Rheumatol Int (2013) 33:1185–1192
DOI 10.1007/s00296-012-2522-1

ORIGINAL ARTICLE

Is the prevalence of arterial hypertension in rheumatoid arthritis and osteoarthritis associated with disease?

Jadranka Morović-Vergles · Lea Šalamon · Daniela Marasović-Krstulović · Tatjana Kehler · Davorin Šakić · Olga Badovinac · Tonko Vlak · Srđan Novak · Nives Štiglić-Rogoznica · Marino Hanih · Dražen Bedeković · Simeon Grazio · Mira Kadojić · Jasminka Milas-Ahić · Višnja Prus · Doris Stamenković · Daniela Šošo · Branimir Anić · Đurđica Babić-Naglić · Stjepan Gamulin

Received: 8 March 2012 / Accepted: 23 August 2012 / Published online: 11 September 2012

Abstract In this study, we compare the prevalence of arterial hypertension (HT) in rheumatoid arthritis (RA) and osteoarthritis (OA) patients, exposed to high- and low-grade chronic inflammation, respectively, to assess the possible association between chronic inflammation and HT. A total of consecutive 627 RA and 352 OA patients were enrolled in this multicentric study. HT was defined as a systolic blood pressure (BP) $\geq$ 140 and/or diastolic BP $\geq$ 90 mmHg or current use of any antihypertensive drug. Overweight/obesity was defined as body mass index (BMI) $\geq$ 25, and patients $\geq$65 years were considered elderly. The prevalence of HT was higher in the OA group than in the RA group [73.3 % (95 % CI, 68.4, 77.7) and 59.5 % (95 % CI, 55.6, 68.4) $P < 0.001$, respectively]. When the results were adjusted for age and BMI, the HT prevalence was similar in both groups [RA 59 % (95 % CI, 55.1, 63.8) OA 60 % (95 % CI, 58.4, 65.0)]. In both groups, the prevalence of HT was higher in the elderly and those who were overweight than in the younger patients and those with a BMI < 25. Overweight (BMI $\geq$ 25) and age $\geq$65 were independent predictors of HT in multivariate logistic regression model, which showed no association between HT and the disease (RA or OA). The results indicate a robust association of age and BMI with HT prevalence in both RA and OA. The difference in HT

Electronic supplementary material The online version of this article (doi:10.1007/s00296-012-2522-1) contains supplementary material, which is available to authorized users.

J. Morović-Vergles (✉) · L. Šalamon
Division of Clinical Immunology and Rheumatology, Department of Internal Medicine, Dubrava University Hospital, University of Zagreb School of Medicine, Av. G. Šuška 6, 10 040 Zagreb, Croatia
e-mail: jmorovic@kbd.hr

D. Marasović-Krstulović
Division of Clinical Immunology and Rheumatology, Department of Internal Medicine, Split University Hospital, University of Split School of Medicine, Split, Croatia

T. Kehler
Hospital for Cardiac, Pulmonary and Rheumatic Rehabilitation, Talassotherapia, Opatija, Croatia

D. Šakić · O. Badovinac
Department of Physical Medicine, Dubrava University Hospital, Zagreb, Croatia

T. Vlak · D. Šošo
Department of Rehabilitation Medicine and Rheumatology, Split University Hospital, University of Split School of Medicine, Split, Croatia

S. Novak
Division of Clinical Immunology and Rheumatology, Department of Internal Medicine, Clinical Hospital Center Rijeka, University of Rijeka School of Medicine, Rijeka, Croatia

N. Štiglić-Rogoznica · D. Stamenković
Department for Rheumatology and Rehabilitation, Clinical Hospital Centre Rijeka, School of Medicine University of Rijeka, Rijeka, Croatia

M. Hanih
Department of Rheumatic Diseases, Physical Medicine and Rehabilitation, GH "Dr. Josip Benčević", Slavonski Brod, Croatia

D. Bedeković · J. Milas-Ahić · V. Prus
Department of Internal Medicine, Osijek University Hospital, Osijek, Croatia

S. Grazio
Department of Rheumatology, Physical and Rehabilitation Medicine, "Sisters of Charity" Clinical Hospital Center, Referral Center for Spondyloarthropathies, Ministry of Health and Social Welfare, Republic of Croatia, Zagreb, Croatia

prevalence between RA and OA is due rather to age and BMI than to the features of the disease, putting into question specific association of HT with RA.

Keywords Rheumatoid arthritis · Osteoarthritis · Hypertension

Introduction

Excessive cardiovascular (CV) morbidity and mortality leading to premature death is common in rheumatoid arthritis (RA) patients. The mechanism of this comorbidity is not well understood. Chronic systemic inflammation is thought to have a pivotal role in increased CV disease risk in RA, contributing to vascular damage (endothelial dysfunction, accelerated atherosclerosis and atherosclerotic plaque instability) [1].

Among the classic CV risk factors, hypertension (HT) has a prominent role in RA patients [1, 2]. An increased prevalence of HT in RA patients was found in a number of studies, but not in all. A 52–73 % prevalence of HT in RA patients was found in the studies with a large number of patients that used the current definition of hypertension [3]. The mechanisms leading to frequent HT in RA patients are not clear; the association is likely due to a complex interplay of various factors, including chronic systemic inflammation [3]. However, the recently published meta-analysis did not show increased HT prevalence in RA [4].

CV comorbidities, particularly HT, have not been investigated in osteoarthritis (OA) patients as extensively as in RA patients. The prevalence of CV disease in OA was found to be approximately 55 % [5, 6]. The reported prevalence of HT in OA was 40 % in one study [7] and 75 % in another [8]. The studies comparing CV disease risk in RA and OA are rather scarce. The CV disease risk and the presence of CV disease risk factors in OA were found to be lower than [5] or similar [9] to those in RA. The CV disease risk in OA has been attributed to a high prevalence of classic CV disease risk [9], and in the case of HT to medication, especially the use of nonsteroidal anti-inflammatory drugs (NSAIDs) and cyclooxygenase-2 inhibitors [10].

The aim of this study is a comparison of HT prevalence and disease features in RA and OA patients. A comparison of the two diseases, which are both characterized by a chronic course and painful joint involvement, but with either high (RA) or low (OA) levels of chronic systemic inflammation [11, 12], may reveal an association between various disease features and HT in conditions that differ in terms of the level of chronic systemic inflammation.

Patients and methods

In order to collect data concerning HT prevalence in RA and OA from all parts of the country, we preformed this multicentric cross-sectional study in collaboration with outpatient rheumatology clinics in regional medical centers of Croatia (Table 1). A total of 625 RA and 352 OA patients who attended the outpatient clinics from September 1 to December 31, 2009, were consecutively enrolled in the study. The diagnoses of RA and OA (knee, hip and hand) were established by qualified rheumatologists according to the 1987 American College of Rheumatology (ACR) classification criteria for RA [13] and the ACR criteria for OA [14–16]. The study protocol was approved by the Ethical Committee of the Dubrava University Hospital, Zagreb, the coordinative center of the study, and a written informed consent (according to the Declaration of Helsinki) was obtained from all study participants.

All participants underwent a detailed evaluation guided by a questionnaire administered in all collaborative departments. The evaluation included a detailed medical history, physical examination and the measurement of body height and weight. Patients with ischemic heart disease were not included in the study.

In order to compare the present study with the study [17], the RA and OA subgroups comprising all 50–70-year-old patients were selected.

Patients $\geq$65 years of age were considered elderly. Body mass index (BMI) was calculated according to the standard formula [18], and patients with BMIs $\geq$ 25 were qualified as overweight (including obesity). Waist and hip circumferences were measured, and the waist-to-hip ratio (WHR) was calculated [19].

Pain and the patients' general health (GH) were assessed using the appropriate visual analog scales (VAS). Pain VAS (VASP) ranged from 0 to 10, with 10 being the most intensive pain [20]. General health VAS (VASGH) was

M. Kadojić
Department of Physical Medicine and Rehabilitation, Osijek University Hospital, Osijek, Croatia

B. Anić
Division of Clinical Immunology and Rheumatology, Department of Internal Medicine, Zagreb Clinical Hospital Center, University of Zagreb School of Medicine, Zagreb, Croatia

Đ. Babić-Naglić
Department of Rheumatology and Rehabilitation, Zagreb Clinical Hospital Center, University of Zagreb School of Medicine, Zagreb, Croatia

S. Gamulin
Department of Pathophysiology, University of Zagreb School of Medicine, Zagreb, Croatia

Table 1 Collaborative departments

Division of Clinical Immunology and Rheumatology, Department of Internal Medicine, Dubrava University Hospital, University of Zagreb School of Medicine, Zagreb, Croatia (coordinative center of the study)
Department of Physical Medicine, Dubrava University Hospital, Zagreb, Croatia
Division of Clinical Immunology and Rheumatology, Department of Internal Medicine, Zagreb Clinical Hospital Center, University of Zagreb School of Medicine, Zagreb, Croatia
Department of Rheumatology and Rehabilitation, Zagreb Clinical Hospital Center, University of Zagreb School of Medicine, Zagreb, Croatia
Department of Rheumatology, Physical and Rehabilitation Medicine, "Sisters of Charity" Clinical Hospital Center, Referral Center for Spondyloarthropathies, Ministry of Health and Social Welfare, Republic of Croatia, Zagreb, Croatia
Division of Clinical Immunology and Rheumatology, Department of Internal Medicine, Clinical Hospital Center Rijeka, University of Rijeka School of Medicine, Rijeka, Croatia
Department for Rheumatology and Rehabilitation, Clinical Hospital Centre Rijeka, School of Medicine University of Rijeka, Rijeka, Croatia
Hospital for Cardiac, Pulmonary and Rheumatic Rehabilitation, Thalassotherapia, Opatija, Croatia
Department of Rehabilitation Medicine and Rheumatology, Split University Hospital, University of Split School of Medicine, Split, Croatia
Division of Clinical Immunology and Rheumatology, Department of Internal Medicine, Split University Hospital, University of Split School of Medicine, Split, Croatia
Department of Internal Medicine, Osijek University Hospital, Osijek, Croatia
Department of Physical Medicine and Rehabilitation, Osijek University Hospital, Osijek, Croatia
Department of Rheumatic Diseases, Physical Medicine and Rehabilitation, GH "Dr. Josip Benčević", Slavonski Brod

part of the DAS28-CRP score [21]. VAS was represented by a 100-mm-long line on which the patients evaluated their own health, with 100 mm representing the best health. RA patient functional status and disease activity were assessed by the Croatian translation of the Health Assessment Questionnaire (HAQ) [22] and by the DAS28-CRP [21] using a DAS calculator [23], respectively.

All antihypertensive and antirheumatic medications taken by the enrolled patients were recorded in detail (indications, dose and duration of treatment).

Blood pressure (BP) was measured after a 5-min rest in a sitting position on the right arm with a mercury sphygmomanometer and a standard cuff. The recorded BP value for each patient was the mean of three subsequent measurements at 5-min intervals. HA was defined according to the European Society of Hypertension and the European Society of Cardiology 2007 guidelines with BP $\geq$ 140 mmHg and/or diastolic BP $\geq$ 90 mmHg [18] or any BP with antihypertensive treatment. Newly discovered HT was defined as actual HT without HT history and was expressed as the prevalence and the fraction of actual HT. Uncontrolled HT was defined as HT on hypertensive therapy having BP with HT values.

Venous blood samples were collected for laboratory investigations after overnight fasting. The following tests were performed in the laboratories of the collaborative hospitals: erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), total cholesterol (Chol), high-density lipoproteins (HDL), low-density lipoproteins (LDL), triglycerides (TG), creatinine and plasma glucose (Glc). When required, oral glucose tolerant tests (OGTT) were performed. Diabetes (DM) was defined by a history of DM with current use of antidiabetic medication or fasting Glc $\geq$ 7 mmol/L or Glc in OGTT (2 h) $\geq$ 11.1 mmol/L [24]. The same standard methods were used in all laboratories, and biochemical assays were performed using Olympus autoanalyzers according to the manufacturer's protocol.

Statistical analysis

The normality of the data distribution was assessed using the Kolmogorov–Smirnov test. Values are presented as median [interquartile range (IQR], mean (SD) or percentage [confidence interval (CI)] as appropriate. Comparisons were performed with the Student's t test, Mann–Whitney U test and chi-squared test for normally, nonnormally distributed and categorical variables, respectively. Binary logistic regression was used to assess the independency of the association of various variables with the prevalence of HT in RA, OA and all patients. P values < 0.05 (two-tailed) were considered significant. All statistical analyses were performed using SPSS 17.0 software (SPSS Inc., Chicago, USA). The adjustment of HT prevalence for age and BMI was made according to [25].

Results

Characteristics of RA and OA patients (Table 2)

The proportion of female patients was higher than that of men in both the RA and OA groups. In comparison with OA, RA was characterized by younger age, a lower

Table 2 Characteristics of RA and OA patients

	RA ($N = 627$)	OA ($N = 352$)	P values
Sex female *n* [% (95 % CI)]	522 [83.3 (80.2, 86.0)]	295 [83.8 (79.6, 87.3)]	0.823
Age (years)	59.00 (52.00–68.00)	67.00 (58.00–73.00)	<0.001
Age ≥ 65 years *n* [% (95 % CI)]	208 [33.2 (26.6, 37.0)]	199 [56.5 (51.3, 61.2)]	<0.001
Disease duration (years)	7.00 (3.00–15.00)	5.00 (2.00–10.00)	<0.001
BMI	26.50 (23.80–29.34)	29.39 (26.0–32.09)	<0.001
BMI ≥ 25 *n* [% (95 % CI)]	395 [63.2 (59.4, 66.9)]	288 [82.3 (77.0, 85.0)]	<0.001
WHR	0.88 (0.82–0.94)	0.90 (0.83–0.96)	0.004
VASP	50.00 (30.00–70.00)	50.00 (32.00–70.00)	0.983
VASGH	50.00 (25.00–63.00)	50.00 (30.00–60.00)	0.289
Dyslipidemia *n* [% (95 % CI)]	250 [39.8 (36.0, 43.7)]	185 [52.3 (47.1, 57.5)]	0.001
DM *n* [% (95 % CI)]	60 [9.69 (7.6, 12.3)]	59 [16.8 (13.3, 21.1)]	0.001
Smoking habit			
Ex-smokers *n* [% (95 % CI)]	139 [22.1 (19.0, 25.5)]	55 [15.6 (12.3 (19.8)]	0.014
Current smokers *n* [% (95 % CI)]	137 [21.9 (18.8, 25.3)]	52 [14.8 (11.8, 18.9)]	0.007
Laboratory data			
ESR	25 (13–42)	14 (9–23)	<0.001
CRP (mgL)	8.60 (3.10–15.80)	2.35 (1.33–3.78)	<0.001
Chol (mmol/L)	5.49 (4.80–6.30)	5.70 (4.83–6.50)	0.044
TG (mmol/L)	1.32 (1.033–1.80	1.70 (1.20–2.20)	<0.001
HDL (mmol/L)	1.40 (1.20–1.79)	1.40 (1.20–1.71	0.789
LDL (mmol/L)	3.30 (2.80–3.94)	3.20 (2.43–3.90)	0.069
Glc (mmol/L)	4.50 (4.50–5.40)	5.50 (4.93–6.00)	<0.001
Creatinine (mmol/L)	76.00 (66.75–86.25)	78.00 (68.00–89.00)	0.196

Results are expressed as percentages (CI) or median values (interquartile range) as appropriate

RA rheumatoid arthritis, *OA* osteoarthritis, *CI* confidence interval, *BMI* body mass index, *WHR* waist-to-hip ratio, *VASP* pain visual analog scale, *VASGH* general health visual analog scale, *DM* diabetes mellitus, *ESR* erythrocyte sedimentation rate, *CRP* C-reactive protein, *Chol* plasma cholesterol, *TG* plasma triglycerides, *HDL* high-density lipoprotein, *LDL* low-density lipoprotein, *Glc* plasma glucose

proportion of elderly patients, a longer duration of the disease, a higher proportion of smokers (ever and current), lower BMI and WHR, a lower proportion of overweight/obese patients, similar VASP and VASGH, and lower proportions of dyslipidemic and DM patients.

Laboratory investigations showed higher plasma CRP concentrations and ESR, and lower Chol, TC and Glc plasma concentrations in the RA group. HDL, LDL and plasma creatinine concentrations were similar in both groups of patients.

Prevalence of HT in RA and OA patients (Table 3)

The prevalence of HT was lower in the RA group than in the OA group. However, when the results were adjusted for age and BMI, the prevalence was similar in both groups. Also, HT prevalence in RA and OA 55–70-year subgroups was similar.

The proportion of patients with a history of HT was lower in the RA group than in the OA group. The prevalence of newly discovered HT was similar in RA and OA, but newly discovered HT comprised a higher fraction of actual HT in RA than in OA patients. The rate of uncontrolled HT, expressed as fraction of treated HT, was similar in the RA and OA groups.

In both RA and OA, the prevalence of HT was higher in the elderly and overweight/obese patients than in patients under 65 years of age or with BMI values < 25. When RA and OA patients less than 65 years of age were sorted according to both age and BMI, the prevalence of HT was higher in overweight/obese patients than in those with BMI values < 25. In the elderly, this difference was smaller and statistically insignificant.

Taking the cutoff value for CRP concentration of 5 mg/L, the prevalence of HT was higher in the RA subgroup with higher CRP concentration than in that with lower concentration. In the OA there was no such difference.

In both RA and OA patients, the prevalence of HT was higher in DM than in nondiabetic patients. Upon comparing RA and OA, the prevalence of HT in DM was similar in both groups and that in nondiabetics was higher in the latter group than in the former group.

Table 3 Prevalence of hypertension in RA and OA patients

		RA ($N = 627$)	OA ($N = 352$)	P value
1	All patients, HTn/N [% (95 % CI)]	373/627 [59.5 (55.6, 63.3)]	258/352 [73.3 (68.4, 77.7)]	<0.001
	Adjusted for age and BMI, [% (95 % CI)]	[59.1 (55.1, 63.8)]	[60.0 (54.8, 65.0)]	0.609
2	HT anamnestic, HTn/N [% (95 % CI)]	281/627 [44.8 (41.0, 48.7)]	211/352 [59.9 (53.8, 64.0)]	<0.001
3	Newly discovered HT prevalence, HTn/N [% (95 % CI)]	111/627 [17.7 (14.9, 20.9)]	48/352 [13.6 (10.4, 17.6)]	0.185
4	Fraction of actual HT, HTn/n [% (95 %CI)]	111/373 [29.8 (25.4, 34.6)]	48/258 [18.6 (14.3, 23.8)]	0.017
5	Uncontrolled HT, fraction of treated HT, HTn/n [% (95 % CI)]	153/280 [54.6 (48.7, 60.3)]	131/222 [59.0 (52.4, 65.3)]	0.255
6	Age < 65 years, HTn/n [% (95 %CI)]	216/419 [51.6 (46.8, 56.3)]	91/153 [59.5 (51.6, 67.0)]	0.092
7	Age ≥ 65 years, HTn/n [% (95 %CI)]	157/208 [75.5 (69.2, 80.8)]	167/199 [83.9 (78.2, 88.4)]	0.035
	P value 6 versus 7	<0.001	<0.001	
8	Age 55–70 years, HTn/n [% (95 %CI)]	209/307 [68.8 (63.4, 73.7)]	122/162 [75.3(68.7, 81.3)]	0.163
9	BMI < 25, HTn/n [% (95 %CI)]	106/230 [46.1 (39.8, 52.6)]	38/62 [61.3 (48.9, 72.4)]	0.034
10	BMI ≥ 25, HTn/n [% (95 %CI)]	266/395 [67.3 (62.5, 71.7)]	218/288 [75.7 (70.4, 80.3)]	0.018
	P value 9 versus 10	<0.001	0.020	
11	Age < 65 years, BMI < 25, HTn/n [% (95 %CI)]	58/163 [35.6 (28.7, 43.2)]	13/31 [41.9 (26.4, 59.2)]	0.501
12	Age < 65 years, BMI ≥ 25, HTn/n [% (95 %CI)]	158/255 [62.0 (55.3, 67.7)]	77/122 [63.1 (54.3, 71.1)]	0.754
	P value 11 versus 12	<0.001	0.028	
13	Age ≥ 65 years BMI < 25, HTn/n [% (95 %CI)]	49/69 [71.0 (55.4, 80.4)]	25/31 [80.6 (63.7, 90.8)]	0.310
14	Age ≥ 65 years BMI ≥ 25, HTn/n [% (95 %CI)]	109/140 [77.9 (70.3–84.0)]	141/168 [83.9 (77.6, 88.7)]	0.140
	P value 13 versus 14	0.279	0.599	
15	CRP < 5.0 mg/L, HTn/n [% (95 %CI)]	119/234 [50.9 (44.5, 57.2)]	219/305 [72.0 (66.7, 76.7)]	<0.001
16	CRP > 5.0 mg/L, HTn/n [% (95 %CI)]	274/393 [64.6 (59.8, 69.2)]	39/48 [81.3(68.1, 89.8)]	0.023
	P value 15 versus 16	0.001	0.220	
17	HT in DM, HTn/n [% (95 %CI)]	47/60 [78.3 (66.3, 86.9)]	52/59 [88.1 (77.4, 94.1)]	0.153
18	HT in non-DM, HTn/n [% (95 %CI)]	326/567 [57.5 (52.0, 62.9)]	206/293 [70.3 (64.8, 72.2)]	<0.001
	P value 17 versus 18	0.002	0.005	
	HT prevalence and smoking habit			
19	Nonsmokers, HTn/n [% (95 %CI)]	221/351 [63.0 (57.8, 67.9)]	189/245 [77.1 (71.4, 81.9)]	<0.001
20	Ex-smokers, HTn/n [% (95 %CI)]	89/139 [64.0 (56.6, 72.2)]	40/55 [72.7 (59.7, 82.7)]	0.247
21	Current smokers, HTn/n [% (95 %CI)]	63/137 [46.0 (37.9, 54.3)]	29/52 [55.8 (42.4, 68.4)]	0.229
	P value 19 versus 20v21	0.001	0.007	
	Medication			
22	NSAID(s) users, HTn/n [% (95 %CI)]	180/313 [57.5 (52.0, 62.9)]	163/232 [70.3 (64.1, 75.8)]	0.004
23	NSAID(s) nonusers, HTn/n [% (95 %CI)]	193/314 [61.5 (56.0, 66.0)]	95/120 [79.2 (71.1, 85.5)]	<0.001
	P value 22 versus 23	0.313	0.073	
24	Glucocorticoids users, HTn/n [% (95 %CI)]	314/527 [59.6 (55.4, 63.7)]	0	ND
25	Glucocorticoids nonusers, HTn/n [% (95 %CI)]	59/100 [59.0 (49.2, 68.1)]	0	ND
	P value 24 versus 25	0.912		
26	Glucocorticoids duration <3 months, HTn/n [% (95 %CI)]	154/234 [65.8 (59.5-71.6)]	0	ND
27	Glucocorticoids duration > 3 months, HTn/n [% (95 %CI)]	137/246 [55.7 (49.4-61.8)]	0	ND
	P value 26 versus 27	0.025		

Results are expressed as percentages (95 %CI) of prevalence

RA rheumatoid arthritis, *OA* osteoarthritis, *HTn/N* prevalence of hypertension in RA or OA patients, *HTn* number of hypertensive patients, *N* number of the patients in the group, *CI* confidence interval, *BMI* body mass index, *HT* hypertension, *HTn/n* prevalence of hypertension in a subgroup of patients, *HTn* number of hypertensive patients in the subgroup, *n* number of patients in the subgroup, *CRP* C-reactive protein, *DM* diabetes mellitus, *NSAID(s)* nonsteroid anti-inflammatory drugs, *ND* not done

Regarding smoking habit, HT prevalence was higher in nonsmoker and ex-smokers than in current smokers in both groups.

The HT prevalence was similar in NSAIDs users and nonusers in both the RA and OA groups. In RA group, there was no difference in HT prevalence between

glucocorticoid users and nonusers, but in current users the prevalence of HT was higher in those taking glucocorticoids for more than 3 months.

Results regarding comparison of HT and NT (normotensive) subgroups of RA and OA patients and comparison of hypertensive RA and OA patients are shown in Online Resource table 1-S and 2-S.

Multivariate analysis

Variables that were significantly different comparing the HT and NT subgroups in RA and OA groups (see Online Resource table 1-S) were introduced in logistic regression models. The variables that were independently associated with HT presence in both, RA and OA, groups were age and BMI (see Online Resource table 2-S). To analyze mutual contribution of these variables to HT prevalence in all patients, age and BMI as numerical variables and the disease (RA or OA) as categorical variable were introduced in a logistic regression model (Table 4). The analysis indicated independent association of age and BMI with HT prevalence without contribution of features of the disease (RA or OA). From the date generated by the model, adjusted HT prevalence was calculated (Table 3).

Discussion

The characteristics of our RA and OA patients and their differences, including a higher prevalence in females in both RA and OA, higher age in OA and a longer duration of the disease for RA and higher proportion of smokers in RA, are consistent with reported epidemiological and clinical features of the diseases, reflecting a greater increase in OA prevalence with age and a lower age of onset of RA, a strong association of BMI with OA and an association of RA with smoking [26].

The prevalence of HT is associated with age [27] and BMI [28], which explains the higher prevalence of HT in OA. When the results were adjusted for age and BMI, the HT prevalence in RA and OA was similar.

In comparison with others studies, the prevalence of HT in RA group is lower than that reported in a similar study of Panoulas et al. [17]. The patients in that study were older than in the present study [63.1(55–69.6) vs. 59.00(52.00–68.00) median (IQR), respectively]. Similar HT prevalence in 55–70-year RA subgroups and that in the study [17] indicates that the difference in HT prevalence between the present study and the study [17] is due to difference in age of the patients. Regarding OA, our finding is similar to that reported in one of the previous studies [7].

The overall prevalence of HT in Croatia (44.2 %) is similar to that in other European countries [30]. When age was taken into account, only the higher prevalence of HT in OA patients under 65 years, compared with the prevalence in the general Croatian population, could be assumed (Fig. 1). However, this indirect comparison of prevalence is rather insufficient, and investigations with proper control groups are needed.

Upon comparing the rates of the newly discovered HT, the HT treated with antihypertensive therapy and the uncontrolled HT in the present study with the rates in the general Croatian population [29] and the rates described for RA [17], there is a lower rate for newly discovered HT ([29]: 44.5 %; [17]: 39.4 % vs. present study: 29.9 and 18.6 % for RA and OA, respectively), a higher rate for treated HT ([29]: 44.5 %; [17]: 60.6 % vs. present study: 75.1 and 86.0 % for RA and OA, respectively) and a lower rate for uncontrolled HT ([29]: 85.6 %; [17]: 78.36 % vs. present study: 41.0 and 50.8 % for RA and OA, respectively). This improvement in HT screening and therapy in rheumatologic diseases is probably the result of recently increased awareness of HT prevalence in RA [17, 30].

In both RA and OA, the association of HT with various variables follows that of HT in general (increased HT prevalence with age and BMI, association of HT with DM and with metabolic variables associated with HT) [26] (see Online Resource table 1-S) and is similar to that described for RA [17].

Table 4 Logistic regression analysis with HT as dependent variable in all patients

Variable	OR (95 %CI)	*P* value
RA-OA	1.040 (0.748–1.445)	0.816
Age	1.076 (1.061–1.091)	<0.001
BMI	1.115 (1.078–1.154)	<0.001

HT hypertension, *RA* rheumatoid arthritis, *OA* osteoarthritis, *BMI* body mass index

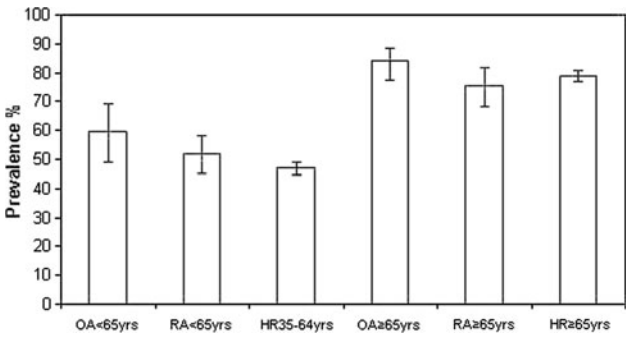

Fig. 1 Prevalence (confidence interval) of hypertension in osteoarthritis (OA) and rheumatoid arthritis (RA) patients and the Croatian (HR) population in age-groups <65 and ≥65 years. *Bars* for HR were constructed using data from Erceg et al. [29]

Due to the change in body composition (loss of lean body mass with an increase in fat body mass) in RA, BMI is lower for a given fat mass [31], which should be taken into account when BMI in RA is compared with that in other conditions. Alternatively, we measured WHR, which correlates with visceral adipose tissue and CV disease risk [19]. The higher WHR in OA (all patients) indicates a higher visceral adiposity in OA than in RA. Lower BMI values and similar WHRs in HT RA versus HT OA patients may indicate an underestimation of overweight and obesity in the former group (see Online Resource table 1-S).

The prevalence of HT in subgroups defined by both age and BMI (higher in the subgroup with BMI $\geq$ 25 than BMI $<$ 25 in patients $<$65 years of age and similar regarding BMI in patients $\geq$65 years of age) indicates a stronger association between age and HT than between BMI and HT.

Smoking has been shown to be a risk factor for HT in general [18], and an association with HT in RA has been described [17]. The lack of association of smoking with HT in both RA and OA in our study might be explained by the higher age of nonsmokers versus current smokers and ex-smokers in both the RA and OA groups (results not shown).

Higher values for markers of inflammation (ESR, CRP concentration) in RA compared to OA, as well as in the RA HT subgroup compared to NT RA (see Online Resource table 1-S) and higher HT prevalence in the CRP $>$ 5 mg/L than in the CRP $<$ 5 mg/L RA subgroup, show a higher grade of systemic inflammation in RA than in OA and an association of HT with degree of systemic inflammation in RA, respectively. This association was rather weak because it was not expressed in the multivariate analysis (Online Resource table 2-S), and there was no association between disease activity and HT assessed by the DAS28-CRP (see Online Resource table 1-S). In a retrospective study, an association between CRP concentration and HT was shown in RA [2], whereas no association of HT with either CRP or DAS was found in the cross-sectional study [17]. A causative role of systemic inflammation in the pathogenesis of HT in RA was proposed, but there was no conclusive evidence for that hypothesis [3, 17]. Cross-sectional studies with one point of measurement for inflammatory markers and HT, such as this study and that reported in [17], are not adequate to answer questions regarding the duration of disease, and future longitudinal studies are essential.

Antirheumatic therapy may provoke HT or interfere with its control, particularly in the case of NSAIDs used for the treatment of OA [11] and RA and for various DMARDs and GCs used to treat RA [3]. Our results, which showed no association of HT with NSAID use in RA and OA and an association of HT with leflunomide use (see Online Resource table 1-S) and with the duration of GC use in RA, were similar to the findings of others for RA [17, 32].

Finally, age and BMI were the only variables that were independently associated with HT in both the RA and OA (see Online Resource table 2-S) and in all patients (RA and OA). However, age and BMI, which are higher in OA than in RA, act as confounding variables that may obscure the association of other variables with HT, particularly systemic inflammation [33], and the influence of these variables could not be excluded.

Confounding effect of age and BMI has to be taken into account when comparing HT prevalence between RA and OA with other conditions in order to avoid erroneous conclusions.

In conclusion, this cross-sectional study has shown a robust association of age and BMI with HT prevalence in both RA and OA. The difference in HT prevalence between RA and OA is rather due to age and BMI than due to features of the disease, putting into question specific association between HT and RA [3].

Indirect comparison showed that HT prevalence in RA in our study was similar to the Croatian general population. For OA, HT prevalence was higher than that of the Croatian general population under 65 years and similar to that over 65 years.

Acknowledgments The authors thank Professor Davor Eterovic, Ph.D., of the University of Split Medical School for statistical advice. This work was supported by a grant from the Ministry of Science, Education and Sport, the Republic of Croatia (198-1081874-0183 to JMV).

Conflict of interest The authors declare no conflicts of interest.

References

1. John H, Kitas G, Toms T, Goodson N (2009) Cardiovascular co-morbidity in early rheumatoid arthritis. Best Pract Res Clin Rheumatol 23:71–82
2. Serelis J, Panagiotakos DB, Mavrommati M, Skopouli FN (2011) Cardiovascular disease is related to hypertension in patients with rheumatoid arthritis: a Greek cohort study. J Rheumatol 38:236–241
3. Panoulas VF, Metsios GS, Pace AV et al (2008) Hypertension in rheumatoid arthritis. Rheumatology (Oxford) 47:1286–1298
4. Boyer JF, Gourraud PA, Cantagrel A, Davignon JL, Constantin A (2011) Traditional cardiovascular risk factors in rheumatoid arthritis: a meta-analysis. Joint Bone Spine 78:179–183
5. Marks R, Allegrante JP (2002) Comorbid disease profiles of adults with end-stage hip osteoarthritis. Med Sci Monit 8:CR305-9
6. van Dijk GM, Veenhof C, Schellevis F et al (2008) Comorbidity, limitations in activities and pain in patients with osteoarthritis of the hip or knee. BMC Musculoskelet Disord 9:95
7. Singh G, Miller JD, Lee FH, Pettitt D, Russell MW (2002) Prevalence of cardiovascular disease risk factors among US adults with self-reported osteoarthritis: data from the Third National Health and Nutrition Examination Survey. Am J Manag Care 8(15 Suppl):S383–S391

8. Gabriel SE, Crowson CS, O'Fallon WM (1999) Comorbidity in arthritis. J Rheumatol 26:2475–2479
9. Erb N, Pace AV, Douglas KMJ, Banks MJ, Kitas GD (2004) Risk assessment for coronary heart disease in rheumatoid arthritis and osteoarthritis. Scand J Rheumatol 33:293–299
10. Verdecchia P, Angeli F, Mazzotta G, Gentile G, Reboldi G (2010) Emerging therapeutic strategies in osteoarthritic patients with hypertension. In: Optimising the management of osteoarthritis: emerging therapies, London BMJ Group, pp 8–12
11. Sipe JD (1995) Acute-phase proteins in osteoarthritis. Semin Arthritis Rheum 25:75–86
12. Morovic-Vergles J, Culo MI, Gamulin S, Culo F (2008) Cyclic adenosine 5′-monophosphate in synovial fluid of rheumatoid arthritis and osteoarthritis patients. Rheumatol Int 29:167–171
13. Arnett FC, Edworthy SM, Bloch DA et al (1988) The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis Rheum 31:315–324
14. Altman R, Alarcon G, Appelrouth D, Bloch D et al (1991) The American College of Rheumatology criteria for the classification and reporting of osteoarthritis of the hip. Arthritis Rheum 34:505–514
15. Altman R, Alarcon G, Appelrouth D, Bloch D et al (1990) The American College of Rheumatology criteria for the classification and reporting of osteoarthritis of the hand. Arthritis Rheum 33:1601–1610
16. Altman R, Asch E, Bloch D et al (1986) The American College of Rheumatology criteria for the classification and reporting of osteoarthritis of the knee. Arthritis Rheum 29:1039–1049
17. Panoulas VF, Douglas KMJ, Milionis HJ, Stavropoulos-Kalinglou A, Nightingale P, Kita MD et al (2007) Prevalence and associations of hypertension and its control in patients with rheumatoid arthritis. Rheumatology 46:1477–1482
18. Mancia G, De Backer G, Dominiczak A et al (2007) 2007 Guidelines for the management of arterial hypertension: the Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). Eur Heart J 28:1462–1536
19. See R, Abdullah SM, McGuire DK et al (2007) The association of differing measures of overweight and obesity with prevalent atherosclerosis: the Dallas Heart Study. J Am Coll Cardiol 50:752–759
20. Mannion AF, Balagué F, Pellisé F, Cedraschi C (2007) Pain measurement in patients with low back pain. Nat Clin Pract Rheumatol 3:610–618
21. DAS-score. nl: Disease activity score in rheumatic arthritis: http://www.das-score.nl/. Accessed 21 March 2011
22. Kirwan JR, Reeback JS (1986) Stanford health assessment questionnaire modified to assess disability in British patients with rheumatoid arthritis. Br J Rheumatol 25:206–209
23. The DAS calculator: http://www.das-score.nl/dasculators.html. Accessed 21 March 2011
24. World Health Organization. Department of Noncommunicable Disease Surveillance (1999) Definition and diagnostic criteria for diabetes mellitus and other categories of glucose intolerance. In: Definition, diagnosis and classification of diabetes mellitus and its complications. Report of a WHO consultation. Part 1, Diagnosis and classification of diabetes mellitus. World Health Organization, Geneva, pp 2–8
25. Zhang J, Yu KF (1998) What's the relative risk? JAMA 280:1690–1691
26. Woolf AD, Pfleger B (2003) Burden of major musculoskeletal conditions. Bull World Health Organ 81:646–656
27. Wolf-Maier K, Cooper RS, Banegas JR et al (2003) Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States. JAMA 289:2363–2369
28. Aneja A, El-Atat F, McFarlane SI, Sowers JR (2004) Hypertension and obesity. Recent Prog Horm Res 59:169–205
29. Erceg M, Hrabak-Zerjavić V, Ivicević Uhernik A (2007) Regional characteristics of arterial hypertension in adult population of Croatia. Acta Med Croatica 61:293–298 (Croatian)
30. Dessein PH, Norton GR (2008) Should patients with RA be aggressively monitored for hypertension? Nat Clin Pract Rheumatol 4:18–19
31. Stavropoulos-Kalinoglou A, Metsios GS, Koutedakis Y et al (2007) Redefining overweight and obesity in rheumatoid arthritis patients. Ann Rheum Dis 66:1316–1321
32. Panoulas VF, Douglas KM, Stavropoulos-Kalinoglou A et al (2008) Long-term exposure to medium-dose glucocorticoid therapy associates with hypertension in patients with rheumatoid arthritis. Rheumatology 47:72–75
33. Fernández-Real JM, Ricart W (2003) Insulin resistance and chronic cardiovascular inflammatory syndrome. Endocr Rev 24:278–301