Clin Rheumatol (2009) 28:685–691
DOI 10.1007/s10067-009-1132-0

ORIGINAL ARTICLE

The relationship between quality of life and aerobic fitness in patients with rheumatoid arthritis

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Received: 22 August 2008 / Revised: 24 January 2009 / Accepted: 9 February 2009 / Published online: 2 April 2009

Abstract Aerobic fitness is among the various aspects of rheumatoid arthritis (RA) patients' lives that may deteriorate as a result of the disease and, in doing so, influence patient attitudes toward their own general health. This cross-sectional study examined (1) relationships between patients' aerobic fitness and general health perceptions, (2) relationships between functional aerobic impairment and general health perceptions, (3) the impact of body mass index (BMI) on RA patients' cardiopulmonary functioning. Sixty-six RA patients (ten male and 56 female adults) participated in this study. Following maximum graded exercise tolerance testing to determine their subsequent aerobic fitness, they completed a version of the World Health Organization Quality of Life brief form (WHOQOL-BREF, short form) questionnaire. The one sample *t* test determined differences between the RA group and the reference data. We used Spearman's correlation analyses to assess the associations between variables of the WHOQOL-BREF questionnaire and patients' aerobic fitness. $VO_{2\ peak}$ was on average 92.00%±13.37% and 77.93%±20.24% of that predicted for age-matched men and women, respectively. The female patients' BMI was significantly lower than that of the reference data ($P<0.0001$). Spearman's correlation coefficient demonstrated a significant association between WHOQOL-BREF scores and $VO_{2\ peak}$ in the physical ($P=0.002$; mobility, work) and psychological ($P=0.009$; self-esteem, body image, and negative feelings) domains for the female patients. It also demonstrated a significant association between the WHOQOL-BREF scores and functional aerobic impairment in the physical ($P=0.006$; energy, mobility, activity), psychological ($P=0.008$; self-esteem and body images), and environment ($P=0.035$; finance, service) domains for the female patients. Our results indicated that impaired aerobic fitness, combined with poor physical and psychological well-being, influenced midlife transition in Taiwanese RA women.

Keywords Aerobic fitness · Quality of life · Rheumatoid arthritis · WHOQOL-BREF

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Introduction

Rheumatoid arthritis (RA) remains a chronic, disabling disease in spite of progress in therapy, and patients continue to suffer high rates of morbidity [1, 2]. There are several lines of evidence that suggest that the risk of cardiovascular comorbidity in RA may be increased by muscle weakness, restricted range of motion of the joints, and reduced physical activity [3, 4]. The cause of cardiovascular disease in RA is multifactorial, but low body mass index (BMI) [4, 5], inflammation-related dyslipidemia, and immune dysregulation [6], leading to the development of atherosclerosis of the coronary artery in a majority of RA patients [7, 8], are the major extra-articular underlying mechanisms of compromised aerobic fitness in RA. Studies involving individuals with RA have already revealed reduced aerobic fitness levels [9–12]. It has been suggested that this pattern of RA-related poor aerobic fitness stems from the direct impact of chronic inflammation [13, 14] and from the secondary effects of a sedentary life style [15]. Although relationships between aerobic fitness and general health perceptions have been found in population-based studies [16], further research is still needed to investigate this in RA patients and across their different medical conditions.

RA has a major impact on physical and psychological health. It can cause severe disability and affect health-related quality of life (QOL), which is important to patients. Thus, it is important to assess QOL of RA patient in clinical practice [17]. For this reason, traditional clinical measures are increasingly accompanied by health status testing, which assesses the impact of chronic illnesses from the patient's perspective and which encompasses physical, psychological, and emotional aspects of the disease [9, 18].

QOL indicators are among various health status measures that demonstrate physical, emotional, and psychological aspects of RA. There are many general instruments available to measure QOL [19, 20]. The World Health Organization Quality of Life brief form (WHOQOL-BREF) is one of the best-known instruments developed for cross-cultural comparisons of QOL, and it is available in more than 40 languages [21, 22]. It is a shortened version of the WHOQOL-100 that looks at four QOL profiles, using all available data from the field trial version of the WHOQOL-100 [21, 23].

We adopted this questionnaire for the present study to assess RA patients' health status because (1) it has already been used recently in a Taiwanese population-based survey on the relationship between RA and general health perceptions, providing the reference data that we have used for comparison with our own patient sample [24], (2) two Taiwan-specific items, digestion and socially desirable responses, were added to the original WHOQOL-BREF indicators to properly distinguish the psychometric characteristics of Taiwanese people [25], and (3) it is short and easy to administer. We believe that the Taiwanese interview-administered version of WHOQOL-BREF, based on the styles of the responses, the expression of emotions, and on an adjusted definition of QOL, might be more valid and reliable than the original questionnaire for epidemiological and outcome studies [22].

More research is needed to clarify the association between aerobic fitness and general health perceptions of RA patients. The present cross-sectional study was therefore undertaken to examine this association and in particular to investigate (1) relationships between aerobic fitness and general health perception, (2) relationships between functional aerobic impairment and general health perception, and (3) the impact of BMI on cardiopulmonary function in RA patients.

Materials and methods

Ninety-six adult patients diagnosed with RA at the Rheumatology Department of the Veterans Affairs Medical Center, Taipei between July 2006 and December 2007 enrolled in this study. Of the 96 patients, 30 were found to be unable to tolerate the treadmill ambulation testing because of their medical conditions, which were as follows: unstable angina (n=4), uncontrolled cardiac arrhythmias

Table 1 Background characteristics of subjects

	RA		Normal Population	
	Male	Female	Male	Female
Case number	10	56		
Mean age (year)	54.40±16.57	50.55±11.28		
Functional Aerobic Impairment (FAI) (%)	10.40±9.38	24.68±13.99		
$\dot{V}O_{2\ peak}$ (mL kg^{-1} min^{-1})	27.39±8.09	22.60±5.46		
% of predicted $\dot{V}O_{2\ peak}$	92.00±13.37	77.93±20.24		
Body mass index (BMI; kg/m^2)	23.54±3.96 (P>0.5)	21.80±4.47 (P<0.0001)	23.8±3.3	24.6±3.5

causing symptoms or hemodynamic compromise (n=14), painful knees (n=8), and unwillingness to proceed with the project (n=4).

A diagnosis of RA was established according to the criteria of the American Rheumatism Association. The clinical characteristics of the sample are shown in Table 1. Informed consent was obtained after the nature of the procedures of the study had been fully explained and understood. The study was approved by the Ethics Committee for medical research at this institution.

Quality of life questionnaire

We used the WHOQOL-BREF questionnaire to evaluate the QOL in our study subjects. This questionnaire contains questions about four main domains in a person's life (physical health, psychological well-being, social relationships, and environment) and examines each in more detail in facets or levels (rated ranks 1–5; 1, not satisfied at all; 2, somewhat satisfied; 3, moderately satisfied; 4, very satisfied; 5, extremely satisfied). More specific details of this questionnaire are shown in Table 2. The time frame for the patients' perception of QOL was set at a 2-week period shortly before the study. Results were converted through a standardized procedure to domain points, ranging from 0 to 100.

Cardiopulmonary test

To evaluate the subjects' cardiopulmonary function, we used the Vmax® Encore Pulmonary and Cardiopulmonary

Table 2 Domains and facets construction of WHOQOL-BREF

Quality of life	RA		Normal population	
	Male[b] Mean±SD	Female[c] Mean±SD	Male[d] Mean±SD	Female[e] Mean±SD
Domain 1—Physical domain	47.80±20.93	50.75±15.12	71.38±11.63	70.86±10.94
Facet 1. Pain	2.90±1.29	3.25±1.00	3.77±0.98	3.78±0.87
Facet 2. Energy	2.90±0.99	2.77±0.60	3.45±0.83	3.50±0.86
Facet 3. Sleep	2.50±0.85	2.82±1.13	3.58±0.83	3.45±0.76
Facet 9. Mobility	3.20±1.03	3.02±0.96	4.04±0.74	4.06±0.82
Facet 10. Activity	3.30±0.82	3.07±0.87	3.56±0.68	3.63±0.67
Facet 11. Medical condition	2.50±1.27	3.07±1.19	4.77±0.45	4.80±0.45
Facet 12. Work ability	3.30±0.82	3.20±0.88	3.82±0.66	3.61±0.63
Domain 2—Psychological domain	58.40±17.10	52.88±14.00	60.94±13.81	60.44±12.31
Facet 4. Positive feelings	2.80±1.03	2.68±0.92	2.69±0.90	2.72±0.88
Facet 5. Thinking	3.10±0.88	3.02±0.77	3.31±0.81	3.13±0.83
Facet 6. Self-esteem	3.30±0.95	3.23±0.79	3.68±0.76	3.62±0.71
Facet 7. Body image	3.60±1.08	3.23±1.04	3.98±0.86	4.08±0.82
Facet 8. Negative feelings	3.50±0.97	3.32±0.74	3.34±0.81	3.42±0.83
Facet 24. Spirit	3.50±0.85	3.18±0.88	3.63±0.97	3.53±0.86
Domain 3—Social relationship domain	63.20±15.59	63.86±12.37	62.50±12.69	62.50±13.5
Facet 13. Relationship	3.50±0.97	3.59±0.63	3.51±0.77	3.55±0.68
Facet 14. Support	3.70±0.48	3.80±0.67	3.60±0.63	3.51±0.69
Facet 15. Sex	3.00±1.05	3.11±0.76	3.53±0.84	3.61±0.69
Facet 25. Respectedness[a]	3.90±0.74	3.84±0.76	3.35±0.76	3.39±0.79
Domain 4—Environment domain	62.10±12.25	59.20±12.95	56.19±13.00	57.19±14.06
Facet 16. Safety	3.30±0.48	3.13±0.85	3.36±0.85	3.27±0.98
Facet 17. Home	3.50±0.71	3.55±0.85	3.54±0.71	3.54±0.76
Facet 18. Finance	3.10±0.74	2.91±0.82	3.02±0.97	3.13±1.04
Facet 19. Social service	3.90±0.57	3.59±0.73	3.46±0.77	3.58±0.78
Facet 20. Information	3.30±0.82	3.45±0.93	3.28±0.88	3.40±0.85
Facet 21. Leisure	3.00±1.25	2.95±0.82	3.13±0.91	2.98±0.92
Facet 22. Environment	3.20±0.63	3.00±0.87	2.78±0.92	2.80±1.05
Facet 23. Transport	3.80±0.42	3.64±0.70	3.09±0.91	3.09±0.84
Facet 26. Eating[a]	4.10±0.74	3.95±0.82	3.57±0.81	3.83±0.74

[a] Implicate Taiwan native facet
[b] n=10
[c] n=56
[d] n=96
[e] n=116

Stress Testing System (SensorMedics, Yorba Linda, CA, USA), a treadmill-based method for maximal programmed exercise testing. We tested the patients using the Naughton Protocol (Table 3). Each patient's exhaled gases were saved in a collecting tube and analyzed breath by breath to obtain their $VO_{2\ peak}$ value.

The patients completed an entry investigation procedure by exercising on a treadmill until they reached either subjective exhaustion, a plateauing of their oxygen intake, or until clinical contraindications set in [26–28].

Functional aerobic impairment (FAI) was calculated by the following equation:

$$\%FAI = \frac{VO_{2\,peak}\ \text{predicted} - VO_{2\,peak}\ \text{measured}}{VO_{2\,peak}\ \text{predicted}} \times 100\%$$

The predicted $VO_{2\ peak}$ (mL kg^{-1} min^{-1}) was calculated by the following equation:

$$\text{Male} : 57.8 - 0.445 \times \text{age}$$
$$\text{Female} : 42.3 - 0.356 \times \text{age}.$$

Statistical analysis

We conducted the statistical analysis with SPSS software (Version 14.0). Descriptive statistics were used to establish patient characteristics and to obtain the scores on the WHOQOL-BREF questionnaire. The one sample *t* test was used to determine differences between the RA group and the reference data obtained from administering the WHOQOL-BREF questionnaire to non-RA Taiwanese respondents. Analyses were performed separately for men and women. Pearson and Spearman's correlation analyses were used to assess the associations between the variables of the WHOQOL-BREF questionnaire and the patients' aerobic capacity and FAI. A P value of <0.05 was considered statistically significant.

Table 3 Naughton protocol

Step	Speed (mph)	Grade (%)	Duration (min)
Rest/recovery	1	0	–
1	1	0	2
2	2	0	2
3	2	3.5	2
4	2	7.0	2
5	2	10.5	2
6	2	14.0	2
7	2	17.5	2
8	2	21.0	2

Results

$VO_{2\ peak}$ was on average 92.00%±13.37% and 77.93%± 20.24% of that predicted for age-matched men and women, respectively. The RA female patients' BMI was significantly lower than that of females in the reference data ($P<$ 0.0001). Spearman's correlation coefficient demonstrated a significant association between the female patients' WHOQOL-BREF scores and $VO_{2\ peak}$ in the physical domain (facets: mobility and work) and the psychological domain (facets: self-esteem, body image, and negative feelings). No significant relationship was found in any domains between the male patients' WHOQOL-BREF scores and $VO_{2\ peak}$ (Table 4).

Spearman's correlation coefficient demonstrated a significant association between the female patients' WHOQOL-BREF scores and FAI in the physical domain (facets: energy, mobility, and activity), psychological domain (facets: self-esteem and body image), and environment domain (facets: finance and service). No significant relationship was found in any domains between the male patients' WHOQOL-BREF scores and FAI (Table 5).

Discussion

In this study, we demonstrated (1) that the BMI of our female RA patients was significantly lower than that of the general Taiwan population., (2) there is a significant association between the physical/psychological domain and $VO_{2\ peak}$ for female RA patients, and (3) that there is a significant association between the physical/psychological/environment domain and FAI for female RA patients.

Previous studies have reported the association between the increased risk of cardiovascular death and low BMI in RA subjects [4, 5]. The loss of body mass takes place largely in the skeletal muscles [29–31]. The principal contributing factors appear to be the excessive production of proinflammatory cytokines in RA patients [32] as well as a reduction in the peripheral insulin action [30, 33]. We found that our RA female patients had significantly lower BMI than that of our RA males and the reference data for the general Taiwan population. Further contributing factors may be the low physical activity of RA patients [33], their tendency to gain fat mass and develop cachectic obesity [5], and their reduced functional capacity.

These factors may partly explain the compromised aerobic fitness of our RA female patients. Our results revealed them as having 22.1% less aerobic fitness than that of women of a comparable age without RA, as demonstrated in earlier studies [9–12]. However, it was surprising to find distinctive sex differences and that women were more impaired than men in aerobic capacity. These results should

Table 4 The correlation between VO_{2peak} and scores of quality of life

Quality of life	Male		Female	
	R	Sig.	*R*	Sig.
Domain 1—Physical domain	0.006	0.986	0.398	0.002*
Facet 1. Pain	0.221	0.539	0.219	0.105
Facet 2. Energy	0.121	0.740	0.141	0.299
Facet 3. Sleep	0.032	0.929	0.228	0.090
Facet 15. Mobility	0.164	0.651	0.349	0.008*
Facet 17. Activity	0.250	0.486	0.147	0.279
Facet 11. Medical condition	0.019	0.959	0.250	0.063
Facet 12. Work	0.151	0.676	0.346	0.009*
Domain 2—Psychological domain	0.043	0.906	0.347	0.009*
Facet 4. Positive feelings	0.044	0.904	0.049	0.717
Facet 5. Thinking	0.326	0.358	0.170	0.210
Facet 6. Self-esteem	0.326	0.358	0.277	0.038*
Facet 7. Body image	0.594	0.070	0.352	0.008*
Facet 8. Negative feelings	0.072	0.844	0.268	0.046*
Facet 24. Spirit	0.168	0.643	0.095	0.486
Domain 3—Social relationship domain	0.158	0.662	0.054	0.692
Facet 13. Relationship	0.052	0.886	0.131	0.336
Facet 14. Support	0.266	0.458	0.042	0.760
Facet 15. Sex	0.051	0.889	0.224	0.098
Facet 25. Respectedness[a]	0.158	0.663	0.096	0.479
Domain 4—Environment domain	0.068	0.852	0.210	0.120
Facet 16. Safety	0.038	0.917	0.054	0.694
Facet 17. Home	0.173	0.632	0.090	0.509
Facet 18. Finance	0.382	0.277	0.204	0.131
Facet 19. Social service	0.682	0.060	0.143	0.292
Facet 20. Information	0.250	0.486	0.129	0.344
Facet 21. Leisure	0.117	0.747	0.001	0.996
Facet 22. Environment	0.340	0.337	0.022	0.870
Facet 23. Transport[a]	0.087	0.811	0.260	0.053
Facet 26. Eating	0.540	0.107	0.034	0.801

[a] Implicate Taiwan-specific facet

$P<0.05$ indicates significant difference

be carefully interpreted in the context of several factors: First, the number of male subjects in this study was small; therefore, broad generalizations should not be made for our male subjects. Second, previous studies have demonstrated that women generally undertake less vigorous and moderate physical exercise than men and that the age-related decline in physical activity is greater for women. Third, the BMI of our RA male subjects was normal, which might less predispose them to cardiovascular functional loss.

The relationship demonstrated in this study between the psychological domain (self-esteem, body image, and negative feelings), the environment domain (finance and service), and impaired aerobic fitness for the female patients supports previous findings that a pessimistic approach to life is a significant pointer in identifying stresses in psychological well-being and physical health [34]. The findings reported in this study indicated that once middle-aged Taiwanese women sustain RA, their outlook on life becomes increasingly pessimistic during the course of the disease. This change in outlook has a direct influence on their physical/psychological well-being and social participation [34–37]. One possible reason for these findings might be that middle-aged Taiwanese RA women are satisfied with an inactive lifestyle and are not motivated to become more physical active. Middle-aged Taiwanese women attend fewer social activities and rarely look for financial and medical support. Although this situation has been gradually changing in Taiwan's cities, since medical and financial support services are easily accessible, it still exists outside the cities in Taiwan and ageing women—particularly ageing women with medical conditions and decreased mobility—find themselves increasingly isolated from important medical and social support networks.

Table 5 The correlation between functional aerobic impairment (FAI) and quality of life (QOL) scores

Quality of life	Male		Female	
	R	Sig.	*R*	Sig.
Domain 1—Physical domain	0.132	0.717	0.363	0.006*
Facet 1. Pain	0.020	0.957	0.125	0.358
Facet 2. Energy	0.110	0.763	0.348	0.009*
Facet 3. Sleep	0.158	0.664	0.207	0.125
Facet 15. Mobility	0.326	0.358	0.349	0.008*
Facet 17. Activity	0.053	0.883	0.284	0.034*
Facet 11. Medical condition	0.121	0.740	0.127	0.351
Facet 12. Work	0.150	0.678	0.246	0.067
Domain 2—Psychological domain	0.030	0.931	0.353	0.008*
Facet 4. Positive feelings	0.275	0.442	0.063	0.668
Facet 5. Thinking	0.014	0.969	0.091	0.507
Facet 6. Self esteem	0.021	0.954	0.320	0.016*
Facet 7. Body image	0.128	0.128	0.372	0.005*
Facet 8. Negative feelings	0.192	0.596	0.234	0.082
Facet 24. Spirit	0.312	0.380	0.033	0.811
Domain 3—Social relationship domain	0.064	0.860	0.121	0.373
Facet 13. Relationship	0.245	0.496	0.079	0.561
Facet 14. Support	0.234	0.520	0.052	0.701
Facet 15. Sex	0.210	0.561	0.232	0.085
Facet 25. Respectedness[a]	0.053	0.883	0.077	0.571
Domain 4—Environment domain	0.097	0.789	0.282	0.035*
Facet 16. Safety	0.347	0.326	0.078	0.569
Facet 17. Home	0.007	0.985	0.036	0.795
Facet 18. Finance	0.284	0.427	0.360	0.006*
Facet 19. Social service	0.247	0.491	0.294	0.028*
Facet 20. Information	0.053	0.883	0.109	0.424
Facet 21. Leisure	0.096	0.792	0.144	0.291
Facet 22. Environment	0.187	0.606	0.070	0.609
Facet 23. Transport	0.133	0.715	0.226	0.094
Facet 26. Eating[a]	0.124	0.734	0.143	0.293

[a] Implicate Taiwan native facet

*$P<0.05$ indicates significant difference

We acknowledge the limitations of the cross-sectional data in this study. While we have demonstrated that there are significant relationships between aerobic fitness and BMI, physical inactivity, and a pessimistic outlook on life, further studies need to examine the implications of medications for RA treatment and the inflammatory and immune factors contributing to possible impaired cardiopulmonary function.

Conclusion

The findings of our study reconfirm that the QOL of RA patients is determined by a multiplicity of interacting factors—including individual attitudes, social networks, and aerobic fitness as well as the to the nature of the disease itself. This complexity of factors highlights the importance of continuing to examine RA patient perceptions and measurements in assessing the impact of chronic diseases alongside traditional clinical, laboratory, and radiological testing. Impaired aerobic fitness, in combination with poor physical and psychological well-being, strongly impacts in particular on midlife adjustments for Taiwanese women with RA. This study has highlighted the increasing need for proper physical exercise programs to be implemented alongside other lifestyle changes and the strengthening of social support networks to maximize the cardiovascular fitness of RA patients, particularly in aging women, and thus improve their QOL.

Disclosures None

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