International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw,
Poland 00-773
+48 226 0 227 03
editorial_office@rsglobal.pl

ARTICLE TITLE	CARDIOVASCULAR RISK IN RHEUMATOID ARTHRITIS- A COMPREHENSIVE REVIEW OF MECHANISMS, ASSESSMENT, AND MANAGEMENT
DOI	https://doi.org/10.31435/ijitss.4(48).2025.4470
RECEIVED	13 November 2025
ACCEPTED	23 December 2025
PUBLISHED	29 December 2025
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

CARDIOVASCULAR RISK IN RHEUMATOID ARTHRITIS- A COMPREHENSIVE REVIEW OF MECHANISMS, ASSESSMENT, AND MANAGEMENT

Magdalena Morytko *(Corresponding Author, Email: m.morytko1@gmail.com)*
The University Hospital in Kraków, Kraków, Poland
ORCID ID: 0009-0005-3913-4457

Szymon Rudawski
The University Hospital in Kraków, Kraków, Poland
ORCID ID: 0009-0000-4793-3244

Magdalena Zięba
Gabriel Narutowicz Municipal Specialist Hospital in Kraków, Kraków, Poland
ORCID ID: 0009-0009-3281-1725

Maja Elertowicz
Ludwik Rydygier Memorial Hospital in Kraków, Kraków, Poland
ORCID ID: 0009-0002-8802-0323

Mikołaj Moskwa
Jagiellonian University Medical College, Kraków, Poland
ORCID ID: 0009-0006-4404-8243

Patrycja Herod
Ludwik Rydygier Memorial Hospital in Kraków, Kraków, Poland
ORCID ID: 0000-0002-4232-771X

Aleksandra Wójciak
The New Hospital in Olkusz, Olkusz, Poland
ORCID ID: 0009-0003-2398-863X

Kateryna Shtohryn
Jagiellonian University Medical College, Kraków, Poland
ORCID ID: 0009-0009-9134-4741

ABSTRACT

Rheumatoid arthritis (RA) is a systemic inflammatory condition associated with a markedly increased risk of cardiovascular (CV) morbidity and mortality, approximately 1.5-2- fold higher than in the general population. Chronic systemic inflammation, immune dysregulation, and increased oxidative stress in RA contribute to accelerated atherosclerosis, endothelial dysfunction, and cardiac remodeling. Conventional CV risk factors- such as dyslipidemia, hypertension, diabetes, and smoking- are also more prevalent in RA, further amplifying vascular injury. Despite advances in understanding these mechanisms, CV disease remains the leading cause of death among patients with RA. Traditional risk assessment tools are often insufficient in RA, highlighting the need for improved risk stratification and preventive strategies. Current management focuses on early and aggressive control of inflammation using disease-modifying antirheumatic drugs (DMARDs) to achieve remission or low disease activity. According to recent European League Against Rheumatism (EULAR) recommendations, coordinated multidisciplinary care involving both rheumatology and cardiology is essential for early detection and prevention of CV complications. Patient education, lifestyle modification, and stringent management of modifiable risk factors are key strategies that can significantly reduce CV events and improve long-term outcomes in RA.

Materials and methods: This narrative review aims to address current knowledge on cardiovascular risk in rheumatoid arthritis, including underlying mechanisms, assessment methods, and management strategies. A nonsystematic literature search of PubMed, Embase, and Directory of Open Access Journals (DOAJ) was conducted in August 2025 using keywords such as “rheumatoid arthritis”, “cardiovascular disease”, “cardiovascular risk”, “atherosclerosis”, “disease-modifying antirheumatic drugs”. Studies published between 2000 and 2025 were considered. Peer-reviewed original research articles and systematic or narrative reviews written in English were included based on their relevance to the topic.

KEYWORDS

Rheumatoid Arthritis, Cardiovascular Disease, Cardiovascular Risk, Inflammation, Atherosclerosis, Disease-Modifying Antirheumatic Drugs

CITATION

Magdalena Morytko, Szymon Rudawski, Magdalena Zięba, Maja Elertowicz, Mikołaj Moskwa, Patrycja Herod, Aleksandra Wójciak, Kateryna Shtohryn (2025) Cardiovascular Risk in Rheumatoid Arthritis: A Comprehensive Review of Mechanisms, Assessment, and Management. *International Journal of Innovative Technologies in Social Science*. 4(48). doi: 10.31435/ijitss.4(48).2025.4470

Introduction

Rheumatoid arthritis (RA) is a chronic autoimmune disease characterized by progressive and destructive polyarthritis. According to comprehensive epidemiological reports, the global prevalence of RA is approximately 0.46%, although rates vary substantially across regions and populations. The disease occurs two to three times more frequently in women than in men, with peak onset typically between 40 and 60 years of age. Additionally, the risk of developing RA increases significantly after the age of 60 [1].

RA predominantly affects the small joints of the hands, wrists, and feet. The hallmark articular features include joint pain, swelling, and prolonged morning stiffness, often leading to reduced mobility and functional impairment. If not properly managed, RA can greatly diminish quality of life and result in progressive joint damage as well as multiple associated comorbidities [2]. Beyond the musculoskeletal system, the chronic inflammation characteristic of RA contributes to a wide range of extra-articular manifestations, which occur in approximately 40% of patients. Patients with RA often experience fatigue, weight loss, and low-grade fever, as well as various systemic involvements. Subcutaneous rheumatoid nodules, particularly over extensor surfaces, are the most frequent skin manifestations. They predominantly occur in seropositive RA, which is indicated by the presence of rheumatoid factor (RF) and/or anti-citrullinated protein antibodies (ACPA) [3]. Pulmonary involvement usually presents as pleuritis or interstitial lung disease, while renal manifestations include secondary amyloidosis and mesangial glomerulonephritis. Patients may also experience xerostomia (oral dryness) and salivary gland swelling, which can lead to secondary Sjogren’s syndrome. Other extra-

articular manifestations include peripheral neuropathy, small vessel vasculitis, and ocular involvement such as keratoconjunctivitis sicca [4].

Patients with RA are also more likely to develop cardiovascular (CV) disease, which represents the leading cause of premature mortality in this population [5, 6]. Current evidence demonstrates that RA is associated with a 50% higher risk of CV mortality compared with the general population. CV incidents typically occur approximately 10 years earlier in individuals with RA, suggesting that RA itself may serve as an independent risk factor for ischemic heart disease [7]. The term "CV disease" in RA encompasses a broad range of cardiac and vascular conditions rather than a single entity. Patients are at increased risk of hypertension (HT), heart failure (HF), atrial fibrillation (AF), coronary artery disease (CAD), and myocardial infraction (MI) [8]. Importantly, RA is associated with a higher risk of silent MI and sudden cardiac death. Similar trends have been observed for stroke and thromboembolic events, both of which occur at roughly twice the rate seen in the general population.

The elevated CV risk in RA is driven by both traditional risk factors- such as hypertension, type 2 diabetes, smoking, dyslipidemia, and obesity- and the pro-atherogenic effects of systemic inflammation and immune dysregulation [9]. Atherosclerosis, often identified through increased carotid intima-media thickness, is a major comorbidity in RA and a key contributor to CV complications [10]. Traditional CV risk assessment tools, although useful in the general population, tend to underestimate the risk in RA. Atypical presentations of coronary events, the scarcity of large randomized-controlled trials (RCTs), and inadequate implementation of prevention strategies further contribute to suboptimal identification and management of CV risk in this population. These challenges highlight the need for a tailored approach to improve risk stratification and guide evidence-based management strategies.

Etiology of rheumatoid arthritis and atherosclerosis

Although the pathogenesis of RA is not yet fully understood, current evidence indicates that it is driven by a multifactorial interaction among genetic predisposition, environmental triggers, and immunological factors [11]. The heritability of RA is estimated to be approximately 60%, with some of the strongest genetic associations found within human leukocyte antigen (HLA) alleles such as HLA-DRB1*01, DRB*04, DRB*13, and DRB*15 [12]. These HLA alleles, which are highly associated with seropositive RA, play a crucial role in regulating autoantibody production, a central mechanism in the disease's pathogenesis. Moreover, large-scale genome-wide association studies (GWAS) have identified several non- HLA susceptibility genes in RA, including PTPN22, TRAF1/C5, STAT4, PADI4, among others. It is well-established that certain genetic variants are associated with increased disease severity and worse clinical outcomes in RA, likely through their role in promoting ACPA formation [13].

According to numerous studies, smoking, along with other lifestyle-related factors, may trigger ACPA production and contribute to the development of seropositive RA. The interaction between smoking and certain HLA alleles can lead to extra-articular manifestations, including rheumatoid nodules and CV disease, and is associated with a more aggressive disease course [14]. Smoking, in particular, is a well-established and common risk factor for both RA and CV disease [15]. Additional factors, such as alternations in the gut microbiome, female sex, and air pollution, may further contribute to disease onset in genetically predisposed individuals [16]. The progression of RA typically begins several years prior to clinical symptom onset, with the formation of certain autoantibodies. This initiates a chronic autoimmune response, characterized by macrophage activation through complement and Fc receptors. The local inflammatory response, particularly in the joints, is further intensified by T-cell activation, ultimately leading to synovial damage and clinically manifesting as pain, swelling and joint stiffness [5]. Secretion of pro-inflammatory cytokines and chemokines attracts immune effector cells, thereby amplifying local and systemic inflammation. The clinical progression of RA is strongly influenced by elevated levels of mediators such as tumor necrosis factor-alpha (TNF- α), interleukin (IL)-1, IL-6, IL-8, IL-12, and IL-18, as well as growth factors including vascular endothelial growth factor (VEGF) and fibroblast growth factor-2 (FGF-2). Many of these pro- inflammatory cytokines signal through the Janus kinase/signal transducer and activator of transcription (JAK/STAT) pathway, amplifying inflammatory gene transcription and driving synovitis and progressive joint destruction. Consequently, JAK inhibitors such as tofacitinib, baricitinib, and upadacitinib, have emerged as effective treatment options in RA and other inflammatory diseases [17].

Cardiovascular risk in rheumatoid arthritis

The development of atherosclerosis represents the primary mechanism underlying CV disease in RA, involving inflammatory pathways that resemble those mediating synovial inflammation. According to a recent systematic review, accelerated atherosclerosis is highly prevalent in patients with RA and is driven by proinflammatory cytokines, specific autoantibodies, and endothelial disfunction [18]. Current evidence indicates that even patients with persistent mild RA disease activity often exhibit signs of accelerated atherosclerosis [19]. Elevated levels of cytokines, including TNF-α, IL-1 and IL-6, promote endothelial disfunction, vascular remodeling, and plaque formation. Furthermore, increased CRP and IL-6 levels are independent markers of CV risk and correlate with higher mortality in patients with acute coronary syndrome (ACS). Growing evidence suggests that suppressing inflammatory activity, with the goal of achieving disease remission or minimal disease activity, reduces CV risk in RA [20]. Conventional CV risk factors, such as dyslipidemia, hypertension, and smoking, further contribute to the formation of atherosclerotic plaques by damaging the arterial endothelium [21].

Hypertension (HT) is a highly prevalent CV risk factor in RA, substantially contributing to the excess CV burden in this patient population. The chronic inflammation characteristic of RA promotes HT by inducing endothelial dysfunction, vascular remodeling, and increased arterial stiffness [22]. In a cohort of more than 600 patients with RA, approximately 52% had HT, although prevalence rates vary across populations [23, 24]. Importantly, certain medications commonly used in RA can contribute to elevated blood pressure. Special caution is advised in patients prescribed glucocorticoids, COX-2 inhibitors, or leflunomide, which carry the highest risk of inducing HT [25, 26]. Despite growing recognition of HT as a major contributor to excess CV risk, it frequently remains underdiagnosed and undertreated, highlighting the importance of regular blood pressure monitoring and effective therapeutic strategies [7].

Alternations in lipid metabolism, referred to as the “lipid paradox”, are a well- documented feature of RA. Increased inflammation is associated with decreases in lipid levels, a phenomenon also observed in other inflammatory conditions such as sepsis or cancer. Consequently, patients with RA may present with low or normal levels of total cholesterol (TC), low-density lipoprotein (LDL), and high-density lipoprotein (HDL) [27]. Importantly, the inflammatory burden in RA is linked to both quantitative and qualitative alternations in lipoproteins. The composition and function of HDL particles are altered, with reduced anti- oxidative and atheroprotective properties [28]. Notably, several studies have reported that lipid concentrations increase following successful anti-inflammatory treatment. According to the Apolipoprotein-related Mortality RISk (AMORIS) study, the association between total cholesterol and MI is less consistent in patients with RA compared with the general population [29]. These findings suggest that standard interpretation of lipid profiles for estimating CV risk may be misleading in RA [20].

While obesity is typically considered a risk factor for CV disease in the general population, the relationship between body mass and CV risk in patients with RA is more complex and not fully understood [30]. In RA, both high and low body mass index (BMI) have been associated with adverse CV outcomes. Evidence indicates that obesity may exacerbate conventional risk factors such as hypertension and dyslipidemia, thereby impairing vascular function [31]. Conversely, low BMI in RA has also been linked to increased CV mortality, potentially due to rheumatoid cachexia, in which chronic systemic inflammation leads to significant abnormalities in body composition [32]. This phenomenon, often referred to as the “obesity paradox”, emphasizes the importance of considering both body composition and inflammatory activity, rather than relying solely on BMI, when assessing CV risk in RA.

Assessment of cardiovascular risk in rheumatoid arthritis

CV risk in RA can be assessed using calculators such as the Framingham and SCORE models; however, these tools tend to underestimate risk in RA patients due to the additional burden of systemic inflammation [33]. Consequently, current EULAR guidelines recommend adjusting conventional risk scores by applying a 1.5 multiplication factor if two or three of the following criteria are met: RF or ACPA positivity, disease duration longer than 10 years, and the presence of extra-articular manifestations [20]. Nonetheless, multiple studies highlight the limitations of this approach, demonstrating that CV risk in RA remains underestimated even after applying the recommended adjustment [33].

When available, RA-specific tools may be used, including the Expanded Cardiovascular Risk Prediction Score for Rheumatoid Arthritis (ERS-RA) developed by Solomon et al. [34] which incorporates RA-specific variables such as disease activity, disability, daily prednisone dose, and disease duration. Combining traditional risk factors with such disease-specific variables has been shown to improve CV risk prediction

compared with general population algorithms. Similarly, the QRISK3 score, developed and validated for the UK population, includes RA and glucocorticoid use as independent risk factors. Although it enhances risk estimation by incorporating RA-specific predictors, its generalizability to non- UK populations may be limited [35]. Recent studies suggest that indicators of systemic inflammation, such as C-Reactive Protein (CRP), represent additional independent risk factors for CV mortality in RA patients [36]. Furthermore, higher disease activity, reflected by an increased 28 joint disease activity score (DAS28), has been shown to correlate with an elevated risk of ACS in patients with RA [37].

Available imaging modalities can assist in estimating CV risk in patients with RA. Carotid artery ultrasound has proven useful for detecting atherosclerotic plaques in subclinical disease, providing a more comprehensive assessment of CV risk [38]. Carotid intima-media thickness (cIMT) is widely employed as an indicator of subclinical atherosclerosis and correlates with CV risk [18]. Numerous studies have demonstrated that RA patients have substantially elevated cIMT values compared with healthy control groups [39, 40]. Moreover, a recent cross-sectional study reported a strong association between increased cIMT and both disease activity (DAS28) and disease duration [41]. In recent years, emerging artificial intelligence-based approaches applied to carotid ultrasound have shown potential to enhance CV risk assessment and support the clinical management of RA. These models are capable of analyzing plaque morphology, quantifying vascular stiffness, and integrating inflammatory markers with metabolic risk factors to provide a more precise prediction of CV events [42]. Although the results are promising, further external validation is needed to ensure the clinical applicability of these methods.

Management strategies

Cardiovascular risk management in RA focuses on both aggressive suppression of systemic inflammation and careful screening of traditional risk factors. Effective control of disease activity through disease-modifying antirheumatic drugs (DMARDs) can reduce the inflammation-mediated vascular damage and thereby lower the risk of atherosclerosis and CV events. Current evidence indicates that the use of methotrexate, the most commonly prescribed conventional DMARD (cDMARD), is associated with a 21% reduction in CV disease risk in patients with RA. Methotrexate has been shown to lower CV risk primarily through its anti- inflammatory effects rather than by modifying conventional CV risk factors [43]. It is well established that high-grade systemic inflammation contributes to premature atherosclerosis. TNF-a inhibitors, a class of biologic DMARDs (bDMARDs), reduce immune response by targeting a key pro-inflammatory cytokine involved in the pathogenesis of RA. Multiple studies have shown that TNF-a inhibitors such as infliximab, etanercept, and adalimumab improve vascular function and reduce the incidence of major CV events in patients with RA [44].

An important step in managing CV risk in RA is implementing lifestyle modifications, including smoking cessation and improving physical fitness. Proper patient education, adherence to a healthy diet, and structured exercise programs are essential for achieving adequate control of disease activity. Regular monitoring of lipid levels, blood pressure, and blood sugar levels is also necessary. Patients with RA exhibit higher rates of metabolic syndrome, which is characterized by the presence of at least three of the following five components: excess abdominal weight, hypertriglyceridemia, low HDL cholesterol, elevated fasting glucose, and high blood pressure [45]. According to a recent meta-analysis, the prevalence of metabolic syndrome in RA is estimated to be approximately 30.7% [7]. Importantly, insulin resistance, often exacerbated by glucocorticoid therapy, is a major contributor to the increased CV risk associated with metabolic syndrome.

Alternations in lipid profiles are another key component of the increased CV risk in RA. Management of dyslipidemia requires attention to both standard lipid-lowering therapies and rigorous control of systemic inflammation, as the so-called “lipid paradox” complicates the interpretation of lipid profiles [46]. Statins have been shown to be effective for the primary prevention of CV events in this group of patients, and withdrawal of statin treatment is associated with an increased risk of ACS and CV mortality [44]. The use of statins in RA may provide additional benefits, as they also exhibit potential anti-inflammatory properties [47].

The management of hypertension requires an aggressive approach, as the high rates of underdiagnosis and undertreatment in the RA population are associated with poorer clinical outcomes. Current evidence suggests that RA patients with hypertension have an 84% increased risk of MI compared with those without hypertension [48]. Blood pressure targets in RA should follow recommendations established for the general population, as no disease-specific thresholds have been proposed [49, 50]. Studies have shown that RA patients often exhibit subclinical hypertension, underscoring the importance of regular screening [51]. According to EULAR recommendations, ACE inhibitors/A-II blockers should be considered first-line treatments for

hypertension due to their additional beneficial anti-inflammatory effects [33]. Antiplatelet therapy, although recommended for individuals with established CV disease, has uncertain benefits in patients with RA and must be balanced against the potential gastrointestinal risks [47].

Although non-steroidal anti-inflammatory drugs (NSAIDs) can effectively reduce pain and restore physical function of affected joints, they should be used carefully in patients with RA due to their potential side-effects, including an increased risk of CV disease. The CV risk associated with NSAID use depends on the specific NSAID, patient-related factors, and duration of exposure. Clinicians should carefully balance the benefits of pain relief with the possibility of significant treatment-related complications. Current evidence indicates that rofecoxib, diclofenac, and etoricoxib are associated with the highest increase in CV risk in RA and should be avoided in patients with established CV disease [52]. Several studies also demonstrate that glucocorticoids may increase CV risk through their effects on blood pressure and lipid metabolism. On the contrary, the antiproliferative and anti-inflammatory effect of glucocorticoids may attenuate atherosclerosis. Evidence demonstrates that high-dose glucocorticoid therapy is associated with a dose-dependent increase in CV risk in RA. Consequently, EULAR recommendations advise using the lowest effective corticosteroid dose [53].

Conclusions

Successful management of CV risk in RA requires a coordinated effort between clinicians and patients, with shared responsibility for implementing both pharmacologic and non-pharmacologic strategies. Lifestyle modifications such as smoking cessation, maintaining a healthy diet, and regular physical activity are essential components of CV risk reduction and should be emphasized in clinical practice. Annual CV risk screening for all patients with RA can facilitate early identification of modifiable risk factors, ultimately reducing the incidence of adverse CV events and improving long-term outcomes. Tight control of hypertension, dyslipidemia, and systemic inflammation is fundamental for achieving optimal disease control and lowering morbidity and mortality in RA. A deeper understanding of the mechanisms underlying immune dysregulation not only improves the ability to identify patients at higher risk of erosive joint damage and CV complications but also enables personalized approaches, including predicting treatment responses to DMARDs and biologic agents. Emerging artificial intelligence-based tools offer promising opportunities to improve diagnostic accuracy and refine risk stratification. Ultimately, a comprehensive approach that integrates lifestyle modification, stringent control of disease activity, and the effective incorporation of innovative technologies is essential for delivering optimal and comprehensive patient care.

Funding Statement: The article did not receive any funding.
Conflict of Interest Statement: No conflicts of interest to declare.

REFERENCES

1. Almutairi K, Nossent J, Preen D, et al (2021) The global prevalence of rheumatoid arthriCs: a meta-analysis based on a systemaCc review. Rheumatol Int 41:863–877. hPps://doi.org/10.1007/s00296-020-04731-0
2. Jahid M, Khan KU, Rehan-Ul-Haq, Ahmed RS (2023) Overview of Rheumatoid ArthriCs and ScienCfic Understanding of the Disease. MJR 34:284. hPps://doi.org/10.31138/mjr.20230801.oo
3. Cojocaru M, Cojocaru IM, Silosi I, et al (2010) Extra-arCcular ManifestaCons in Rheumatoid ArthriCs. Maedica (Bucur) 5:286–291
4. Figus FA, Piga M, Azzolin I, et al (2021) Rheumatoid arthriCs: Extra-arCcular manifestaCons and comorbidiCes. Autoimmunity Reviews 20:102776. hPps://doi.org/10.1016/j.autrev.2021.102776
5. Dijkshoorn B, Raadsen R, Nurmohamed MT (2022) Cardiovascular Disease Risk in Rheumatoid ArthriCs Anno 2022. JCM 11:2704. hPps://doi.org/10.3390/jcm11102704
6. Dadoun S, Zeboulon-Ktorza N, Combescure C, et al (2013) Mortality in rheumatoid arthriCs over the last fidy years: SystemaCc review and meta-analysis. Joint Bone Spine 80:29–33. hPps://doi.org/10.1016/j.jbspin.2012.02.005
7. Jagpal A, Navarro-Millán I (2018) Cardiovascular co-morbidity in paCents with rheumatoid arthriCs: a narraCve review of risk factors, cardiovascular risk assessment and treatment. BMC Rheumatol 2:10. hPps://doi.org/10.1186/s41927-018-0014-y
8. Kerola AM, Rollefstad S, Semb AG (2021) AtheroscleroCc Cardiovascular Disease in Rheumatoid ArthriCs: Impact of InflammaCon and AnCrheumaCc Treatment. Eur Cardiol 16:e18. hPps://doi.org/10.15420/ecr.2020.44
9. Farhat H, Irfan H, Muthiah K, et al (2022) Increased Risk of Cardiovascular Diseases in Rheumatoid ArthriCs: A SystemaCc Review. Cureus. hPps://doi.org/10.7759/cureus.32308

10. England BR, Thiele GM, Anderson DR, Mikuls TR (2018) Increased cardiovascular risk in rheumatoid arthriCs: mechanisms and implicaCons. BMJ k1036. hPps://doi.org/10.1136/bmj.k1036
11. McInnes IB, ScheP G (2011) The Pathogenesis of Rheumatoid ArthriCs. N Engl J Med 365:2205–2219. hPps://doi.org/10.1056/NEJMra1004965
12. Gonzalez-Gay MA, Gonzalez-Juanatey C, Lopez-Diaz MJ, et al (2007) HLA–DRB1 and persistent chronic inflammaCon contribute to cardiovascular events and cardiovascular mortality in paCents with rheumatoid arthriCs. ArthriCs & RheumaCsm 57:125–132. hPps://doi.org/10.1002/art.22482
13. Raychaudhuri S (2010) Recent advances in the geneCcs of rheumatoid arthriCs. Current Opinion in Rheumatology 22:109–118. hPps://doi.org/10.1097/BOR.0b013e328336474d
14. Kurkó J, Besenyei T, Laki J, et al (2013) GeneCcs of Rheumatoid ArthriCs — A Comprehensive Review. Clinic Rev Allerg Immunol 45:170–179. hPps://doi.org/10.1007/s12016-012-8346-7
15. Sugiyama D, Nishimura K, Tamaki K, et al (2010) Impact of smoking as a risk factor for developing rheumatoid arthriCs: a meta-analysis of observaConal studies. Annals of the RheumaCc Diseases 69:70–81. hPps://doi.org/10.1136/ard.2008.096487
16. Deane KD, Demoruelle MK, Kelmenson LB, et al (2017) GeneCc and environmental risk factors for rheumatoid arthriCs. Best PracCce & Research Clinical Rheumatology 31:3– 18. hPps://doi.org/10.1016/j.berh.2017.08.003
17. Ciobanu D, Poenariu I, Crlll 뀀掴 nguș L-I, et al (2020) JAK/STAT pathway in pathology of rheumatoid arthriCs (Review). Exp Ther Med. hPps://doi.org/10.3892/etm.2020.8982
18. Raj R, Thomas S, Gorantla V (2022) Accelerated atherosclerosis in rheumatoid arthriCs: a systemaCc review. F1000Res 11:466. hPps://doi.org/10.12688/f1000research.112921.1
19. Biskup M, Biskup W, Majdan M, Targońska-Stępniak B (2018) Cardiovascular system changes in rheumatoid arthriCs paCents with conCnued low disease acCvity. Rheumatol Int 38:1207–1215. hPps://doi.org/10.1007/s00296-018-4053-x
20. Choy E, Ganeshalingam K, Semb AG, et al (2014) Cardiovascular risk in rheumatoid arthriCs: recent advances in the understanding of the pivotal role of inflammaCon, risk predictors and the impact of treatment. Rheumatology 53:2143–2154. hPps://doi.org/10.1093/rheumatology/keu224
21. Tekeoglu S (2024) Prevalence and Risk Factors of Cardiovascular Disease in Rheumatoid ArthriCs PaCents: A ComparaCve Analysis of Real-World Data. IJGM Volume 17:5859– 5868. hPps://doi.org/10.2147/IJGM.S490916
22. Manavathongchai S, Bian A, Rho YH, et al (2013) InflammaCon and Hypertension in Rheumatoid ArthriCs. J Rheumatol 40:1806–1811. hPps://doi.org/10.3899/jrheum.130394
23. Dougados M, Soubrier M, Antunez A, et al (2014) Prevalence of comorbidiCes in rheumatoid arthriCs and evaluaCon of their monitoring: results of an internaConal, cross-secConal study (COMORA). Annals of the RheumaCc Diseases 73:62–68. hPps://doi.org/10.1136/annrheumdis-2013-204223
24. Gonzalez A, Kremers HM, Crowson CS, et al (2008) Do cardiovascular risk factors confer the same risk for cardiovascular outcomes in rheumatoid arthriCs paCents as in non- rheumatoid arthriCs paCents? Annals of the RheumaCc Diseases 67:64–69. hPps://doi.org/10.1136/ard.2006.059980
25. Hadwen B, Stranges S, Barra L (2021) Risk factors for hypertension in rheumatoid arthriCs paCents–A systemaCc review. Autoimmunity Reviews 20:102786. hPps://doi.org/10.1016/j.autrev.2021.102786
26. Popescu D, Rezus E, Badescu MC, et al (2023) Cardiovascular Risk Assessment in Rheumatoid ArthriCs: Accelerated Atherosclerosis, New Biomarkers, and the Effects of Biological Therapy. Life 13:319. hPps://doi.org/10.3390/life13020319
27. Venetsanopoulou AI, Pelechas E, Voulgari PV, Drosos AA (2020) The lipid paradox in rheumatoid arthriCs: the dark horse of the augmented cardiovascular risk. Rheumatol Int 40:1181–1191. hPps://doi.org/10.1007/s00296-020-04616-2
28. Rodríguez-Carrio J, Alperi-López M, López P, et al (2017) High triglycerides and low high- density lipoprotein cholesterol lipid profile in rheumatoid arthriCs: A potenCal link among inflammaCon, oxidaCve status, and dysfuncConal high-density lipoprotein. Journal of Clinical Lipidology 11:1043-1054.e2. hPps://doi.org/10.1016/j.jacl.2017.05.009
29. Semb AG, Kvien TK, Aastveit AH, et al (2010) Lipids, myocardial infarcCon and ischaemic stroke in paCents with rheumatoid arthriCs in the Apolipoprotein-related Mortality RISk (AMORIS) Study. Annals of the RheumaCc Diseases 69:1996–2001. hPps://doi.org/10.1136/ard.2009.126128
30. Escalante A, Haas RW, Del Rincón I (2005) Paradoxical Effect of Body Mass Index on Survival in Rheumatoid ArthriCs: Role of Comorbidity and Systemic InflammaCon. Arch Intern Med 165:1624. hPps://doi.org/10.1001/archinte.165.14.1624
31. Stavropoulos-Kalinoglou A, Metsios GS, Panoulas VF, et al (2009) AssociaCons of obesity with modifiable risk factors for the development of cardiovascular disease in paCents with rheumatoid arthriCs. Annals of the RheumaCc Diseases 68:242–245. hPps://doi.org/10.1136/ard.2008.095596
32. Baker JF, Billig E, Michaud K, et al (2015) Weight Loss, the Obesity Paradox, and the Risk of Death in Rheumatoid ArthriCs. ArthriCs & Rheumatology 67:1711–1717. hPps://doi.org/10.1002/art.39136

33. Zegkos T, Kitas G, Dimitroulas T (2016) Cardiovascular risk in rheumatoid arthriCs: assessment, management and next steps. TherapeuCc Advances in Musculoskeletal 8:86–101. hPps://doi.org/10.1177/1759720X16643340
34. Solomon DH, Greenberg J, CurCs JR, et al (2015) DerivaCon and Internal ValidaCon of an Expanded Cardiovascular Risk PredicCon Score for Rheumatoid ArthriCs: A ConsorCum of Rheumatology Researchers of North America Registry Study. ArthriCs & Rheumatology 67:1995–2003. hPps://doi.org/10.1002/art.39195
35. Hippisley-Cox J, Coupland C, Brindle P (2017) Development and validaCon of QRISK3 risk predicCon algorithms to esCmate future risk of cardiovascular disease: prospecCve cohort study. BMJ j2099. hPps://doi.org/10.1136/bmj.j2099
36. Drosos AA, Venetsanopoulou AA, Pelechas E, Voulgari PV (2024) Exploring Cardiovascular Risk Factors and Atherosclerosis in Rheumatoid ArthriCs. European Journal of Internal Medicine 128:1–9. hPps://doi.org/10.1016/j.ejim.2024.07.016
37. Mantel Ä, Holmqvist M, Nyberg F, et al (2015) Risk Factors for the Rapid Increase in Risk of Acute Coronary Events in PaCents With New-Onset Rheumatoid ArthriCs: A Nested Case–Control Study. ArthriCs & Rheumatology 67:2845–2854. hPps://doi.org/10.1002/art.39267
38. Wah-Suarez MI, Galarza-Delgado DA, Azpiri-Lopez JR, et al (2019) CaroCd ultrasound findings in rheumatoid arthriCs and control subjects: A case-control study. Int J of Rheum Dis 22:25–31. hPps://doi.org/10.1111/1756-185X.13377
39. Ruscix P, Cipriani P, Masedu F, et al (2017) Increased Cardiovascular Events and Subclinical Atherosclerosis in Rheumatoid ArthriCs PaCents: 1 Year ProspecCve Single Centre Study. PLoS ONE 12:e0170108. hPps://doi.org/10.1371/journal.pone.0170108
40. Hannawi SMa, Hannawi H, Alokaily F, Salmi IA (2020) Subclinical atherosclerosis in rheumatoid arthriCs paCents of the Gulf Cooperated Council. SMJ 41:1022–1025. hPps://doi.org/10.15537/smj.2020.9.25319
41. González Mazarío R, Fragío Gil JJ, Marynez Calabuig P, et al (2022) Cardiovascular risk assessment with caroCd ultrasound in rheumatoid arthriCs. Medicina Clínica 159:470– 474. hPps://doi.org/10.1016/j.medcli.2022.01.017
42. Khanna NN, Jamthikar AD, Gupta D, et al (2019) Rheumatoid ArthriCs: Atherosclerosis Imaging and Cardiovascular Risk Assessment Using Machine and Deep Learning–Based Tissue CharacterizaCon. Curr Atheroscler Rep 21:7. hPps://doi.org/10.1007/s11883- 019-0766-x
43. Micha R, Imamura F, Wyler Von Ballmoos M, et al (2011) SystemaCc Review and Meta- Analysis of Methotrexate Use and Risk of Cardiovascular Disease. The American Journal of Cardiology 108:1362–1370. hPps://doi.org/10.1016/j.amjcard.2011.06.054
44. Singh T, Laxmiraj B, Chukka RCH, Noor T (2024) Cardiovascular Risk Management In PaCents With Rheumatoid ArthriCs: A SystemaCc Review. Cureus. hPps://doi.org/10.7759/cureus.58409
45. NaConal Cholesterol EducaCon Program (NCEP) Expert Panel on DetecCon, EvaluaCon, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) (2002) Third Report of the NaConal Cholesterol EducaCon Program (NCEP) Expert Panel on DetecCon, EvaluaCon, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. CirculaCon 106:3143–3421
46. Myasoedova E, Crowson CS, Kremers HM, et al (2011) Lipid paradox in rheumatoid arthriCs: the impact of serum lipid measures and systemic inflammaCon on the risk of cardiovascular disease. Annals of the RheumaCc Diseases 70:482–487. hPps://doi.org/10.1136/ard.2010.135871
47. Gabay C, Buchs N, Dudler J (2015) Cardiovascular Risk Management in PaCents with Rheumatoid ArthriCs. Cardiovasc Med 18:127–133. hPps://doi.org/10.4414/cvm.2015.00307
48. Baghdadi LR, Woodman RJ, Shanahan EM, Mangoni AA (2015) The Impact of TradiConal Cardiovascular Risk Factors on Cardiovascular Outcomes in PaCents with Rheumatoid ArthriCs: A SystemaCc Review and Meta-Analysis. PLoS ONE 10:e0117952. hPps://doi.org/10.1371/journal.pone.0117952
49. Panoulas VF, Douglas KMJ, Milionis HJ, et al (2007) Prevalence and associaCons of hypertension and its control in paCents with rheumatoid arthriCs. Rheumatology 46:1477–1482. hPps://doi.org/10.1093/rheumatology/kem169
50. Panoulas VF, Toms TE, Metsios GS, et al (2010) Target organ damage in paCents with rheumatoid arthriCs: The role of blood pressure and heart rate. Atherosclerosis 209:255–260. hPps://doi.org/10.1016/j.atherosclerosis.2009.08.047
51. AnyfanC P, Gkaliagkousi E, Triantafyllou A, et al (2021) Hypertension in rheumaCc diseases: prevalence, awareness, treatment, and control rates according to current hypertension guidelines. J Hum Hypertens 35:419–427. hPps://doi.org/10.1038/s41371-020-0348-y
52. Lindhardsen J, Gislason GH, Jacobsen S, et al (2014) Non-steroidal anC-inflammatory drugs and risk of cardiovascular disease in paCents with rheumatoid arthriCs: a naConwide cohort study. Annals of the RheumaCc Diseases 73:1515–1521. hPps://doi.org/10.1136/annrheumdis-2012-203137
53. Peters MJL, Symmons DPM, McCarey D, et al (2010) EULAR evidence-based recommendaCons for cardiovascular risk management in paCents with rheumatoid arthriCs and other forms of inflammatory arthriCs. Annals of the RheumaCc Diseases 69:325–331. hPps://doi.org/10.1136/ard.2009.113696