Each item is scored between 1 and 5, and the total score obtained from the scale is divided by the number of related items. Higher scores indicate the presence of intuitive eating and more positive eating habits. IES-2 total scores are negatively correlated with impulsivity (41). Bas et al. (2017) conducted the Turkish translation's validity and reliability (42). In this study, IES-2 was used to evaluate the effect of impulsivity on eating attitudes that may be important for the course of the disease.

Health Assessment Questionnaire HAQ

Health Assessment Questionnaire (HAQ) was used to measure the functional status of the participants (43). HAQ is a 20-item self-report scale. Each item is scored between 0 to 3. Kucukdeveci et al. (2004) conducted the Turkish translation's validity and reliability (44).

Statistical Analysis

We used SPSS Statistics 23.0 to examine the data. The normal distribution was assessed using the Kolmogorov-Smirnov test, the Shapiro-Wilk test, and histograms. We used mean, standard deviation, and median to express descriptive statistics, percentages for categorical variables, and minimum and maximum values for continuous variables. Data from two groups were compared using Mann-Whitney U tests. The Chi-square test was performed to compare categorical variables between the groups. The Spearman test was used to examine the correlation coefficients for the relationships between the variables. This study's statistical significance threshold was established at 5% ($p < .05$).

Results

Clinical and demographic features of the patients

Age (mean \pm standard deviation: 45.7 ± 12.8 and 48.4 ± 11.6 respectively; $U=283.0$, $p= .384$) and education level (mean \pm standard deviation: 9.32 ± 4.2 and 10.2 ± 3.7 respectively; $U=279.0$, $p= .434$) were statistically similar across the two groups (RF- and RF+). Furthermore, there was no significant difference among the groups

regarding sex or occupation. Table 1 summarizes the demographic features of the groups.

Table 1. Sociodemographic characteristics of the RF+, and RF- groups

	Total (n: 52) n (100%)	RF - (n: 22) n (42%)	RF + (n: 30) n (58%)	χ ²	p*
Sex				.057	.812
Male	11 (21%)	5 (23 %)	6 (20%)		
Female	41 (79%)	17 (77 %)	24 (80%)		
Occupation				2.316	.314
Student	1 (2%)	1 (5%)	0 (0%)		
Employed	9 (17%)	5 (23%)	4 (13%)		
Unemployed	42 (81%)	16 (73%)	26 (87%)		
Years of education				2.916	.233
≤ 8 years	21 (41%)	12 (55 %)	9 (31%)		
9-12 years	16 (31%)	5 (23 %)	11 (38%)		
> 12 years	14 (27%)	5 (23%)	9 (31%)		

Note: Significant p values are marked in bold.
* Chi-square test for the comparison between study groups.

Table 2 represents the clinical feature of the patients with rheumatoid arthritis. Except for smoking, Clinical characteristics did not significantly differ across the groups. The smoking rate was higher in the RF+ group than RF- group. The two groups were statistically similar regarding rheumatoid arthritis-related features. There were joint deformities in six participants (20%) in the RF+ group and five (23%) in the RF- group.

Table 2. Clinical characteristics and rheumatoid arthritis related features of the RF+, and RF- groups

	Total (n: 52)	RF - (n: 22)	RF + (n: 30)	χ ²	U	p
Clinical characteristics, n (%)						
Physical disease	24 (46%)	11 (50%)	13 (43%)	.227		.634*
Fibromyalgia syndrome	3 (6%)	2 (9%)	1 (3%)	.774		.567*
Smoking	18 (35%)	4 (18%)	14 (47%)	4.550		.033*
Operation history	26 (50%)	14 (64%)	12 (40%)	2.836		.092*
Family history of RA	8 (15%)	3 (14%)	5 (17%)	.090		.765*
RA-related features, Md (m-M;IQR)						
Age at first diagnosis	39(14-62;21)	39(14-62;22)	39(16-62;21)		296.0	.528†
Duration of RA (year)	8 (1-37;8)	7 (1-27;8)	8.5 (1-37;9)		306.0	.656†
HAQ	0.3(0.0-2.4;.52)	0.3(0.0-2.4;0.5)	0.3(0.0-1.7;0.5)		303.5	.622†

DAS 28	2.9 (1.3-4.9;1.2)	2.8 (1.4-4.9;0.9)	2.9 (1.3-4.8;1.9)	312.5	.746†
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Note: Significant p values are marked in bold.
Abbreviations: RF, Rheumatoid Factor; RA, Rheumatoid Arthritis; HAQ, Health Assessment Questionnaire; DAS-28, Disease Activity Score -28
*Chi-square test for the comparison between study groups.
† Mann-Whitney U test for the comparison between study groups.

Comparison of scores linked to impulsivity, depression, anxiety, medication adherence and adaptive eating habits between RF +, and RF - groups

Table 3 shows depression, impulsivity features and anxiety-related clinical scores for all participants. The BIS overall scores of the RF+ group were higher than the RF- group. However, the two groups were statistically similar concerning IES-2, MMAS, BDI and BAI total scores.

Table 3. Comparison of depression, anxiety, IES-2, MMAS and impulsivity scores between the RF+, and RF- groups

	RF - (n:22) Mean (SD) Md (m-M);	RF+ (n:30) Mean (SD) Md (m-M);	U	p*
BDI	13 (10) 13 (1-42)	14 (9) 12 (0-43)	314.5	.774
BAI	20 (14) 16 (1-40)	19 (12) 18 (1-46)	323.5	.904
BIS				
Non-planning	23 (6) 21 (14-35)	25 (5) 25 (15-34)	255.5	.166
Motor	18 (4) 17 (12-27)	20 (4) 21 (14-30)	235.5	.079
Attentional	15 (4) 13 (9-23)	15 (3) 15 (10-21)	294.5	.508
Total	56 (11) 54 (43-85)	59 (7) 59(39-70)	219.0	.039
IES-2	3.4 (0.5) 3.5 (1.9-4.0)	3.6 (0.4) 3.7 (2.5-4.2)	249.5	.186
MMAS	5 (2) 5 (0-8)	5 (2) 5 (0-8)	304.0	.626

Note: Significant p values are marked in bold.
Abbreviations: BDI, Beck Depression Inventory; BAI, Beck Anxiety Inventory; BIS, Barratt Impulsiveness Scale-11; IES-2, Intuitive Eating Scale-2; MMAS, Morisky Medication Adherence Scale; m, minimum; M, maximum; Md, Median; SD, Standard Deviation.
*: Mann-Whitney U Test.

Relationship between the inflammation biomarkers and impulsivity in RF+ and RF- groups

Table 4 displays the findings of the correlation analysis between the inflammation biomarkers (ESR and CRP) and impulsivity in RF+ and RF- groups. Higher attentional impulsivity correlated with higher CRP levels in RF+ group. However there was no correlation between inflammation markers and impulsivity scores with BIS in RF- group.

Discussion and Conclusion

This study focused on examining the impulsive features with self-report scales in RF + and RF- rheumatoid arthritis patients. For the objectives of this study, patients with rheumatoid arthritis were split into RF+ and RF- groups.

Table 4. Correlation analysis between the scores on the inflammation biomarkers and impulsivity in RF+ and RF- groups.

Variable			1	2	3	4	5	6
1.	BIS	r		.281	.373	.771	.048	.059
	Non-planning	p		.205	.088	<.001	.830	.796
2.	BIS	r	.052		.435	.714	-.400	-.286
	Motor	p	.787		.043	<.001	.065	.197
3.	BIS	r	.358	-.051		.686	-.339	-.184
	Attentional	p	.052	.789		<.001	.122	.411
4.	BIS	r	.788	.473	.593		-.254	-.182
	Total	p	<.001	.008	<.001		.255	.417
5.	ESR	r	.005	-.133	.339	.176		.314
		p	.978	.485	.067	.351		.155
6.	CRP	r	-.034	-.021	.415	.083	.538	
		p	.856	.910	.023	.663	.002	

Abbreviations: BIS, Barratt Impulsivity Scale; ESR: Erythrocyte Sedimentation Rate; CRP: C-Reactive Protein; r: Correlation Coefficient. The correlation coefficients for the relationships between the variables were examined using the Spearman test. Correlations are reported for the RF+ (below) and the RF- group (above).

RF+ patients had higher impulsivity scores of BIS than RF- patients, consistent with the study's hypothesis.

The clinical and demographic features of the participants in the groups were statistically comparable, with the exception of smoking. Consistent with this study, previous studies also found that RF positivity was associated with smoking frequency (45). Moreover, smoking has been linked to elevated levels of pro-inflammatory cytokines (46). Besides that, it is a common finding of many studies that smoking frequency is associated with impulsivity (47-49). As a result, smoking may be the primary cause of inflammation, or it may be the outcome of impulsivity provoked by inflammatory processes. Although the cause and effect relationship is not fully known, treatments for high impulsivity detected in RF+ patients will be useful for preventing behaviors that may adversely affect the prognosis of the disease, such as smoking.

Depression and anxiety disorders are more common in rheumatoid arthritis patients than in the general population (50). Different factors may cause these psychological symptoms in rheumatoid arthritis. Socioeconomic factors (such as income, education, etc.), patient-related factors (such as gender, age, etc.), and disease-related factors (such as disease activity, pain, etc.) are the main factors in the emergence of mental symptoms (51). Moreover, it has been shown that inflammation is associated with higher severity of depression and anxiety (52). This study found no significant relationship between RF positivity and depression or anxiety symptoms in rheumatoid arthritis patients. RF may not be the primary biologic marker predicting depression or anxiety symptoms in rheumatoid arthritis patients. The findings need to be

replicated in studies with larger samples. In addition, it is known that the severity of depression and anxiety symptoms can affect impulsivity characteristics (53). The fact that both groups had similar severity of anxiety and depression made it easier to compare the groups in their impulsivity in this study.

Seronegative and positive rheumatoid arthritis have different genetic and environmental backgrounds, disease presentations, and treatment response levels (54). Therefore, it is thought that both groups refer to different entities (7). It has been reported that RF + is associated with a more severe, more erosive phenotype and extra-articular manifestations (45). Furthermore, it has been reported that RF may be an essential marker regarding psychiatric symptoms in rheumatoid arthritis patients (8). RF - is found to be related to higher emotion expression than RF + (8). Besides, this study indicates that RF + patients had higher impulsivity scores of BIS than RF- patients. It can be concluded that RF+ patients are more impulsive and may have difficulty expressing emotions. Consistent with these findings, it has been shown that there is a correlation between impulsivity, and emotion recognition difficulties (55). Moreover, impulsivity, emotion recognition, and expression difficulties were associated with impulse control problems such as binge drinking (55). This study shows the relationship between RF +and impulsivity. However, further studies are needed to evaluate the relationship between seropositivity and increased impulsivity dimensions. It will be important to investigate the impulsivity characteristics determined by behavioral impulsivity tasks in future studies.

Previous studies have shown that the RF + group had cognitive impairment according to MoCA (Montreal

Cognitive Assessment) than the RF- group (11). In this study, it was shown that there was a correlation between CRP, an inflammation biomarker, and attention impulsivity scores in the RF+ group. All these findings suggest that RF+ patients may experience impairment in areas related to attention and memory during the inflammation process. Furthermore, an increasing number of research have been published demonstrating that inflammation is connected with cognitive impulsivity (19, 20). Further studies on the etiology of attentional impulsivity in RF+ patients and its relationship with inflammation are needed.

This study found no statistical relationship between RF positivity and treatment compliance. In this study, the impulsivity dimension that increased in the inflammation RF+ group was attentional impulsivity. In a previous study using the BIS in HIV patients, non-planning impulsivity was shown to be associated with treatment adherence (56). In this study, the fact that there was no change in the non-planning impulsivity dimension between the groups may have caused the lack of difference in terms of treatment adherence. Furthermore, this study found no statistical relationship between RF positivity, and eating behaviors. These results indicate that impulsivity, which was shown to be increased in RF+ patients, did not affect eating attitudes and treatment compliance in rheumatoid arthritis. Moreover, this may also be related to the scales' limitations. The IES-2 focuses on adaptive types of eating behaviors. In future studies, it may be helpful to use scales that evaluate pathological eating behaviors that may be associated with impulse control problems.

In conclusion, the study findings showed a relationship between RF positivity and impulsivity with BIS in patients with rheumatoid arthritis. Recognition and management of behaviors associated with impulsivity may benefit those with RF positivity. More study is required to evaluate the different characteristics of impulsivity and their effect on prognosis in rheumatoid arthritis.

Limitations

This study has several limitations. Firstly, this study has a limitation since it is a cross-sectional design. This prevents the establishment of a cause-and-effect link between the findings. There is a need for future studies with follow-up periods. Secondly, the statistical significance of some comparisons may be constrained by the small sample sizes in the groups. Replicating

the study findings with bigger samples will overcome these limitations. Thirdly, no structured clinical interview was used to exclude mental disorders. Nevertheless, the exclusion of those diagnosed with mental illness provided a more homogeneous study sample. Fourthly, it has been reported that ESR and CRP values, which are biomarkers used to evaluate inflammation in this study, may not be entirely reliable (57). It would be beneficial to repeat the study findings by developing better biomarker panels to assess inflammatory activity. Fifthly, treatments used by the participants were not taken into account can be considered another limitation of the study. Further studies with drug naive patients are needed to confirm our findings. Sixthly, diseases other than rheumatologic diseases that could lead to RF positivity were not excluded. Nevertheless, the exclusion of other rheumatologic diseases in this study enabled the exclusion of most of the other causes of RF positivity. Lastly, in this study, impulsivity was assessed using a self-report measure. Another gap in the literature will be covered by studies that assess impulsivity with behavioral tasks.

Statements and Declarations

Competing Interests

The author declares no potential conflicts of interest concerning this article's research, authorship, or publication.

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Data Availability

The data sets generated during or analyzed during the current study are available from the corresponding author upon reasonable request.

Authors' Contributions

Both authors conceptualized and designed the study, collected the data, analysed and interpreted data, revised the manuscript, and approved the final manuscript as submitted.

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