Use of Lipid-lowering Agents in Rheumatoid Arthritis: A Population-based Cohort Study

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ABSTRACT. ***Objective.*** Rheumatoid arthritis (RA) is associated with an increased risk of cardiovascular disease and mortality. Lipid-lowering therapy is reportedly underused in patients with RA. Longitudinal cohort studies comparing use of lipid-lowering medications in patients with RA versus the general population are lacking.

Methods. Cardiovascular risk factors, lipid measures, and use of lipid-lowering agents were assessed in a population-based inception cohort of patients with RA and a cohort of non-RA subjects followed from January 1, 1988, to December 31, 2008. The National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATPIII) guidelines were assessed at the time of each lipid measure throughout followup. Time from meeting guidelines to initiation of lipid-lowering agents was assessed using Kaplan-Meier methods.

Results. The study population included 412 RA and 438 non-RA patients with ≥ 1 lipid measure during followup and no prior use of lipid-lowering agents. Rates of lipid testing were lower among patients with RA compared to non-RA subjects. Among patients who met NCEP ATPIII criteria for lipid-lowering therapy (n = 106 RA; n = 120 non-RA), only 27% of RA and 26% of non-RA subjects initiated lipid-lowering agents within 2 years of meeting the guidelines for initiation.

Conclusion. There was substantial undertreatment in both the RA and the non-RA cohorts who met NCEP ATPIII criteria for initiation of lipid-lowering agents. Patients with RA did not have as frequent lipid testing as individuals in the general population. (J Rheumatol First Release May 1 2013; doi:10.3899/jrheum.121302)

Key Indexing Terms:
RHEUMATOID ARTHRITIS LIPIDS LIPID-LOWERING THERAPY

Hyperlipidemia is an important risk factor for coronary heart disease (CHD) in the general population[1,2], with a continuous, graded increase in cardiovascular (CV) risk with increasing serum cholesterol levels and a concomitant decline in CV risk with reductions in serum cholesterol[3,4].

Research over the past decade has demonstrated increased CV risk in patients with rheumatoid arthritis (RA) versus non-RA subjects[5,6,7]. However, the association between lipid levels and CV risk in RA appears to be more complex than in the general population, with systemic inflammation being a potential important contributor to changes in lipid profile[8]. Growing evidence suggests that patients with active untreated RA have reduced total cholesterol (TC), low-density lipoprotein cholesterol (LDL), and high-density lipoprotein cholesterol (HDL)[9,10,11,12]. In contrast, declines in inflammatory activity may be accompanied by increases in serum lipid values[8,13,14,15,16,17].

Lipid-lowering therapy is recommended for patients at risk for CV disease related to hyperlipidemia. The National Cholesterol Education Program (NCEP) has published clinical guidelines (Adult Treatment Panel III; ATPIII) for cholesterol testing and management in the general population (Table 1). The need for increased attention to CV risk reduction in RA is highlighted by recent studies reporting the underuse of lipid-lowering agents (LLA) in patients with RA during both primary[18] and secondary prevention[19]. To address the need for CV risk management in RA, the European League Against Rheumatism (EULAR) has recommended that interventions for CV risk factor reduction, including the management of hyperlipidemia, should be undertaken according to national guidelines[20]. To better assess CV risk management in RA, we performed a study of use of LLA in patients with RA compared to patients without RA.

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Table 1. The National Cholesterol Education Program Adult Treatment Panel III guidelines for initiation of lipid-lowering therapy.

Cardiovascular Risk Category	LDL Level to Consider Lipid-lowering Therapy
High risk: CHD or CHD risk equivalent (MI, PAD, AAA, DM, revascularization procedures) or 10-year FRS for hard CHD endpoints > 20%	≥ 130 mg/dl
Moderately high risk: ≥ 2 risk factors* AND 10-year FRS for hard CHD endpoints 10%–20%	≥ 130 mg/dl
Moderate risk: ≥ 2 risk factors* AND 10-year FRS for hard CHD endpoints < 10%	≥ 160 mg/dl
Low risk: 0–1 risk factor*	≥ 190 mg/dl

* Risk factors include current smoking, hypertension or antihypertensive medication use, high-density lipoproteins < 40 mg/dl, family history of premature CHD, and age (≥ 45 years in men and ≥ 55 years in women). AAA: abdominal aortic aneurysm; CHD: coronary heart disease; DM: diabetes mellitus; MI: myocardial infarction; PAD: peripheral arterial disease; LDL: low-density lipoprotein; FRS: Framingham risk score.

MATERIALS AND METHODS

This retrospective population-based study was conducted using the unique medical records linkage system of the Rochester Epidemiology Project (REP), which allows access to the complete records from all healthcare providers in the area. The potential of the REP for population-based research has been well established, and its capabilities for studies in patients with rheumatic diseases have been well described[21,22].

The study population included all Olmsted County, Minnesota, residents age ≥ 18 years who fulfilled the 1987 American College of Rheumatology (ACR) criteria for RA between January 1, 1988, and December 31, 2007, and a comparison cohort of subjects without RA of similar age and sex from the same underlying community. RA incidence date was defined as the first day of fulfillment of 4 out of 7 ACR criteria for RA. For each patient with RA, a comparator subject without RA of similar age and sex was randomly selected from the same underlying population. The index date for non-RA subjects corresponded to the RA incidence date of the corresponding patient with RA. All subjects were followed longitudinally until death, migration from the county, or December 31, 2008.

The original and complete medical records of all subjects were reviewed longitudinally by trained nurse abstractors, supervised by the principal investigator. Information on CV risk factors [current cigarette smoking; blood pressure, diagnosis of hypertension/use of antihypertensive medication; family history of premature CHD; personal history of myocardial infarction (MI), peripheral arterial disease, abdominal aortic aneurysm, diabetes mellitus, revascularization procedures], the use of LLA (including statins, fibrates, bile acid sequestrants, and niacin), and RA characteristics was abstracted.

All clinically measured lipid values, i.e., TC, LDL, HDL, and triglycerides from incidence/index date to the last followup were abstracted. The NCEP/ATPIII guidelines were used to identify indications for initiation of LLA. Study subjects were classified into 4 CV risk categories (Table 1). In accord with the NCEP/ATPIII guidelines, the Framingham risk score (FRS) was used to define the 10-year risk for hard CHD endpoints, namely MI/coronary death[1]. The study protocol was approved by Mayo Clinic and Olmsted Medical Center institutional review boards.

Statistical analysis. Several subgroups of patients were used to examine the rate of LLA initiation. First, patients in either cohort who were not taking LLA prior to RA incidence/index date were compared (n = 536 RA; 544 non-RA). Second, patients in either cohort with > 1 lipid measure were compared (n = 412 RA; 438 non-RA). In these patients, the NCEP/ATPIII criteria were assessed using the first lipid test after RA incidence/index date. Finally, each patient's lipid measures and other CV risk factors were examined chronologically to identify patients who met NCEP/ATPIII criteria at any time during followup (n = 106 RA and 120 non-RA subjects). Kaplan-Meier methods were used to examine the rate of initiation of LLA; the log-rank test was used to compare the cohorts. Cox proportional hazards models were used to compare the cohorts adjusting for age, sex, time since RA incidence/index date, and CV risk level. Time to the next lipid test following a normal or an abnormal lipid test in the RA versus the non-RA cohort was examined using mixed models with random effects for subject to account for variation within subjects.

RESULTS

The study population included 650 patients with RA and 650 non-RA subjects. There were 536 patients with RA and 544 non-RA subjects with no LLA use prior to RA incidence/index date. The mean age at RA incidence for these RA patients (53.8 yrs, SD 15.6 yrs) was similar to that of the non-RA subjects at the index date (54.0 ± SD 15.7 yrs; p = 0.87). The proportion of women was similar in RA (70%) versus non-RA (71%; p = 0.82). The median followup was 7.4 years in RA and 8.4 years in the non-RA cohort. There were 21% of patients with family history of CHD in RA versus 22% in non-RA (p = 0.59). There were similar proportions of current smokers in RA (20%) versus non-RA (17%) cohorts (p = 0.25). In the RA cohort, 374 patients (70%) were positive for rheumatoid factor or anti-citrullinated peptide antibodies, and 148 (28%) had radiographic joint erosions/destructive changes in the first year of RA. The baseline erythrocyte sedimentation rate was 23.1 ± 19.0 mm/h. During the followup, 336 patients (63%) were exposed to methotrexate, 382 (71%) used other disease-modifying antirheumatic drugs (DMARD), 110 (21%) received biologics, and 424 (79%) used systemic corticosteroids.

There was no statistically significant difference in the time from index date to the first lipid measure in RA versus non-RA subjects (log-rank p = 0.68). By 5 years after RA incidence/index date, 80.5% of patients with RA and 77.4% of non-RA subjects had been tested. The rates of lipid testing were lower in RA than in non-RA subjects, with 2209 lipid tests during 4454 person-years (0.50 per patient per year; 95% CI 0.48, 0.52) in patients with RA and 2780 lipid tests during 5119 person-years (0.54 per patient per year; 95% CI 0.52, 0.56) in the non-RA subjects (p < 0.001). While patients with lipid values within the normal range may be less likely to receive repeat lipid tests than those with abnormal lipid values, we found no differences when

comparing RA versus non-RA patients in the time to next lipid test following a normal LDL test (defined as LDL < 160 mg/dl; p = 0.78) or in the time from an abnormal LDL test (LDL > 160 mg/dl) to the next lipid test (p = 0.88).

Apart from lower rates of lipid testing among patients with RA, by 2 years after RA incidence/index date, only 3.3% of patients with RA versus 4.7% of non-RA subjects had initiated LLA (log-rank p = 0.019). By 5 years the LLA initiation rates were 9.0% in RA versus 13.5% in the non-RA cohort, and by 10 years, 20.6% versus 27.6%, respectively. There was no apparent difference in initiation of LLA in the RA versus non-RA cohorts, adjusting for age, sex, TC, and LDL (HR 0.92; 95% CI 0.70, 1.21).

To assess the NCEP/ATPIII criteria, a lipid measure was required. A total of 412 patients with RA and 438 non-RA subjects had > 1 lipid measure after RA incidence/index date with no prior LLA use and were included in this analysis (Table 2). The age and sex distributions and time from the incidence/index to the first lipid test were similar in both groups. RA subjects had lower TC and LDL and higher systolic blood pressure than non-RA subjects. The baseline prevalence of CV risk factors and the prevalence of CHD (or CHD risk equivalents) were similar in both groups (Table 2). FRS estimates and the initial spread of risk per the NCEP/ATPIII criteria were similar in RA versus non-RA subjects.

The first lipid test result after incidence/index date met the NCEP/ATPIII criteria for initiation of LLA in 14% of RA patients and 15% of non-RA subjects. In this subset, the difference in LLA initiation between the 2 groups did not reach statistical significance (HR 0.84, 95% CI 0.52, 1.34). During the 2 years after the first lipid test, 24.5% of RA patients and 24.8% of non-RA subjects had initiated LLA (log-rank p = 0.61).

To further investigate the use of LLA in RA, we identified patients who had any lipid test that met NCEP/ATPIII criteria. During followup, there were 106 patients with RA and 120 non-RA subjects with a lipid test that satisfied the criteria (Table 3). These patients were older, with similar proportions of women in both groups. The prevalence of CHD and most CV risk factors were similar in both groups. However, FRS was higher in RA versus non-RA subjects (p = 0.007), in spite of lower TC and LDL. Increased levels of systolic blood pressure in RA

Table 2. Baseline characteristics of patients with rheumatoid arthritis (RA) and non-RA subjects with at least 1 lipid test after RA incidence/index date with no prior use of lipid-lowering medication.

Characteristic	RA, n = 412	Non-RA, n = 438	p†
Age at lipid test*, yrs, mean ± SD (range)	56.2 ± 13.9 (21–90)	55.8 ± 13.9 (22–94)	0.60
Sex female (%)	287 (70)	314 (72)	0.52
RA duration at lipid test*, yrs, mean ± SD	2.1 ± 2.2	2.2 ± 2.3	0.52
Length of followup from lipid test* to last followup, yrs, mean ± SD	7.6 ± 4.8	8.3 ± 5.0	—
TC, mg/dl, mean ± SD	**195 ± 37**	**205 ± 43**	**0.002**
LDL, mg/dl, mean ± SD	**115 ± 33**	**122 ± 37**	**0.017**
HDL, mg/dl, mean ± SD	55 ± 17	56 ± 17	0.19
HDL < 40 mg/dl (%)	72 (17)	67 (15)	0.39
TG, mg/dl, mean ± SD	128 ± 78	136 ± 99	0.62
Current smoker (%)	80 (19)	70 (16)	0.19
Hypertension or antihypertensive medication use (%)	117 (28)	105 (24)	0.14
Systolic blood pressure, mm Hg	**131 ± 19**	**129 ± 19**	**0.021**
Diastolic blood pressure, mm Hg	77 ± 11	77 ± 11	0.89
Family history of premature CHD (%)	84 (20)	104 (24)	0.24
Personal history of CHD or CHD risk equivalent (MI, PAD, AAA, DM, revascularization procedures; %)	54 (13)	51 (12)	0.52
Framingham risk score, %	6.1 ± 7.4	5.8 ± 7.6	0.46
Cardiovascular risk category (%)			0.48
High	74 (18)	71 (16)	
Moderately high	42 (10)	34 (8)	
Moderate	85 (21)	101 (23)	
Low	211 (51)	232 (53)	
NCEP ATPIII criteria recommend initiation of lipid-lowering therapy (%)	56 (14)	65 (15)	0.60

* The first lipid test after RA incidence/index date. † Statistically significant differences (p < 0.05) are shown in bold type. HDL: high-density lipoproteins; LDL: low-density lipoproteins; TC: total cholesterol; TG: triglycerides; CHD: coronary heart disease; AAA: abdominal aortic aneurysm; DM: diabetes mellitus; MI: myocardial infarction; PAD: peripheral arterial disease; NCEP ATPIII: The National Cholesterol Education Program Adult Treatment Panel III.

Table 3. Characteristics of patients for whom a lipid test* during followup met the National Cholesterol Education Program Adult Treatment Panel III criteria for initiation of lipid-lowering therapy.

Characteristic	RA, n = 106	Non-RA, n = 120	p†
Age at lipid test*, yrs, mean ± SD (range)	63.4 ± 12.2 (min 36, max 90)	62.8 ± 11.7 (min 36, max 94)	0.70
Sex female (%)	60 (57)	81 (68)	0.09
RA duration at lipid test, yrs, mean ± SD	4.1 ± 3.6	3.8 ± 3.9	0.26
Length of followup from lipid test to last followup, yrs, mean ± SD	7.6 ± 4.7	8.1 ± 5.1	—
TC, mg/dl, mean ± SD	**240 ± 31**	**251 ± 35**	**0.017**
LDL, mg/dl, mean ± SD	**159 ± 24**	**166 ± 26**	**0.032**
HDL, mg/dl, mean ± SD	49 ± 13	52 ± 15	0.18
HDL < 40 mg/dl (%)	29 (27)	28 (23)	0.49
TG, mg/dl, mean ± SD	160 ± 75	169 (79)	0.34
Current smoker (%)	29 (27)	23 (19)	0.14
Hypertension or antihypertensive medication use (%)	54 (51)	52 (43)	0.25
Systolic blood pressure, mm Hg	**142 ± 19**	**136 ± 23**	**0.005**
Diastolic blood pressure, mm Hg	84 ± 10	81 ± 13	0.29
Family history of premature CHD (%)	29 (27)	44 (37)	0.14
Personal history of CHD or CHD risk equivalent (MI, PAD, AAA, DM, revascularization procedures; %)	31 (29)	30 (25)	0.47
Framingham risk score, %	**12.9 ± 7.8**	**10.4 ± 8.3**	**0.007**
Cardiovascular risk category (%)			**0.018**
High	48 (45)	39 (32)	
Moderately high	27 (35)	35 (29)	
Moderate	13 (12)	33 (2)	
Low	8 (8)	13 (11)	

* The first lipid test after rheumatoid arthritis (RA) incidence/index date that meets criteria for initiation of lipid-lowering therapy. † Statistically significant differences ($p < 0.05$) are shown in bold type. HDL: high-density lipoproteins; LDL: low-density lipoproteins; TC: total cholesterol; TG: triglycerides; CHD: coronary heart disease; AAA: abdominal aortic aneurysm; DM: diabetes mellitus; MI: myocardial infarction; PAD: peripheral arterial disease.

versus non-RA subjects ($p = 0.005$) could contribute to the higher FRS in RA. There was a higher percentage of RA subjects categorized as high and moderately high risk based on their FRS compared to non-RA subjects. In the study subjects with any lipid test that met the NCEP/ATPIII criteria, the difference in initiation of LLA between patients with RA and non-RA subjects did not reach statistical significance (log-rank $p = 0.36$; Figure 1). By 2 years after the lipid test, 27.3% of patients with RA and 25.7% of non-RA subjects had initiated LLA. By 5 years, 43.2% of RA patients and 46.5% of non-RA subjects had initiated LLA. By 10 years after the lipid test, 58.0% of patients with RA and 69.9% of non-RA subjects had initiated LLA. After adjustment for age, sex, time since RA incidence/index date, and CV risk category, patients with RA were somewhat less likely to receive LLA than non-RA subjects, but this difference did not reach statistical significance (HR 0.81; 95% CI 0.56, 1.16).

Considering that the NCEP/ATPIII criteria were published in 2001 and could not have been used in clinical practice prior to their publication, we performed a sensitivity analysis of a subset of patients who met NCEP/ATPIII criteria in 2001 or after (n = 63 RA and n = 79 non-RA). In this subset the results were similar to those in all the patients who met NCEP/ATPIII criteria, with no significant difference in LLA initiation in RA versus non-RA subjects (log-rank $p = 0.81$), and no significant difference in the likelihood of using LLA in RA versus non-RA, adjusting for age, sex, time since incidence/index date, and CV risk category (HR 0.86; 95% CI 0.54, 1.36).

The rate of subsequent improvement of lipid profile without initiation of LLA was also examined. Improvement was defined as no longer meeting the NCEP/ATPIII criteria at the time of a subsequent lipid measurement in a patient who had not initiated LLA. No difference in improvement was found in RA versus non-RA subjects (log-rank $p = 0.26$). By 2 years after the lipid test, 80.6% of patients with RA and 82.5% of non-RA subjects had a continuing indication for LLA per the NCEP/ATPIII criteria. By 10 years after the lipid test, the estimates were 65.7% in RA versus 73.7% in non-RA subjects. After adjustment for age, sex, time since incidence/index date, and CV risk category, patients with RA who met NCEP/ATPIII criteria for LLA initiation but did not start this therapy were somewhat less likely to need LLA in the future (HR for subsequently achieving improved lipids without therapy = 1.51; 95% CI 0.91, 2.52) than non-RA subjects.

We examined the type of LLA used at initiation of

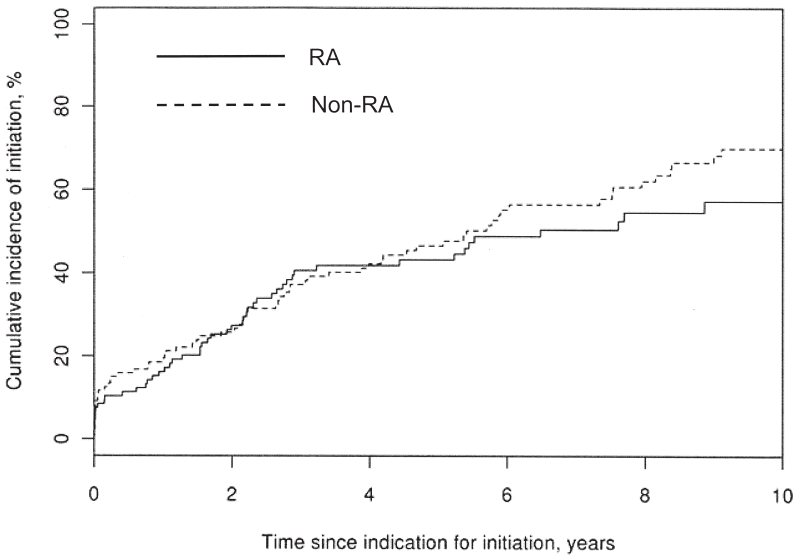

Figure 1. Cumulative incidence of initiation of lipid-lowering therapy among 106 patients with rheumatoid arthritis (RA) and 120 non-RA subjects who meet The National Cholesterol Education Program Adult Treatment Panel III criteria for initiation of lipid-lowering therapy.

lipid-lowering therapy. Among patients with RA who met NCEP/ATPIII criteria for LLA initiation and started LLA (n = 54) the majority (85%) were started on statins, 2 patients used fibrates (gemfibrozil), 2 patients used bile acid sequestrants (cholestyramine and colesevelam), and 4 patients used niacin. Similarly, of 72 non-RA subjects who met NCEP/ATPIII criteria for LLA initiation and started LLA, the vast majority (94%) were started on statins, 2 subjects used fibrates (gemfibrozil), and 2 subjects used niacin. Only 2 RA and 2 non-RA subjects used LLA before the publication of the Scandinavian Simvastatin Survival Study (4S) in April 1994[23], suggesting that the majority of lipid-lowering treatment in our study was initiated after this landmark publication.

DISCUSSION

The results of our study provide compelling evidence that there is substantial undertreatment of adverse lipid profiles in patients with RA, as well as the general population. However, among individuals who met the NCEP/ATPIII criteria for LLA, the difference in likelihood of initiating LLA between the RA and non-RA subjects did not reach statistical significance. Over the time period of the study, there was substantial undertreatment in both patients with RA and non-RA subjects, with only 26%–27% of patients with indications for LLA in either group having started therapy within 2 years after meeting the criteria.

We found that the rates of lipid testing were significantly lower in RA patients versus non-RA subjects. This is in keeping with previous findings from our cohort and others reporting less than optimal preventive screening of individuals with RA[24,25]. It could be suggested that initial lower lipid levels in RA versus non-RA subjects may lead to the lower likelihood of subsequent reassessment of lipid levels in RA. However, our finding of similar time to next lipid test in RA versus non-RA subjects with LDL < 160 mg/dl, as well as in those with LDL > 160 mg/dl, suggests that lower lipid levels may not be the major reason for decreased likelihood of lipid reassessment in RA.

Interestingly, by 2 years after meeting NCEP/ATPIII criteria for LLA initiation, only 27% of patients with RA and 26% of non-RA subjects had initiated LLA. Other investigators using cross-sectional data have also reported undertreatment along these lines[18,26]. Toms, *et al* found that only 5.2% of patients with RA who were eligible for statin therapy per the NCEP criteria received LLA[18]. That study, unlike ours, excluded patients with established CV disease and diabetes, and lipids were measured in all participants, which allowed the identification of patients meeting the criteria who had not yet come to clinical attention. This likely explains why more undertreatment in RA was reported in that study than in our study. Further, that study did not include a comparison cohort and thus low rates of statin use in RA may be due to the general undertreatment of subjects in the population at large. In a recent study, Lindhardsen, *et al*, using a very large cohort of patients with incident MI, found that patients with RA were ~30% less likely to initiate a statin within 30 days after MI and had decreased adherence to statin use compared to the non-RA subjects[19]. Together with our findings, these results suggest that, among RA patients, undertreatment with lipid-lowering

medications may be more apparent in patients with a history of CV disease.

The observed undertreatment may have serious implications, because patients with RA are less likely to report symptoms of angina and more likely to experience unrecognized MI and sudden cardiac death than non-RA subjects[6]. In our study, a substantial proportion of patients with RA who met criteria for initiation of LLA (Table 3) were already in the advanced CV risk groups (high and moderately high CV risk). This may be related to the less frequent lipid testing, a phenomenon also noted by others[27,28], suggesting that patients with RA were identified as meeting NCEP/ATPIII criteria much later than non-RA subjects, but after meeting the criteria they had the same chance of receiving LLA as the non-RA cohort.

In the general population, underuse of LLA remains widespread despite published management guidelines[1]. It has been estimated that, based on the NCEP/ATPIII guidelines, 65 million Americans would be eligible for LLA, of which only 50% have had their lipids assessed and < 25% are treated to their NCEP/ATPIII target LDL levels[29]. Concordant with these observations we found substantial undertreatment of adverse lipid profiles in the non-RA subjects, and the rates of LLA use seen in our non-RA population are consistent with these numbers.

Reasons for the undertreatment in the RA cohort and the general population were not explored further, but may relate to the lack of systematic screening, lack of adherence to the NCEP/ATPIII criteria for clinical decision-making, and lack of clarity regarding which of a patient's physicians should be responsible for managing CV risk. Other contributing factors could be patient preferences regarding statin use and insufficient awareness among physicians and patients regarding the CV influence of chronic inflammatory diseases such as RA, drug cost, and concerns about polypharmacy. Because of the fluctuations of lipid levels with changes of inflammatory activity and the decrease in lipid levels in patients with active RA, the prevalence of hyperlipidemia in RA may vary and the true extent of undertreatment may be easily underestimated, suggesting the need for more thorough CV risk screening in patients with severe RA. However, these considerations are purely speculative and require further investigation.

A majority of patients (65.7%) with RA and the non-RA subjects (73.7%) who met the NCEP/ATPIII criteria for starting LLA but did not do so were found to still satisfy the criteria 10 years later. Reasons for spontaneous reversal of the adverse lipid profile might have included improvement in modifiable CV risk factors such as smoking, body weight, lifestyle, and others, which could not be explored adequately in our study.

Our investigation is among the first population-based studies to examine the differences in use of LLA in RA versus the general population. It has the advantage of longitudinal followup of a population-based RA incidence cohort and a non-RA cohort from the same community. A comprehensive review of the entire (inpatient and outpatient) medical records of all subjects was performed. The availability of extensive data on CV risk factors and LLA use is another strength of the study. We rigorously applied the NCEP/ATPIII criteria to determine indications for LLA.

The results should be interpreted in light of the fact that the population of Olmsted County, Minnesota, during the calendar years under investigation was > 95% white. With the exception of a higher proportion of the working population employed in the healthcare industry, and correspondingly higher education levels, the population is socioeconomically similar to American whites[21]. Thus, our results may not be generalizable to more diverse populations. We applied the NCEP/ATPIII criteria to identify indications for LLA in RA and the non-RA cohort. These criteria were published in 2001, so could not have been used for clinical decision-making prior to 2001. However, a sensitivity analysis in the subset of patients who met NCEP/ATPIII criteria in 2001 or after yielded results that were similar to those for all patients.

As with any longitudinal study, there is a possibility that changes in the assessment of CV risk factors may have occurred during the study time. However, all subjects in both the RA and non-RA cohorts received their medical care from similar healthcare facilities in the area, and any changes in the risk factor assessment during the study time would affect both groups equally. As in any retrospective study, only information about medications recorded in the medical record was available. Data were not available regarding medication adherence, and the effect of any recommendations about lifestyle modifications was not examined. Although we did not study nonpharmacologic interventions or their effects, the majority of patients in our study had a continuing indication for LLA at 10 years. Finally, the sample size of our study resulted in limited statistical power for some comparisons.

This study provides compelling evidence that there is substantial undertreatment of adverse lipid profiles in patients with RA, as well as the general population. These findings have important implications for the detection and prevention of CV comorbidity in RA. As findings from our study demonstrate, patients with RA, in spite of having lower lipid levels, tend to have higher FRS, putting them at a greater CV risk. Physicians who care for these patients should be aware of the higher risk of CV disease already present at the time of initial diagnosis of RA and should actively monitor patients for it and pursue risk modification. Patients with RA do not have lipid testing as often as individuals in the general population. Perhaps a greater awareness of guidelines regarding LLA could improve treatment initiation overall. Co-management between

primary care and rheumatologists may improve the delivery of preventive care for patients with arthritis[25].

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