EXTENDED REPORT

Determinants of happiness and quality of life in patients with rheumatoid arthritis: a structural equation modelling approach

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ABSTRACT

Objectives Besides increasing longevity, the ultimate goal of medical care is to improve patients' enjoyment of life, a concept akin to happiness. This study examined the determinants of happiness and quality of life (QoL) in patients with rheumatoid arthritis (RA).

Methods In this observational, cross-sectional study, patients were assessed on disease activity, disease impact, personality, QoL and happiness. Structural equation modelling estimation was used to analyse the associations between these dimensions, pursuing three hypotheses: H_1—disease activity and perceived impact of disease are negatively associated with overall QoL and happiness in patients with RA; H_2—'positive' personality traits are related to happiness both directly and indirectly through perceived disease impact; H_3—happiness has a mediating effect in the relation between impact of disease and QoL.

Results Data from 213 patients were analysed. Results supported all driving hypotheses. Happiness was positively related to 'positive' personality and, to a lesser extent, negatively related to impact of disease. Impact of disease, in turn, was positively related to disease activity and mitigated by 'positive' personality traits. Impact of disease had a much stronger relation with QoL than with happiness. Happiness mitigated the negative effect of disease impact on QoL.

Conclusion Optimisation of QoL and happiness of people with RA requires effective control of the disease process and also improvement of the disease impact domains. Personality seems to play a pivotal mediating role in these relations.

INTRODUCTION

The current paradigm for the management of rheumatoid arthritis (RA), in both clinical and research settings, is epitomised by the treat-to-target strategy[1 2] which establishes that the target of remission, or at least low disease activity, should be pursued and achieved as early and consistently as possible. This target is defined essentially by measures designed to gauge the disease process: number of tender and swollen joints and acute phase reactants supplemented by the patient's and physician's global impression of disease activity.[3] The incorporation of patient-reported outcomes (PROs), designed to provide the patient's perspective of the disease[4–9] into clinical practice and research, is widely supported by international organisations and professional groups.[2 4 10]

Many studies have shown that the control of inflammation through immunosuppressive therapy has a markedly positive impact on PROs: controlling the disease process is, undoubtedly, as important to prevent long-term damage as to improve patients' quality of life (QoL).[2 4–6 11 12] Despite this, a sizeable proportion of patients with RA who are in remission still describe a high impact of disease[13 14] and reduced QoL.[15]

Our group has recently highlighted this view by proposing that the management of RA should pursue two different targets: disease process remission and disease impact control.[13 14] Controlling the disease impact, in terms of quality and duration of life, are the final objectives of disease management, while controlling the disease process should be seen as an important means to that end, but not a guarantee.

Within this perspective, the concept of overall subjective well-being, equivalent to 'happiness', emerges as a decisive goal as well ('the ultimate currency').[16–18] All healthcare professionals know patients who lead a reasonably happy and fulfilling life despite aggressive disease, while others seem to succumb to the diagnosis. Understanding the main determinants of happiness in patients with rheumatic diseases and exploring the potential avenues to maximise it is, in this light, an ethical obligation. Curing or controlling disease is, certainly, an essential contribution, but we need to understand how far disease control can go towards happiness and whether health professionals may contribute to that goal beyond disease control.

Happiness includes different aspects of life such as life satisfaction, healthy interpersonal relationships, personal growth and appreciation of nature, beauty and other people, resulting in a global predominance of positive emotions over negative ones.[16 17] QoL is more focused on physical functioning and negative mental aspects, such as depressed mood and anxiety.[18 19] Happiness is, therefore, a broader concept than QoL, as it goes beyond the ability to do things and incorporates the satisfaction of doing them, that is, the enjoyment of life as a whole.[18 19] Personality is recognised as a key factor in predicting happiness,[16 20 21] as it provides the context in which the roots of happiness operate.[22] Although happiness levels may be

negatively influenced by the experience of living with a disease, especially if it has a chronic course and causes a marked impairment in daily functioning, several studies in this area have also demonstrated that happiness may have a positive impact on physical health and longevity. This has been mostly attributed to its effect on the perception of impact disease and on the engagement in health-related behaviours.[18]

Based on the previous literature, this study was designed to address the following hypotheses in patients with RA:

- H_1—Disease activity and perceived impact of disease are negatively associated to overall QoL and happiness;
- H_2—'Positive' personality traits are related with happiness, both directly and indirectly through perceived disease impact;
- H_3—Happiness has a mediating effect in the relation between impact of disease and QoL.

METHODS

Participants and study design

We used data from an observational, cross-sectional study, performed in a single rheumatology outpatient department,[14] that aimed at exploring the determinants of patient global assessment. The study included consecutive adult patients with RA[23 24] who (1) were followed and treated according to standard guidelines, (2) had the ability to read and interpret the questionnaires applied, and (3) agreed to participate. The current analysis included data from patients who answered all measurements required.

All participants provided informed written consent before the start of study procedures, and the ethical approval was granted by the University of Coimbra's Faculty of Medicine Ethics Committee (CEU 037/2015).

Measures/instruments

Data collection included the Rheumatoid Arthritis Impact of Disease score,[25 26] which is composed of seven items rated on a 10-point numeric rating scale. A higher score indicates greater impact of the disease. Happiness was assessed through the Subjective Happiness Scale (SHS),[27] a four-item measure (seven-point Likert scale). A higher mean score indicates more intense perception of a 'happy life'. Personality was assessed by the Ten-Item Personality Inventory (TIPI),[28] a brief measure of the Big-Five personality dimensions, each being scored as the mean of two items (seven-point Likert scale) addressing extraversion, agreeableness, conscientiousness, emotional stability and openness to experience. Higher scores indicate a stronger expression of the respective trait. We designated the latent higher order factor derived from TIPI as 'Positive' personality to represent the predominantly adaptive nature of the represented dimensions. We recognise that the term 'positive' is questionable especially in the extremes of expression of certain traits, such as conscientiousness. Health-related QoL was accessed by the EuroQOL (EQ-5D) questionnaire, which includes five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression). Each dimension has three levels: no problems, some problems and extreme problems. The combination of the five scores leads to an index score between −0.59 and 1.00.[29] Higher scores indicate a best perceived health status and QoL.

Disease activity was measured with the Disease Activity Score 28 joints (DAS28), in its three variables (3v) and C reactive protein (CRP) variant—DAS28CRP(3v).[30]

For patient's characterisation, demographic data, disease characteristics, comorbidities and current treatment were collected.

Data analysis

Descriptive and correlational analyses were performed with SPSS V.23 (IBM). Pearson correlation analyses were conducted to examine the associations between disease activity, measures of disease impact, personality traits, QoL and happiness and interpreted as small (0.10 to 0.30), moderate (0.30 to 0.50) or large (>0.50).[31]

Structural equation modelling (SEM, latent variable structural model) was used to estimate the association between the variables under analysis in the theoretical model and performed with AMOS V.24.0 (IBM SPSS, Chicago, Illinois, USA), using a maximum-likelihood estimation. SEM defines latent variables (summary constructs) from one or more observed variables and examines in a structured way models specifying relationships between these latent variables.

Prior to this analysis, the assumptions of normality and multicollinearity were confirmed. Skewness values ranged from −0.93 to 0.98, while values of kurtosis ranged from –1.1 to 1.29, indicating no violation of univariate and multivariate normality.[32] Variance inflation factor values were below 5 for all variables included in the model, excluding multicollinearity as an issue.

As recommended, different goodness-of-fit indices were used to estimate the model fit, namely (1) the χ^2, (2) the Comparative-of-Fit Index (CFI), (3) the Goodness-of-Fit Index (GFI), (4) the Tucker-Lewis Index (TLI) and (5) the root mean square error of approximation (RMSEA). A good fit of the models was assumed when the ratio of χ^2 to its df was less than 3.0 and CFI, GFI and TLI were larger than 0.90[33]; RMSEA values <0.06 were considered ideal and values between 0.08 and 0.10 were considered acceptable.[34]

Four covariances were entered in the measurement model following modification indices examination/analysis.

The examination of the structural model included a test of the overall model fit as well as individual tests of the relationships among latent constructs. Statistically significant effects were assumed for $P < 0.05$. Other paths with theoretical and clinical plausibility were also tested (DAS28CRP3v→happiness; 'positive' personality→QoL). Non-significant paths were excluded, and the initially proposed model was readjusted accordingly. Furthermore, the bootstrap resampling method, with 700 bootstrap samples and 95% bias-corrected CIs around the standardised estimates of total, direct and indirect effects, was used to test the significance of the mediational path.[35]

To address the potential bias due to missing data, we tested a model-based missing data method (full information maximum-likelihood), which did not show significant differences. In the end, we preferred to use only truly obtained data.

RESULTS

Patient characteristics

This study included 213 of the original sample of 309 patients with RA due to missing data. Baseline demographic and clinical characteristics of patients are presented in table 1. Participants were aged between 27 and 88 (M=57.8) years and had a mean disease duration of 11.8 years. Around one-third (n=69, 32.4%) of patients had no identified comorbidities. The mean DAS28CRP3v was 2.48, with 59.6% (n=127) of patients being in remission according to this index.

Table 1 Demographic and clinical characteristics of 213 patients with RA

Variables	Scores
Age, years, mean (SD)	57.8 (13.2)
Female gender, n (%)	172 (80.8)
Disease duration, years, mean (SD)	11.8 (8.9)
Rheumatoid factor positive, n (%)*	154 (72.3)
Anticitrullinated antibody positive, n (%)*	101 (70.6)
Comorbidities, yes, n (%)	
Fibromyalgia*	35 (16.4)
Depression*	38 (17.8)
Low back pain*	40 (18.8)
Osteoporotic fractures*	16 (7.5)
Osteoarthritis*	108 (50.7)
Stroke*	4 (1.9)
Current treatment with biologic agents, n (%)	66 (31)
Tender joint counts using 28 joints (0–28), mean (SD)	1.52 (3.2)
Swollen joint counts using 28 joints (0–28), mean (SD)	1.46 (2.7)
C reactive protein, CRP (mg/dL), mean (SD)	0.81 (1.4)
Disease Activity, DAS28CRP3v (0–9.4), mean (SD)	2.48 (0.93)
Remission, n (%)	127 (59.6)
Low, n (%)	49 (23)
Moderate, n (%)	34 (16)
High, n (%)	3 (1.4)
Physician global assessment (VAS, 0–100), mean (SD)	14.2 (15. 9)
Patient global assessment (VAS, 0–100), mean (SD)	47.5 (28.6)
Rheumatoid Arthritis Impact of Disease (0–10), mean (SD)	
Pain	4.8 (2.5)
Functional disability	4.9 (2.6)
Fatigue	5.1 (2.7)
Emotional well-being	4.6 (2.7)
Sleep	4.4 (2.9)
Coping	4.2 (2.7)
Physical well-being	4.9 (2.5)
EuroQOL five dimensions (–0.59 to 1), mean (SD)	0.43 (0.26)
Subjective Happiness Scale (1–7), mean (SD)	4.8 (1.3)
Ten-Item Personality Inventory (1–7), mean (SD)	
Extraversion	4.1 (1.5)
Agreeableness	5.7 (1.3)
Conscientiousness	5.6 (1.3)
Emotional stability	3.7 (1.5)
Openness to experience	4.4 (1.5)

*Percentages of patients with missing data were <2.8%, except for ACPA (32.8%) and erosions (18.8%), fibromyalgia (7%), depression (7.5%), low back pain (10.3%), osteoporotic fractures (19.7%), osteoarthritis (8.9%) and stroke (8.5%).

Correlation coefficients

Pearson correlation coefficients for the measured variables are presented in table 2.

As expected, QoL was found to be strongly and inversely correlated with impact of disease.

The personality traits extraversion, emotional stability and openness to experience were associated, with low correlations, with QoL and with virtually all aspects of impact of disease. Openness to experience was not associated with sleep. All happiness items except item 4 presented moderate positive correlations, with QoL; low to moderate positive correlations with all personality traits, except for agreeableness (not significant at SHS 1 and 3); and negative correlations, with impact of disease. Finally, DAS28CRP3v showed moderate associations with impact of disease (positive correlation) and QoL (negative correlations), low correlations with happiness and no significant correlations with each personality trait.

The fourth question of SHS (which was a complex item with a negative formulation and reversed scoring) showed a totally discordant profile vis-a-vis the other three (ie, harming internal consistency of the SHS). For this reason, this question was not included in the happiness construct when we performed the structural equations model, as technically recommended.[34]

Structural equation modelling

The overall fit of the final measurement model was good, thus permitting the examination of the structural model ($\chi^2_{(111)}$=154.22, χ^2/df=1.38, P=0.004; CFI=0.98; GFI=0.92; TLI=0.97; RMSEA=0.04, 95% CI 0.02 to 0.05). Although the χ^2 statistic was significant (P<0.05), its ratio regarding the df was within the accepted range (χ^2/df <3).[33]

The direct path coefficients for the model are shown in table 3 and figure 1. The bootstrap indirect effects are shown in table 4.

H_1—*Disease activity and perceived impact of disease are negatively associated to overall QoL and happiness in patients with RA.*

Impact of disease showed a significant negative direct relation with QoL (β=−0.70; P<0.001) and happiness (β=−0.17; P=0.02). Impact of disease was higher with higher disease activity (DAS28CRP3v) (β=0.36; P<0.001) (table 3 and figure 1).

Moreover, disease activity had also a negative indirect effect of −0.26 (P=0.003) on QoL, through the perception of impact of disease (table 4).

H_2—*'Positive' personality traits are related with happiness, both directly and indirectly through perceived disease impact.*

'Positive' personality traits had a total effect of 0.56 on happiness, being a direct effect of β=0.50 (P<0.001) and an indirect effect of β=0.06 (P=0.03) through impact of disease.

'Positive' personality traits showed also a negative direct relation with impact of disease (β=−0.37; P<0.001), and an indirect effect of β=0.33 (P=0.004) on QoL, through the impact of disease (tables 3 and 4 and figure 1).

'Positive' personality and disease activity explained 27% of the variance of impact of disease (R^2=0.27) (figure 1).

H_3—*Happiness has a mediating effect in the relation between impact of disease and QoL.*

Impact of disease had a total effect of 0.72 on QoL, of which β=−0.02 (P=0.04) was an indirect effect through happiness, indicating a mediating influence between this relationship. Furthermore, there was a significant direct association between happiness and QoL (β=0.13; P=0.01) (tables 3 and 4 and figure 1).

Disease activity had a negative indirect effect of β=−0.06 (P=0.04) on happiness, through the perception of impact of disease (table 4).

Altogether, happiness and impact of disease explained 57% of the variance of QoL (R^2=0.57), and 35% of the variance of happiness (R^2=0.35) was explained by impact of disease and personality traits (figure 1).

DISCUSSION

This study provides a comprehensive model that illustrates the relationships between disease activity, impact of disease, personality traits, QoL and happiness in people with RA. Overall, the results show that happiness is related to a 'positive' personality and, to a small extent, to the perception of impact of disease. The latter was, in turn, positively related to disease activity and

Table 2 Pearson correlation coefficients among variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Impact of disease																				
Pain (1)	1.00																			
Functional disability (2)	0.82**	1.00																		
Fatigue (3)	0.76**	0.82**	1.00																	
Sleep (4)	0.66**	0.69**	0.71**	1.00																
Physical well-being (5)	0.75**	0.82**	0.84**	0.73**	1.00															
Emotional well-being (6)	0.71**	0.72**	0.77**	0.75**	0.85**	1.00														
Coping (7)	0.72**	0.74**	0.79**	0.70**	0.81**	0.80**	1.00													
RAID score (8)	0.89**	0.91**	0.91**	0.83**	0.92**	0.89**	0.89**	1.00												
Quality of life (9)	−0.60**	−0.69**	−0.68**	−0.59**	−0.69**	−0.64**	−0.63**	−0.73**	1.00											
Positive personality																				
Extraversion (10)	−0.18**	−0.20**	−0.23**	−0.20**	−0.21**	−0.19**	−0.24**	−0.23**	0.23**	1.00										
Agreeableness (11)	−0.03	−0.01	−0.03	−0.10	−0.03	−0.14*	−0.10	−0.07	0.04	0.04	1.00									
Conscientiousness (12)	−0.01	−0.06	−0.08	−0.15*	−0.07	−0.15*	−0.12	−0.1	0.10	0.28**	0.40**	1.00								
Emotional stability (13)	−0.21**	−0.26**	−0.29**	−0.29**	−0.29**	−0.35**	−0.25**	−0.31**	0.25**	0.32**	0.20**	0.21**	1.00							
Openness to experience (14)	−0.16*	−0.21**	−0.27**	−0.11	−0.21**	−0.18**	−0.24**	−0.23**	0.15*	0.39**	0.18**	0.28**	0.21**	1.00						
Happiness																				
SHS 1 (15)	−0.22**	−0.21**	−0.28**	−0.29**	−0.25**	−0.32**	−0.29**	−30**	0.31**	0.36**	0.12	0.24**	0.32**	0.17*	1.00					
SHS 2 (16)	−0.26**	−0.23**	−0.31**	−0.30**	−0.30**	−0.33**	−0.32**	−0.33**	0.36**	0.33**	0.17*	0.28**	0.31**	0.23**	0.82**	1.00				
SHS 3 (17)	−0.26**	−0.18**	−0.28**	−0.25**	−0.29**	−0.31**	−0.32**	−0.30**	0.33**	0.39**	0.10	0.23**	0.31**	0.25**	0.58**	0.60**	1.00			
SHS 4 (18)	0.04	0.09	0.05	0.04	0.08	0.07	0.09	0.08	−0.07	−0.02	0.03	−0.01	−0.04	−0.05	0.04	0.02	0.09	1.00		
SHS three-item score (19)	−0.28**	−0.24**	−0.33**	−0.32**	−0.33**	−0.37**	−0.36**	−0.35**	0.38**	0.41**	0.15*	0.29**	0.36**	0.25**	0.90**	0.91**	0.84**	0.07	1.00	
DAS28CRP3v (20)	0.34**	0.35**	0.31**	0.32**	0.35**	0.30**	0.32**	0.37**	−0.34**	−0.001	−0.05	0.01	−0.11	0.01	−0.15*	−0.21**	−0.15*	0.09	−0.20**	1.00

DAS28CRP3v, DiseaseActivity Score using 28 joints and C reactive protein and three variables; RAID, Rheumatoid Arthritis Impact of Disease; SHS, Subjective Happiness Scale.
*P<0.05, ** P<0.001.

Table 3 Regression weights between structural parameters

	Unstandardised direct effects	Standardised direct effects	SE	Critical ratio	Significance level
Impact of disease←positive personality	−0.84	−0.37	0.19	−4.30	<0.001
Impact of disease←DAS28CRP3v	0.91	0.36	0.16	5.66	<0.001
Happiness←positive personality	0.59	0.50	0.12	4.81	<0.001
Happiness←impact of disease	−0.09	−0.17	0.03	−2.31	0.02
Coping←impact of disease	1.00	0.87			
Emotional well-being←impact of disease	1.01	0.90	0.05	18.99	<0.001
Physical well-being←impact of disease	1.00	0.94	0.04	21.09	<0.001
Sleep←impact of disease	0.98	0.80	0.06	15.23	<0.001
Fatigue←impact of disease	1.02	0.90	0.05	19.05	<0.001
Function disability←impact of disease	0.98	0.89	0.05	18.51	<0.001
Pain←impact of disease	0.88	0.82	0.05	15.84	<0.001
Extraversion←positive personality	1.00	0.67			
Agreeableness←positive personality	0.38	0.32	0.11	3.20	0.001
Conscientiousness←positive personality	0.55	0.46	0.11	5.02	<0.001
Emotional stability←positive personality	0.76	0.52	0.13	5.57	<0.001
Openness to experience←positive personality	0.77	0.54	0.13	5.68	<0.001
SHS 1←happiness	1.00	0.89			
SHS 2←happiness	1.08	0.92	0.06	15.95	<0.001
SHS 3←happiness	0.88	0.67	0.08	10.95	<0.001
Quality of life←impact of disease	−0.08	−0.70	0.01	−12.20	<0.001
Quality of life←happiness	0.03	0.13	0.01	2.44	0.014

Unstandardised direct effects come directly out of the estimation procedure. Due to the metric differences of the instruments, in this case, standardised direct effects should be preferred to indicate the strength of the associations (magnitude between −1 and +1). Higher absolute values indicate a stronger (positive or negative) association. An absolute critical ratio >1.96 reflects that path coefficients are significant at the 0.05 level.
DAS28CRP3v, Disease Activity Score using 28 joints and C reactive protein and three variables; SHS, Subjective Happiness Scale.

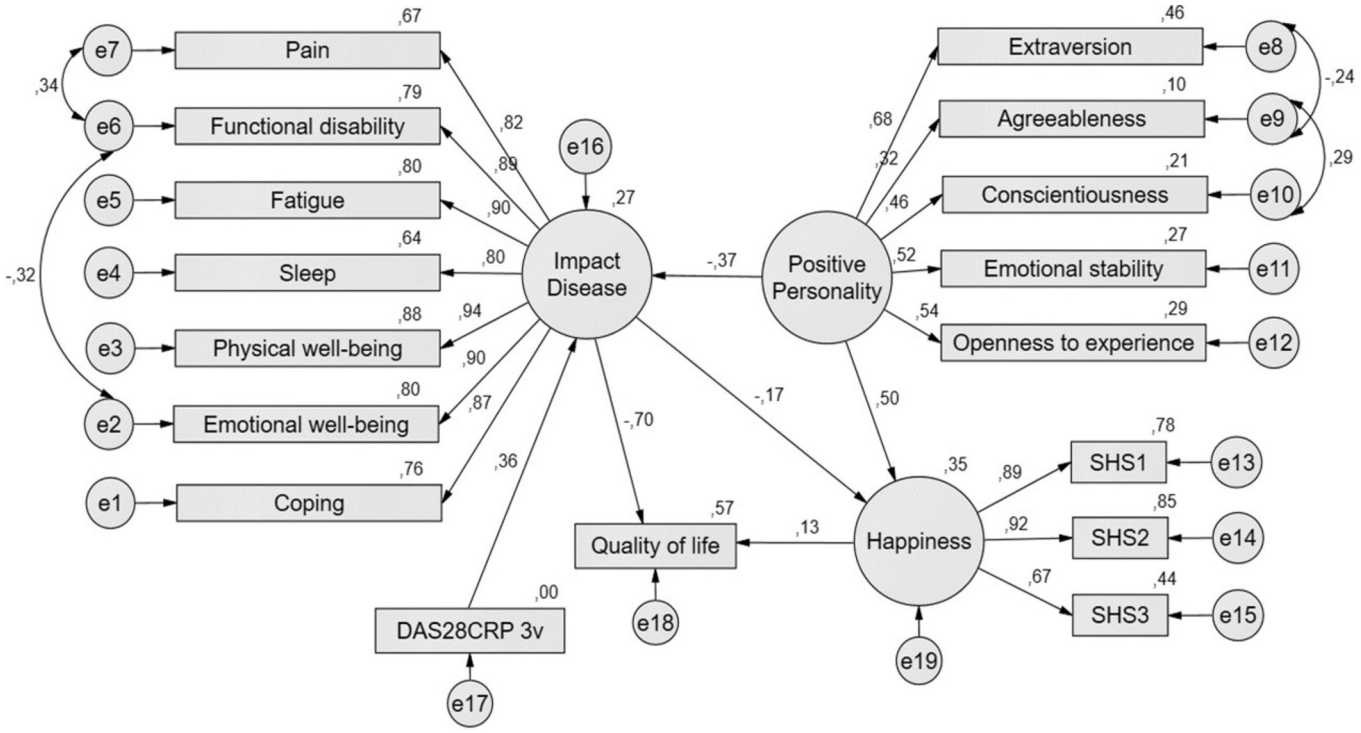

Figure 1 Estimated standardised direct effects for the proposed model. Circles represent latent factors. Squares represent measured variables (the scale scores). Arrows connecting circles and rectangles in one direction show a hypothesized direct relationship between the two variables. Curved lines with an arrow in both directions demonstrate a bi-directional relationship (covariance). Circles with the letter "e" written in it represent the associated error. DAS28CRP3v, Disease Activity Score using 28 joints and C-reactive protein and three variables; SHS, Subjective Happiness Scale.

Table 4 Bootstrap results for indirect effects between structural parameters

	Quality of life		Happiness	
	Estimates, SE	95% CI, significance level	Estimates, SE	95% CI, significance level
DAS28CRP3v	β=−0.26, 0.05	(−0.36 to −0.16), 0.003	β=−0.06, 0.03	(−0.13 to −0.01), 0.04
Positive personality	β=0.33, 0.06	(0.21 to 0.45), 0.004	β=0.06, 0.03	(0.01 to 0.14), 0.03
Impact of disease	β=−0.02, 0.01	(−0.06 to −0.001), 0.04	–	

Standardised indirect effects indicate the strength of the associations (magnitude between −1 and +1). Higher absolute values indicate a stronger (positive or negative) association.
DAS28CRP3v, Disease Activity Score using 28 joints and C reactive protein and three variables.

mitigated by 'positive' personality with very similar weights. Our findings also show that happiness mediates (and mitigates) the association between impact of disease and QoL. Impact of disease has a stronger relation with QoL than with happiness, further supporting the distinct nature of the latter two concepts.

Taken together, these findings imply important clinical implications. Assuming that the perceived impact of disease is, in itself, a valuable treatment target, the model suggests that healthcare professionals should consider personality traits while making the best efforts to control the disease process. In fact, disease activity and personality explained around 27% of the variance in perceived impact, with similar weights for each.

If quality of life is elected as a high-priority treatment objective,[8] the perceived impact of disease should be acknowledged as major determinant,[36 37] but, to a lesser extent, happiness should be considered an ameliorating factor as well. Happiness has been shown to be related to QoL[38 39] and to a variety of better health outcomes, also in a prospective study.[39]

If happiness is taken as the ultimate goal of disease management, the model suggests that personality traits are the most important determinants, with small influences of perceived impact of disease and QoL. The relationship between personality traits, most clearly extraversion, and happiness is well established in the literature.[16 20 21] Our results highlight that this association persists even in the presence of a severely impacting disease, such as RA. Four personality domains seem particularly important in this association: extraversion, emotional stability, conscientiousness and openness to experience. Multiple potential mechanisms may explain these associations: the ability to establish positive personal relationships,[40] to adopt positive attitudes in life's challenging events[41 42] and to accept novel attitudes and unaccustomed values[16] have all been shown to be important ingredients of happiness. It is easy to conceive that they become even more important when facing such a challenging health condition. According to our model, the disease activity control on happiness is indirect, through perceived disease impact, and accounts only for ∼6% of its variance.

Our results should be interpreted while taking into account some limitations. First, although the sample size and the diversity of patients' characteristics were satisfactory, the recruitment was performed in a single centre, which advises caution in results' generalisation. Second, this was a cross-sectional design, not allowing testing causal relationships: longitudinal studies are thus indispensable to further assess the associations suggested here. Third, although we have accessed the presence of some comorbidities, we did not use a validated index for that purpose. This precluded the inclusion of this variable in the statistical analyses, despite its potential confounder effect. Fourth, all variables of this study are also influenced by other factors, such as material wealth, occupation and loneliness, which were not accounted for in the present study, as it was focused on exploring the relevance of disease activity. Finally, the reader should take into account that the concepts of happiness and QoL herein should be interpreted according to the instruments used to define them.

In summary, our results indicate, in line with a substantial literature, that personality traits have a considerable influence on how impactful/disrupting patients perceive their disease to be, with decisive consequences on their QoL, and also on how happy they feel towards life. Taken together, our observations indicate that treatment strategies focused solely on the control of disease activity can be expected to have only a limited impact on QoL and a probably minor effect on happiness. Personality traits represent another realm of potential intervention towards minimising the effects of disease on patients' lives. They seem to be as important as disease control regarding QoL and more important than the disease process if happiness is taken as the ultimate goal. Fully gauging these dimensions would require a more detailed evaluation of patients and a wider scope of interventions than usually done in rheumatology practice.

This can only be attained by multidisciplinary teams working to optimise RA management through tight control of the disease process and also by exploring the full potential of interventions beyond immunosuppression. Within this context, appropriate pain control and non-pharmacological interventions, such as patient education, counselling and support[43 44] and occupational therapy,[45] deserve additional consideration. Interventions in the scope of the positive psychology movement, including 'third wave' cognitive–behavioural therapies designed to boost resilience factors such as acceptance, mindfulness, positive affect and happiness,[46 47] may be of paramount importance for the individual patient's global health and enjoyment of life.

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REFERENCES

1 Smolen JS, Breedveld FC, Burmester GR, *et al*. Treating rheumatoid arthritis to target: 2014 update of the recommendations of an international task force. *Ann Rheum Dis* 2016;75:3–15.
2 Smolen JS, Landewé R, Breedveld FC, *et al*. EULAR recommendations for the management of rheumatoid arthritis with synthetic and biological disease-modifying antirheumatic drugs: 2013 update. *Ann Rheum Dis* 2014;73:492–509.
3 Felson DT, Smolen JS, Wells G, *et al*. American College of Rheumatology/European League against Rheumatism provisional definition of remission in rheumatoid arthritis for clinical trials. *Ann Rheum Dis* 2011;70:404–13.
4 Boers M, Kirwan JR, Wells G, *et al*. Developing core outcome measurement sets for clinical trials: OMERACT filter 2.0. *J Clin Epidemiol* 2014;67:745–53.
5 Castrejón I, Pincus T. Patient self-report outcomes to guide a treat-to-target strategy in clinical trials and usual clinical care of rheumatoid arthritis. *Clin Exp Rheumatol* 2012;30(Suppl 73):S50–5.
6 Curtis JR, Shan Y, Harrold L, *et al*. Patient perspectives on achieving treat-to-target goals: a critical examination of patient-reported outcomes. *Arthritis Care Res* 2013;65:1707–12.
7 Desthieux C, Hermet A, Granger B, *et al*. Patient–physician discordance in global assessment in rheumatoid arthritis: a systematic literature review with meta-analysis. *Arthritis Care Res* 2016;68:1767–73.
8 Kilic L, Erden A, Bingham CO, *et al*. The reporting of patient-reported outcomes in studies of patients with rheumatoid arthritis: a systematic review of 250 articles. *J Rheumatol* 2016;43:1300–5.
9 Kirwan JR, Bartlett SJ, Beaton DE, *et al*. Updating the OMERACT filter: implications for patient-reported outcomes. *J Rheumatol* 2014;41:1011–5.
10 Nikiphorou E, Radner H, Chatzidionysiou K, *et al*. Patient global assessment in measuring disease activity in rheumatoid arthritis: a review of the literature. *Arthritis Res Ther* 2016;18:251.
11 Gossec L, Dougados M, Dixon W. Patient-reported outcomes as end points in clinical trials in rheumatoid arthritis. *RMD Open* 2015;1:e000019.
12 Overman CL, Jurgens MS, Bossema ER, *et al*. Change of psychological distress and physical disability in patients with rheumatoid arthritis over the last two decades. *Arthritis Care Res* 2014;66:671–8.
13 Ferreira RJO, Dougados M, Kirwan JR, *et al*. Drivers of patient global assessment in patients with rheumatoid arthritis who are close to remission: an analysis of 1588 patients. *Rheumatology* 2017;56:1573–8.
14 Ferreira RJO, Duarte C, Ndosi M, *et al*. Suppressing inflammation in rheumatoid arthritis: does patient global assessment blur the target? A practice-based call for a paradigm change. *Arthritis Care Res* 2018;70.
15 Matcham F, Scott IC, Rayner L, *et al*. The impact of rheumatoid arthritis on quality-of-life assessed using the SF-36: a systematic review and meta-analysis. *Semin Arthritis Rheum* 2014;44:123–30.
16 Bakhshipour B, Panahiyan S, Hasanzadeh R, *et al*. Relationship between personality traits and happiness in patients with thalassemia. *Zahedan J Res in Med Scien* 2014;16:28–32.
17 Argyle M. *The Psychology of happiness*. 2nd ed. New York: Routledge, 2001.
18 Angner E, Ray MN, Saag KG, *et al*. Health and happiness among older adults: a community-based study. *J Health Psychol* 2009;14:503–12.
19 Diener E, Pressman SD, Hunter J, *et al*. If, Why, and when subjective well-being influences health, and future needed research. *Appl Psychol Health Well Being* 2017;9:133–67.
20 DeNeve KM, Cooper H. The happy personality: a meta-analysis of 137 personality traits and subjective well-being. *Psychol Bull* 1998;124:197–229.
21 Cheng H, Furnham A. Personality, self-esteem, and demographic predictions of happiness and depression. *Pers Individ Dif* 2003;34:921–42.
22 Pishva N, Ghalehban M, Moradi A, *et al*. Personality and happiness. *Procedia—Social and Behavioral Sciences* 2011;30:429–32.
23 Arnett FC, Edworthy SM, Bloch DA, *et al*. The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. *Arthritis Rheum* 1988;31:315–24.
24 Aletaha D, Neogi T, Silman AJ, *et al*. 2010 Rheumatoid arthritis classification criteria: an American College of Rheumatology/European League Against Rheumatism collaborative initiative. *Arthritis Rheum* 2010;62:2569–81.
25 Gossec L, Paternotte S, Aanerud GJ, *et al*. Finalisation and validation of the rheumatoid arthritis impact of disease score, a patient-derived composite measure of impact of rheumatoid arthritis: a EULAR initiative. *Ann Rheum Dis* 2011;70:935–42.
26 Ferreira R, Gossec L, Hewlett S, *et al*. FRI0748-HPR Cross-cultural validation of the Portuguese "rheumatoid arthritis impact of disease" score: cross-sectional study. *Ann Rheum Dis* 2017;76(Suppl 2):1501–01.
27 Lyubomirsky S, Lepper HS. A measure of subjective happiness: preliminary reliability and construct validation. *Soc Indic Res* 1999;46:137–55.
28 Gosling SD, Rentfrow PJ, Swann WB. A very brief measure of the Big-Five personality domains. *J Res Pers* 2003;37:504–28.
29 Ferreira LN, Ferreira PL, Pereira LN, *et al*. EQ-5D Portuguese population norms. *Qual Life Res* 2014;23:425–30.
30 van der Heijde DM, van 't Hof M, van Riel PL, *et al*. Development of a disease activity score based on judgment in clinical practice by rheumatologists. *J Rheumatol* 1993;20:579–81.
31 Cohen J. *Statistical power analysis for the behavioral sciences*. 2nd ed. Hillsdale: Lawrence Earlbaum Associates, 1988.
32 Kline RB. *Principles and practice of structural equation modeling*. New York: The Guilford Press, 2005.
33 Hair J, Black WC, Babin B, *et al*. *Multivariate data analyses*. 6th ed. New York, NY: Prentice-Hall, 2005.
34 Byrne BM. *Structural equation modeling with AMOS: basic concepts, applications, and programming*. Mahwah: NJ: Lawrence Erlbaum Associates, 2000.
35 Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods* 2008;40:879–91.
36 Haroon N, Aggarwal A, Lawrence A, *et al*. Impact of rheumatoid arthritis on quality of life. *Mod Rheumatol* 2007;17:290–5.
37 Pollard L, Choy EH, Scott DL. The consequences of rheumatoid arthritis: quality of life measures in the individual patient. *Clin Exp Rheumatol* 2005;23(5 Suppl 39):S43–52.
38 Safdari S, Tarkhan M, Hatami G. Relationship of happiness and quality of life in patients with multiple sclerosis (MS) disorder. *J Appl Environ Biol Sci* 2013;3:35–8.
39 Siahpush M, Spittal M, Singh GK. Happiness and life satisfaction prospectively predict self-rated health, physical health, and the presence of limiting, long-term health conditions. *Am J Health Promot* 2008;23:18–26.
40 Chan R, Joseph S. Dimensions of personality, domains of aspiration, and subjective well-being. *Personality and Individual Differences* 2000;28:347–54.
41 Hayes N, Joseph S. Big 5 correlates of three measures of subjective well-being. *Pers Individ Dif* 2003;34:723–7.
42 Chioqueta AP, Stiles TC. Personality traits and the development of depression, hopelessness, and suicide ideation. *Pers Individ Dif* 2005;38:1283–91.
43 Cramp F, Hewlett S, Almeida C, *et al*. Non-pharmacological interventions for fatigue in rheumatoid arthritis. *Cochrane Database Syst Rev* 2013;8:Cd008322.
44 Vliet Vlieland TP, van den Ende CH. Nonpharmacological treatment of rheumatoid arthritis. *Curr Opin Rheumatol* 2011;23:259–64.
45 Steultjens EM, Dekker J, Bouter LM, *et al*. Occupational therapy for rheumatoid arthritis. *Cochrane Database Syst Rev* 2004;1:Cd003114.
46 Hayes SC, Villatte M, Levin M, *et al*. Open, aware, and active: contextual approaches as an emerging trend in the behavioral and cognitive therapies. *Annu Rev Clin Psychol* 2011;7:141–68.
47 Bolier L, Haverman M, Westerhof GJ, *et al*. Positive psychology interventions: a meta-analysis of randomized controlled studies. *BMC Public Health* 2013;13:119.