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ORIGINAL ARTICLE

Logistic regression models for predicting physical and mental health-related quality of life in rheumatoid arthritis patients

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Abstract The aim of this work was to develop two logistic regression models capable of predicting physical and mental health related quality of life (HRQOL) among rheumatoid arthritis (RA) patients. In this cross-sectional study which was conducted during 2006 in the outpatient rheumatology clinic of our university hospital, Short Form 36 (SF-36) was used for HRQOL measurements in 411 RA patients. A cutoff point to define poor versus good HRQOL was calculated using the first quartiles of SF-36 physical and mental component scores (33.4 and 36.8, respectively). Two distinct logistic regression models were used to derive predictive variables including demographic, clinical, and psychological factors. The sensitivity, specificity, and accuracy of each model were calculated. Poor physical HRQOL was positively associated with pain score, disease duration, monthly family income below 300 US$, comorbidity, patient global assessment of disease activity or PGA, and depression (odds ratios: 1.1; 1.004; 15.5; 1.1; 1.02; 2.08, respectively). The variables that entered into the poor mental HRQOL prediction model were monthly family income below 300 US$, comorbidity, PGA, and bodily pain (odds ratios: 6.7; 1.1; 1.01; 1.01, respectively). Optimal sensitivity and specificity were achieved at a cutoff point of 0.39 for the estimated probability of poor physical HRQOL and 0.18 for mental HRQOL. Sensitivity, specificity, and accuracy of the physical and mental models were 73.8, 87, 83.7% and 90.38, 70.36, 75.43%, respectively. The results show that the suggested models can be used to predict poor physical and mental HRQOL separately among RA patients using simple variables with acceptable accuracy. These models can be of use in the clinical decision-making of RA patients and to recognize patients with poor physical or mental HRQOL in advance, for better management.

Keywords Rheumatoid arthritis · Quality of life · Prediction model

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Introduction

Rheumatoid arthritis (RA) is a chronic disabling disease that affects approximately 1% of the adult population worldwide [1]. This illness is characterized by joint pain, stiffness, and deformity in different joints, particularly the hands and feet, resulting in irreversible joint deformities, physical disability, and functional impairment [2]. Annual indirect costs resulting from the disabilities experienced by the majority of RA patients within ten years of disease onset are estimated to be between 13 and 65 thousand US$ per patient [3].

The terms "quality of life" (QOL) and, more specifically, "health-related quality of life" (HRQOL) refer to the physical, psychological, and social domains of health, which are seen as distinct areas that are influenced by a person's experiences, beliefs, expectations, and perceptions [4]. Due to its chronic, progressive, and painful character, RA tends to have a detrimental effect on all aspects of

HRQOL [5, 6]. HRQOL issues are assuming increasing importance in chronic rheumatic diseases like RA [7]. In addition to patient education, psychosocial assessment, occupational and physical therapy, medications, and surgery, effective management of RA patients may be improved by appropriate utilization of accurate HRQOL prediction models. In RA, the literature supports the potential value of HRQOL patient questionnaires in clinical practice [8]. These questionnaires provide key data from the patient's perspective. The information so gained enables the clinician to select the most cost-effective therapies and interventions that slow disease progression, maintain functional status, and improve HRQOL [9].

In the present study, we sought to develop and determine the accuracy of two logistic regression models capable of predicting poor physical and mental HRQOL among RA patients.

Materials and methods

In this cross-sectional study, 411 consecutive patients from both genders with confirmed rheumatoid arthritis (RA) assessed by a rheumatologist based on American Rheumatism Association criteria [10] with a minimum age of 18 years were included. Exclusion criteria were association with a necrotic vascular disease or a handicap prior to RA. The patients were recruited between June and December 2006 from the outpatient rheumatology clinic of our university hospital. The study was approved by the ethical committee on human research of our university and written informed consent was obtained from all participants prior to taking part.

A detailed, structured interview was conducted with each patient and trained research assistants helped them to complete the following checklist and health questionnaires.

Checklist

The checklist contained questions about demographic data (age, gender, marital status, living place, weight, height, monthly family income and educational status of the patient). A subjective assessment of the health status [patient global assessment of disease activity (PGA)] during the last month was recorded for each patient using a visual analog scale (VAS). A 100 mm rating scale was used, with one end corresponding to the statement "no problem whatsoever" and the other end to "unbearable." Patients were then instructed to place a vertical mark on the scale reflecting their own health status. The distance from the "no problem whatsoever" end was measured in mm. All patients underwent examination by a board-certified rheumatologist and the duration of disease onset was determined for them. A similar VAS was used to determine the physician's assessment of the patient's health status (physician global assessment of disease activity; MDGA). A standard 28-joint assessment for tender and swollen joints was performed and pain score, swelling score, ROM score (possible values of 0–28 for each of them), and Larsen joint damage score [11] were measured for all patients.

Numerical comorbidity index of Ifudu

The presence or absence of comorbidity was assessed using the Ifudu index [12]. Ifudu et al. used an index to monitor the patient's comorbidity over time. After removing items related to the musculoskeletal system, the remaining ten major organ systems included (1) persistent angina or myocardial infarction (ischemic heart disease), (2) nonischemic cardiovascular problems (hypertension, congestive heart failure, cardiomyopathy, other nonischemic diseases), (3) respiratory disease, (4) neuropathy, (5) infections, (6) liver, pancreas, gall bladder disease, (7) hematologic problems, (8) vision impairment, (9) limb amputation, and (10) genitourinary diseases.

Hospital anxiety and depression score (HADS)

This is a 14-item questionnaire that measures the symptoms of anxiety and depression. It has two subscales: anxiety and depression. Each subscale has a score of 0–21 and the higher score indicates more anxiety or depression symptoms [13]. In the current study we used the validated Persian version of the HADS questionnaire [14], and scores ≥ 9 were defined as presence of anxiety or depression.

HRQOL measurement tool and defining a cutoff point

The HRQOL of each patient was measured using the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) [15]. The SF-36 is a generic multidimensional measure of HRQOL that contains eight subscales representing physical functioning, social functioning, role limitations due to physical health problems, role limitations due to emotional problems, mental health, vitality, bodily pain, and general health perceptions. Higher scores for each subscale (0–100) indicate better HRQOL. The physical and mental components of the eight scales were combined into physical component summary (PCS) and mental component summary (MCS) scores. The SF-36 has proven reliable and valid in RA patients [16]. The Persian version of the SF-36 was used to ensure face validity and to maximize acceptability in Iranian participants [17]. In this study, we used PCS and MCS scores separately as the dependent variable; total SF-36 and subscales scores were

not included. The SF-36 questionnaires were completed by the patients, but in some cases an interviewer's assistant was needed. To define which SF-36 scores signified a poor HRQOL, we needed a cutoff point for SF-36 scores below which HRQOL could be considered poor. We defined the first quartiles of the obtained PCS and MCS scores as the cutoff points for poor HRQOL.

Statistical analysis

HRQOL prediction

Using the cutoff values calculated in the previous step, the SF-36 score of each patient was converted into a binominal outcome variable (poor/good HRQOL). A forward (likelihood ratio) logistic regression model was used to quantify associations between the assumed predictor variables and this binominal outcome variable in either of the physical and mental components. The significance level for each variable's entry to the model was set at 0.1. A logistic regression model involves some independent (predictor) variables (nominal or continuous) that may be used to predict a dependent (outcome) binominal variable. The input variables for both models (assumed predictors of physical and mental HRQOL) included age (year), patient gender (female = 0, male = 1), marital status (married = 0, single = 1), level of education (above high school diploma = 0, below high school diploma = 1), living place (village = 0, city = 1), monthly family income (below 300 US$ = 1, above 300 US$ = 0), duration of disease onset (month), swelling score, pain score, ROM score, Larsen score, body mass index (BMI) ($<30 = 0$, $\geq 30 = 1$), comorbidity number (0–11), PGA, and MDGA. The presence of anxiety and/or depression was only included in the model for predicting the physical HRQOL. On the other hand, physical function and bodily pain were only used in the mental HRQOL prediction model.

Testing the derived prediction models

We compared the HRQOL predictions made by the models and the SF-36 scores. The sensitivities, specificities, positive/negative predictive values, and accuracies of both models were calculated. The definitions used to calculate the indices related to model validation were:

True positives (TP)	the number of patients the model correctly predicted as having poor HRQOL
False positives (FP)	the number of the patients with good HRQOL the model falsely predicted as having poor HRQOL
True negatives (TN)	the number of the patients the model correctly predicted as having good HRQOL
False negatives (FN)	the number of the patients with poor HRQOL the model wrongly predicted as having good HRQOL

Then the following formulae were used to calculate the indices related to model validation: sensitivity = TP/(TP + FN); specificity = TN/(TN + FP); positive predictive value (PPV) = TP/(TP + FP); negative predictive value (NPV) = TN/(TN + FN), and accuracy = (TP + TN)/(TP + FP + TN + FN).

The models suggested by regression analysis estimated different probability values to predict poor HRQOL that may vary with the predictor values for each patient. However, it will be useful to know how valid each of these predicted probability levels can be when used as cutoff points to screen patients with poor HRQOL. For instance, if we arbitrarily set the cutoff probability to 0.80 like the one above in which we define a patient as one ending up with a poor HRQOL, then we wish to know the answers to the following two questions. (1) How sensitive is the model at this cutoff value? In other words, what proportion of the patients who really have a poor HRQOL will be present among the patients the model predicted as having poor HRQOL; that is, those with an estimated probability >0.80 in this arbitrary example? (2) How specific is the model at this cutoff, or in other words, what proportion of the patients who truly have a good HRQOL will be present in the group the model predicted to have good HRQOL?

All statistical analyses were performed using SPSS version 13.0 for Windows. Descriptive indices including frequency, percentage, mean, standard deviation (SD), median, and the first and third quartiles (Q1 and Q3) were used to express data. The input variables were compared between two groups (good/poor physical or mental HRQOL) using the chi-square test for categorical variables and the Student *t* test or the Mann–Whitney U test for continuous variables, as appropriate. *P* values of less than 0.05 were considered significant.

Results

Patients were predominantly female (359, 87.3%), and their mean (SD) age was 46.8 (12) years. Mean (SD) disease duration at study entry was 75.7 (68.1) months. Table 1 presents the demographic and clinical characteristics of the studied population. Disease activity scores (DAS28), which were recorded for only 281 patients (70%), had an average (SD) of 3.08 (1.1). Due to a lack of

Table 1 Demographic and clinical characteristics of the studied population ($n = 411$)

Characteristics	Frequency (percentage)
Gender, male/female	52 (12.7%)/359 (87.3%)
Marital status	
Married	347 (84.4%)
Single/widowed	64 (15.6%)
Education	
Below high school diploma	264 (64.2%)
Above high school diploma	147 (35.8%)
Monthly family income	
<300 US$	200 (48.7%)
>300 US$	211 (51.3%)
Living place, city/village	367 (89.3%)/44 (10.7%)
BMI (kg/m^2)	
<30	326 (79.3%)
≥30	85 (20.7%)
Presence of anxiety	137 (33.3%)
Presence of depression	96 (23.4%)
	Mean (SD)
Age in years	46.8 (12)
VAS physician	36.4 (21.7)
VAS patient	46.2 (24.2)
Disease duration (month)	75.7 (68.1)
Comorbidity number	2.4 (2.3)
	Median (Q1–Q3); mean (SD)
ROM score	0 (0–8); 1.7 (3.8)
Swelling score	0 (0–2); 1.5 (3.2)
Pain score	1 (0–3); 2.4 (3.8)
Larsen score	0 (0–2); 6.2 (13.3)

SD standard deviation, *Q1* first quartile, *Q3* third quartile

complete data, this variable was not used in further analyses.

The first quartiles of the SF-36 PCS and MCS scores were 33.4 and 36.8, respectively. PCS scores below 33.4 were therefore defined as indicating poor physical HRQOL, and MCS scores below 36.8 indicated poor mental HRQOL. The mean (SD) scores of different subscales and summary scores of SF-36 among all patients are presented in Table 2.

Tables 3 and 4 compare the input variables among patients with poor versus good physical and mental HRQOL. The input variables recognized by regression analysis as being statistically significant predictors of physical and mental HRQOL are listed in Table 5. Poor physical HRQOL was positively associated with painful score, disease duration (month), the presence of depression, monthly family income below 300 US$, PGA, and presence of comorbidity. Monthly family income below

Table 2 SF-36 subscale and summary scores

	Mean (standard deviation)
Physical function	50.9 (26.4)
Social functioning	56.6 (30.5)
Role limitations due to physical health problems	47.9 (26.5)
Role limitations due to emotional problems	56.1 (29)
Mental health	46.3 (17)
Vitality	46.1 (17)
Bodily pain	40.7 (26.5)
General health perceptions	44 (22.5)
Physical component score	47.6 (19.4)
Mental component score	48.4 (16.7)

300 US$, presence of comorbidity, PGA, and bodily pain variables were recognized by regression analysis as being statistically significant predictors of poor mental HRQOL.

The multiple logistic regression analysis suggested that the following statistical equations can be used to predict poor physical and mental HRQOL:

$$\begin{aligned}\mathrm{Logit}\left(P_{\text{physical HRQOL}}\right) &= 0.107 \times \mathrm{PS} + 0.004 \times \mathrm{DD} + 2.746 \\ &\times \mathrm{MFI} + 0.133 \times \mathrm{Com} + 0.026 \\ &\times \mathrm{PGA} + 0.733 \times \mathrm{Dep} - 5.476\end{aligned}$$

$$\begin{aligned}\mathrm{Logit}(P_{\text{mental HRQOL}}) &= 1.916 \times \mathrm{MFI} + 0.15 \times \mathrm{Com} + 0.014 \\ &\times \mathrm{PGA} + 0.032 \times \mathrm{BP} - 5.575\end{aligned}$$

In these equations, P stands for the probability of poor HRQOL; PS for painful score (0–100); DD for disease duration (months); MFI for monthly family income; Com for comorbidity presence; Dep for presence of depression; and BP for bodily pain. MFI is 1 if the monthly family income is below 300 US$, Dep is 1 if the total score of HADS is ≥9. In fact, logit(P) is equal to $\ln(p/1-p)$, and thus P can be calculated from logit(P).

The sensitivity, specificity, PPV, NPV, and the accuracy of the prediction model for poor physical and mental HRQOL with different cutoff points are presented in Table 6. The optimal accuracy of the sensitivity and specificity was achieved at a cutoff model-estimated probability of poor physical HRQOL of 0.39. Therefore the sensitivity, specificity, PPV, NPV, and the accuracy of the model were 73.8, 87, 65.5, 90.8 and 83.7%, respectively.

The optimal accuracy of the sensitivity and specificity was achieved at a cutoff model-estimated probability of poor mental HRQOL of 0.18. Therefore the sensitivity, specificity, PPV, NPV, and the accuracy of the model were 90.38, 70.36, 50.81, 95.58 and 75.43%, respectively.

Table 3 Comparison of dichotomous input variables between patients with good and poor physical and mental HRQOL

Predictor variable	Physical HRQOL			Mental HRQOL		
	Good	Poor	Sig.	Good	Poor	Sig.
Gender, female	267 (74.4%)	92 (25.6%)	0.4	268 (74.7%)	91 (25.3%)	0.9
Marital status, married	262 (75.5%)	85 (24.5%)	0.5	264 (76.1%)	83 (23.9%)	0.1
Education, below diploma	186 (70.5%)	78 (29.5%)	0.005	188 (71.2%)	76 (28.8%)	0.02
Monthly family income, below 300 US$	106 (53%)	94 (47%)	<0.001	110 (55%)	90 (45%)	0.001
Living place, city	280 (76.3%)	87 (23.7%)	0.06	275 (74.9%)	92 (25.1%)	0.7
BMI (kg/m^2), <30	242 (74.2%)	84 (25.8%)	0.5	240 (73.6%)	86 (26.4%)	0.3
Presence of anxiety	85 (62%)	52 (38%)	<0.001	77 (56.2%)	60 (43.8%)	<0.001
Presence of depression	51 (53.1%)	45 (46.9%)	<0.001	40 (41.7%)	56 (58.3%)	<0.001

Sig. significance, using chi-square test

All data are expressed as frequency (percentage)

Table 4 Comparison of continuous input variables between patients with good and poor physical and mental HRQOL

Predictor variable	Physical HRQOL			Mental HRQOL		
	Good	Poor	Sig.	Good	Poor	Sig.
Age (year)	45 (12)	52 (11)	<0.001[b]	46 (12)	50 (11)	0.001[b]
Disease duration (month)	70.1 (62.1)	92.9 (81.4)	0.02[c]	71.9 (63.6)	87.1 (79.2)	0.1[c]
Bodily pain	50.9 (23.9)	82.2 (19.5)	<0.001[b]	52.2 (25.2)	78 (20.4)	<0.001[b]
Physical function	61.4 (20.9)	19.4 (12.1)	<0.001[b]	61 (29.5)	41 (23)	<0.001[b]
VAS physician	33.1 (20.6)	46.5 (22.1)	<0.001[b]	33.4 (21.1)	45.2 (21.3)	<0.001[b]
VAS patient	41.3 (21.2)	60.9 (26.8)	<0.001[b]	41.7 (22.1)	59.4 (25.5)	<0.001[b]
Comorbidity number	2 (1–3)	3 (1–4)	<0.001[c]	2 (1–3)	3 (1–5)	<0.001[c]
Swelling score[a]	0 (0–1)	1 (0–3)	<0.001[c]	0 (0–1)	0 (0–2)	0.005[c]
Pain score[a]	1 (0–2)	2 (0–5)	<0.001[c]	1 (0–2)	2 (0–4)	0.01[c]
ROM score[a]	0 (0–2)	1 (0–3)	0.02[c]	0 (0–2)	1 (0–2)	0.09[c]
Larsen score[a]	0 (0–8)	0 (0–8)	0.5[c]	0 (0–8)	0 (0–8)	0.6[c]

[a] Data are expressed as mean (SD) aside from the comorbidity number, swelling, pain, ROM, and Larsen scores, which are expressed as median (first–third quartile)

[b] *t*-test

[c] Mann–Whitney *U* test

Discussion

We have presented here two quantitative prediction models that yield acceptable accuracy for poor physical and mental HRQOL in RA patients using relatively simple variables. In the multiple logistic regression analysis we tried to predict poor HRQOL based on cut-off values obtained from SF-36 questionnaire component scores (below 33.4 in PCS and below 36.8 in MCS). The strength of our study was that a wide range of variables (demographic, clinical, and psychological) were used in the analysis before it was finally found that pain score, disease duration, and monthly family income below 300 US$, comorbidity, PGA, and presence of depression yielded the best prediction model for poor physical HRQOL. With this approach it was possible to predict poor HRQOL as measured by the SF-36 with acceptable accuracy (83.7%). In the poor mental HRQOL prediction model, monthly family income below 300 US$, comorbidity, PGA, and bodily pain were used, yielding an accuracy of 75.43%.

Rheumatoid arthritis is a disabling condition that has its greatest impact on the pain and mobility of patients. Functional disability and quality of life in RA are key outcomes that determine the patient's demand for care and influence their compliance and satisfaction with treatment [18]. Preserving acceptable functional status and good HRQOL is one of the major targets in the clinical management of RA patients. The importance of assessing HRQOL in RA patients has been highlighted in different studies [8]. These assessments can provide complementary clinical information which can significantly help the rheumatologist to assess the patient's health status, make predictions about their future status, and generally impact on the choice of treatment [19, 20].

Using different HRQOL assessment tools, different studies have reported variables that affect HRQOL in RA patients. Women with early RA onset have reported significantly higher values on role limitation due to physical problems, bodily pain and social functioning compared with men. Furthermore, after two years of follow up,

Table 5 The input variables in the model that were recognized as being significant predictors of poor physical and mental HRQOL in multiple logistic regression analysis

	B	SE	*P* value	OR	95% CI
Physical HRQOL					
Pain score	0.107	0.037	0.003	1.113	1.036–1.196
Disease duration	0.004	0.002	0.027	1.004	1–1.008
Monthly family income (below 300 US$)	2.746	0.392	<0.001	15.574	7.224–33.572
Comorbidity	0.133	0.06	0.027	1.142	1.015–1.285
VAS patient, PGA	0.026	0.006	<0.001	1.026	1.013–1.039
Depression	0.733	0.317	0.021	2.081	1.118–3.876
Constant	−5.476	0.578	<0.001	0.004	
Mental HRQOL					
Monthly family income (below 300 US$)	1.916	0.331	<0.001	6.791	3.547–13.005
Comorbidity	0.15	0.057	0.008	1.162	1.04–1.298
VAS patient, GPA	0.014	0.006	0.027	1.014	1.002–1.026
Bodily pain	0.032	0.007	<0.001	1.019	1.047
Constant	–5.575	0.592	<0.001	0.004	

Nagelkerke *R* square of physical HRQOL model = 0.49; Nagelkerke *R* square of mental HRQOL model = 0.43

B unstandardized regression coefficient, *CI* confidence interval, *SE* standard error, *OR* odds ratio, *HRQOL* health-related quality of life

Table 6 Accuracy of the prediction model for poor physical and mental HRQOL with different cutoff points

	TN	FP	FN	TP	Sensitivity	Specificity	PPV	NPV	Accuracy	*S* + *S*
Physical HRQOL										
0.36	262	46	27	76	73.79	85.06	62.3	90.66	82.24	158.2
0.37	262	46	27	76	73.79	85.06	62.3	90.66	82.24	158.85
0.38	267	41	27	76	73.79	86.69	64.96	90.82	83.45	160.47
0.39	**268**	**40**	**27**	**76**	**73.79**	**87.01**	**65.5**	**90.8**	**83.7**	**160.8**
0.4	269	39	30	73	70.87	87.34	66.18	89.97	83.21	158.21
0.41	270	38	31	72	69.9	87.66	65.45	89.7	83.21	157.57
0.42	273	35	33	70	67.96	88.64	66.67	89.22	83.45	156.6
Mental HRQOL										
0.15	205	102	8	96	92.31	66.78	48.48	96.24	73.24	159.08
0.16	209	98	9	95	91.35	68.08	49.22	95.87	73.97	159.42
0.17	215	92	10	94	90.38	70.03	50.54	95.56	75.18	160.42
0.18	**216**	**91**	**10**	**94**	**90.38**	**70.36**	**50.81**	**95.58**	**75.43**	**160.74**
0.19	218	89	12	92	88.46	71.01	50.83	94.78	75.43	159.47
0.2	219	88	12	92	88.46	71.34	51.11	94.81	75.67	159.8
0.21	220	87	13	91	87.5	71.66	51.12	94.42	75.67	159.16

Bold line presents optimal accuracy or highest sensitivity + specificity

TN true negative, *FP* false positive, *FN* false negative, *TP* true positive, *PPV* positive predictive value, *NPV* negative predictive value, *S* + *S* sensitivity + specificity

women have reported better physical functioning [21]. However neither of our two models (physical or mental) indicated that gender was one of the predictive variables. This is in agreement with an Indian study in which gender of RA patients did not influence their HRQOL [7]. Marra et al. [22], in their study in Canada, showed that the impact of RA on self-reported health was strongly associated with socioeconomic status as measured by annual household income. They categorized 255 RA patients according to their annual household income into three groups: less than 20,000$, from 20,000$ to 50,000$, and greater than 50,000$ (Canadian dollars). They found that lower levels of income were associated with poorer generic and disease-specific HRQOL and physical function. They concluded that lower socioeconomic situation as measured by household income predicts poor self-reported health independently of RA severity in Canadian English-speaking adults. Similarly, Harrison et al. [23], who conducted their study in Manchester, England revealed significant relationships between lower socioeconomic status determined by area of residence and poorer physical function, poorer emotional aspects of mental health, and lower quality of life among patients with RA. The average monthly family income in our country is about 535 US$ [24]. According to the results obtained, half of the patients had incomes that were much lower than this average, which may relate to the sampling method of the study, which was performed in the rheumatology clinic of a general public hospital. Monthly

family income below 300US$ was one of the predictors of both poor physical and poor mental HRQOL. The effect of this item (OR = 15.574) in the prediction of poor physical HRQOL is even greater than it is in the prediction of poor mental HRQOL (OR = 6.791). With respect to disability and the physical component summary scale of RAND-36, it has been shown that pain is a more important predictor of HRQOL than radiologic damage and disease activity [25]. Pain showed a significant role in the prediction of physical HRQOL. From input variables of the SF-36 subscales to the mental model, only bodily pain (not physical function) was significant in the prediction of poor mental HRQOL. This finding is in agreement with the observations reported by West et al. [21], who demonstrated that bodily pain was highly sensitive to changes in the HRQOL, and assumed that it is an important measure of disease outcome in the early stages of RA. Bazzichi et al. reported that lifetime mood depressive symptoms, as assessed by the Mood Spectrum Questionnaire, Self-Report version (MOODS-SR), correlated with impairment of HRQOL in RA patients without a past psychiatric history [26]. According to the results of another study from this group, a significant worsening of all MOS SF-36 (Medical Outcomes Study 36-Item Short-Form Health Survey questionnaire) scores was related to higher scores for the depressive domains of MOODS-SR [27]. Rupp et al. [28], in their study on 882 RA patients, reported that the assessment of somatic and psychological comorbidity through periodic screening needs to be included in the clinical management of RA in order to prevent poor outcomes. The presence of comorbidity was entered into both of the models obtained. Its effect in the poor physical HRQOL prediction model (OR = 1.1) was equal to its effect in the mental prediction model (OR = 1.1). Similarly, the patient's assessment of his/her disease activity, as measured by VAS, showed equal effects in both physical (OR = 1.02) and mental (OR = 1.01) HRQOL prediction models.

Although there are various patient-based health assessment questionnaires (HAQ), simple and time-saving prediction models such as the ones that have been presented here can be a great help to physicians; such models enable them to consider appropriate interventional programs for HRQOL improvement well in advance [29].

A limitation related to the statistical analysis was that the accuracies of the developed models were determined using the same dataset that was used to produce the models in the first place. Because of low sample size, the validities of the derived models were tested on the same model, which may overestimate the predictive accuracy.

In conclusion, the acceptable accuracy of the models presented here in our setting may increase the acceptance of these models by rheumatologists and encourage them to rely on the predictive equations suggested. If these models can be validated in diverse settings, they will be handy tools for those clinicians who find it difficult to use the conventional time-consuming HRQOL standard measures.

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