Open Access Rheumatology: Research and Reviews Dovepress

Open Access Full Text Article

ORIGINAL RESEARCH

Prevalence of Hyperuricemia and Rheumatoid Factor Positivity Among Patients Aged 35 and Above in Huye District, Southern Province of Rwanda

Ruth Umukundwa[1,*], Elyse Akimana[1,*], Vedaste Nsanzimana[1,2], Herbert Tendayi Mapira[1], Cuthbert Musarurwa[1]

[1]Department of Biomedical Laboratory Sciences, School of Health Sciences, College of Medicine and Health Sciences, University of Rwanda, Kigali, 3286, Rwanda; [2]Department of Pharmacology, College of Medicine, Institute of Health Sciences, Gyeongsang National University, Jinju, 52727, South Korea

*These authors contributed equally to this work

Correspondence: Vedaste Nsanzimana, Department of Biomedical Laboratory Sciences, School of Health Sciences, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda, Tel +250791703216, Email vedastensanzimana7@gmail.com

Video abstract

Point your SmartPhone at the code above. If you have a QR code reader, the video abstract will appear. Or use: https://youtu.be/GZxIYpUWIUc.

Background: Hyperuricemia, a precursor to gout, and rheumatoid factor positivity (RF), an autoantibody linked to rheumatoid arthritis (RA), but also present in various conditions and healthy adults, hold significant health implications, including potential links to cardiovascular diseases and metabolic risks. In Rwanda, data on these conditions in individuals aged 35 and above are lacking. This study aimed to determine the prevalence of hyperuricemia and RF positivity in patients aged 35 and above in Huye district of Rwanda.

Patients and Methods: We conducted a cross-sectional study from October 2023 to January 2024, enrolling 367 patients from Huye and Matyazo Health Centers. We measured rheumatoid factor (RF), C-reactive protein (CRP), and serum uric acid levels, and evaluated risk factors using structured questionnaires.

Results: Among the patients, 38.1% had hyperuricemia, with 9.8% RF positivity and 3.3% CRP positivity. Hyperuricemia was more prevalent in older patients ($p = 0.045$) and females ($p = 0.001$). Notably, 12% of hyperuricemic patients had positive RF results.

Conclusion: This study reveals high hyperuricemia rates and low RF/CRP positivity in patients aged 35 and above, with women and older individuals being more affected. The co-occurrence of hyperuricemia and RF has significant health impacts, highlighting the need for further research on metabolic disorders linked to hyperuricemia to inform better interventions. Our findings underscore the importance of addressing the conditions associated with these abnormalities to improve health outcomes in Rwanda's aging population.

Keywords: hyperuricemia, rheumatoid arthritis, prevalence, Rwanda, metabolic disorders, aging population

Introduction

Hyperuricemia is a pathological condition defined by an increase in serum uric acid concentrations, typically exceeding 416 µmol/L or 357 µmol/L in male and female adults, respectively.[1,2] This condition may result from increased production of uric acid from purine metabolism, diminished renal clearance, or a combination of both factors. Clinically, hyperuricemia is a critical precursor to gout, an arthritic condition resulting from the deposition of monosodium urate (MSU) crystals in and/or around joints.[3] Gout can cause substantial damage to joint integrity. Furthermore, hyperuricemia has been implicated in adverse renal and cardiovascular prognoses highlighting its significance in systemic health.[4]

Received: 10 September 2024
Accepted: 22 November 2024
Published: 26 November 2024

Conversely, rheumatoid arthritis (RA), is a chronic inflammatory disorder characterized by persistent inflammation predominantly affecting peripheral joints, which frequently culminates in the progressive destruction of joint structures.[5] The global prevalence of RA is estimated to be approximately 0.5% to 1% with an annual incidence rate of 40 cases per 100,000 individuals with the incidence higher in females compared to males.[6] Rheumatoid arthritis is associated with significant work-related disability, augmented morbidity, and a reduction in life expectancy.[7]

Rheumatoid Factor (RF), an immunoglobulin M (IgM) autoantibody that targets immunoglobulin G (IgG), serves as a biomarker for RA despite its presence in other autoimmune conditions and chronic infections.[8–10] The prevalence of RF positivity varies significantly, with higher rates in older adults, ranging from 5% to 25% in those aged 60 and above, compared to 1% to 5% in younger populations.[11] Factors such as age, gender, and ethnicity influence RF levels, with women and certain ethnic groups showing higher prevalence rates.[10,11] RF is detectable in approximately 80–85% of individuals diagnosed with RA and has a diagnostic sensitivity ranging from 50% to 90%, and specificity spanning 50% to 95%.[8] Furthermore, a higher titer of RF in serum has been associated with increased disease activity, enhanced radiographic progression, and the emergence of extraarticular manifestations.[5,8,10,11] However, diagnosing RA involves confirming synovitis in at least one joint, excluding other possible diagnoses, and considering other factors such as affected joints, serological abnormalities (increased levels of RF or anti-cyclic citrullinated peptide antibody), high levels of acute phase response, and symptom duration.[12–14]

Hyperuricemia extends beyond its well-established association with gout and is increasingly recognized as a significant risk factor for cardiovascular diseases (CVDs), renal insufficiency, hypertension, and metabolic syndrome.[15–17] Epidemiological evidence has consistently demonstrated the prevalence of these comorbidities in individuals aged ≥40 years old, across both male and female populations, thus indicating a correlation with advancing age. Likewise, the age of onset for RA is a critical factor in the clinical prognosis and therapeutic approach to the disease. Early-onset RA (onset in individuals under 60 years old) predominantly affects females, while late-onset RA (onset in adults over 60 years old) shows no difference in gender distribution.[10,13,18] Furthermore, late-onset RA is characterized by a reduced prevalence of RF positivity when compared to early-onset RA.[18]

While RA may manifest at any age, the incidence increases with advancing age, and the presentation is exacerbated in individuals with comorbid conditions, which are also more likely to occur in advancing age. Thus, the intersection of age, comorbidities, and the influences of RF positivity on the onset of RA, together with hyperuricemia, requires a clear understanding of the underlying pathophysiology and co-management of the two conditions. However, in Rwanda, the epidemiological data on hyperuricemia and RF positivity remain scarce, especially in susceptible populations aged 35 and above. An understanding of the prevalence of these two conditions singly and jointly is imperative for the formulation of effective public health interventions for a maturing Rwandan population. Consequently, this study aimed to determine the prevalence and correlates of hyperuricemia and RF positivity in patients aged 35 years and above attending Huye and Matyazo Health Centers, in the southern province of Rwanda.

Material and Methods

Study Design and Setting

This cross-sectional study was conducted at the Matyazo and Huye Health Centers between October 2023 and January 2024. The two health centers are located within the urban confines of the Huye district in the southern province of Rwanda. These centers predominantly serve the urban population of Huye district and are in proximity to the Butare University Teaching Hospital, the major referral teaching hospital in southern Rwanda.

Study Population and Eligibility Criteria

In this study, 367 individuals aged 35 years and above seeking medical care for conditions other than those listed under the exclusion criteria were consecutively enrolled from the two study sites until the predetermined sample size was achieved. Participation was voluntary, with all participants providing written informed consent before inclusion in the study. Exclusion criteria were meticulously established to eliminate potential confounders in the evaluation of hyperuricemia and rheumatoid factor positivity. Specifically, individuals with a documented history of gout, kidney disease and

those currently receiving uric acid-modifying pharmacotherapy, including diuretics, were excluded. Furthermore, pregnant and lactating women and those with existing acute or chronic infectious morbidity were also excluded.

Sample Size

The determination of the sample size for this study was guided by Cochran's formula[19] as follows: $n = \frac{z^2 p(1-p)}{e^2}$; Herein, (n) denotes the sample size, (Z^2), the Z score, encapsulates the confidence level (with a value of 1.96 corresponding to a 95% confidence interval), (p) represents the proportion of the population possessing the attribute of interest (assumed to be 0.5 in the absence of prior data), and (e^2) signifies the margin of error (a margin of error of 0.05 was employed in this instance). The study ultimately enrolled 387 participants.

Data Collection

After obtaining written informed consent from each participant, sociodemographic data (sex, age, educational attainment, and marital status), health-related lifestyle factors (cigarette smoking status, alcohol consumption, and engagement in regular physical exercise), chronic morbidities (hypertension, diabetes, and hyperuricemia), and current medications (antibiotics, diuretics) were recorded by utilizing a semi-structured questionnaire. Additionally, the questionnaires were developed in both English and Kinyarwanda (the local language) to ensure linguistic accessibility for all participants.

For physical measurements assessments, height was measured in meters (m) using a stadiometer (Seca, Hamburg, Germany) with the participant in an upright position without wearing shoes. Weight was measured in kilograms (kg) using a weight measuring scale (Seca, Hamburg, Germany) with participants wearing minimal clothing. These two measurements were used to calculate the body mass index (BMI) calculated as body mass (kg) divided by the square of the body height (m).

A venous blood sample (5 mL) was collected into a red top tube and centrifuged to obtain serum from each consenting participant. The laboratory analyses of uric acid, RF, and C-reactive protein (CRP) were performed according to the reagent manufacturers' protocols and guided by the principles of good clinical laboratory practice. The RF and CRP were qualitatively and semi-quantitatively measured using the RF latex kit (RF-2106-3, Fortress Diagnostics, UK) and the RHELAX-CRP slide test (2022204E, Tulip Diagnostics, India), respectively. Briefly, for both RF and CRP, a single drop of reagent was mixed with 50 µL of patient serum on a test card, which was subsequently agitated using a mechanical rotor operating at a speed of 80–100 rpm for a duration of 2 minutes. Samples exhibiting visible agglutinations, indicative of RF levels exceeding 8 IU/mL or CRP levels exceeding 6 IU/mL, were subjected to semi-quantitative dilutions to determine the titer. Ultimately, a test diluted at a ratio greater than 1:4 was considered positive in both assessments.[5] In addition, uric acid kits (BXC0603A, Fortress Diagnostics, UK) were used to measure serum uric acid based on the spectrophotometric uricase method using a semi-automated chemistry analyzer (HumaLyser-4000, Human Diagnostics, Wiesbaden, Germany). To ensure the accuracy and reliability of the results, quality control procedures were systematically performed before processing patient samples for all procedures.

Statistical Analysis

Categorical variables were summarized as counts and proportions, while numerical variables were presented as mean ± standard deviation (SD) for parametric data, and median along with interquartile range (IQR) for non-parametric data. Statistical comparison tests, including *t*-tests and their non-parametric equivalents for numerical data, and *z*-tests or chi-square tests for proportions, were employed to compare different data strata. All statistical analyses were done using Stata (version 13) (Stata Corp, College Station, Texas), and a p-value of <0.05 was considered statistically significant.

Results

Table 1 shows the sociodemographic characteristics of study participants (54.77%, n = 201) and (45.23%, n = 166) recruited from Huye and Matyazo health centers, respectively. The participants consisted of 263 (71.7%) and 104 (28.3%) female and male participants respectively, with an overall age range of 35–89 years old. Twenty-seven (7.4%) patients were cigarette smokers, while only twenty (5.5%) participated in regular sports activities, with males

Table 1 Sociodemographic Characteristics of the Study Participants

Variable[a]	Overall n=367	Gender		P-value
		Females n=263	Males n=104	
Age (years) median (IQR)	60(48–70)	59(48–69)	61(48.5–73)	0.416
BMI median (IQR)	22.6(20.5–26.0)	22.7(20.8–26.0)	22.5(19.9–24.7)	0.082
Alcohol drinkers	135(36.8)	98(37.3)	37(35.6)	0.763
Cigarette smokers	27(7.4)	13(4.9)	14(13.6)	**0.004**
Meat Consumption (any type)				
Never	316(86.1)	224(85.2)	92(88.5)	0.602
Once a week	44(12.0)	33(12.5)	11(10.5)	
More than once a week	7(1.9)	6(2.3)	1(1.0)	
Intense physical activity				
Never	297(80.9)	222(84.4)	75(72.1)	**0.014**
< 3 times a week	24(6.5)	16(6.1)	8(7.7)	
≥ 3 times a week	46(12.5)	25(9.5)	21(20.2)	

Notes: [a]All n (%) unless otherwise stated. p<0.05 is bolded to indicate statistical significance. Between-group medians were compared using the Wilcoxon rank sum tests whilst between group proportions were compared using the Chi-square tests.
Abbreviations: BMI, body mass index; IQR, interquartile range.

significantly outnumbering females in cigarette smoking (p = 0.004) and partaking in regular exercises (p = 0.014). However, participants were comparable in terms of meat consumption, age, BMI, and alcohol consumption (p > 0.05).

The laboratory and clinical findings for all study participants are presented in Table 2. Overall, 38.1% (n = 140) of participants were hyperuricemic. Females had a higher frequency of hyperuricemia than males (p = 0.001), although there

Table 2 Laboratory and Clinical Findings of Study Participants

Variable[a]	Overall n=367	Gender		P-value
		Females n=263	Males n=104	
Uric acid (μmol/L) median (IQR)	345.0(267.7–428.3)	344.98(267.7–434.2)	333.1(267.7–422.3)	0.620
Hyperuricemic[1,2]	143(38.9)	117(44.4)	26(25.0)	**0.001**
CRP positive	12(3.3)	8(3.0)	4(3.9)	0.747
RF positive	36(9.8)	24(9.1)	12(11.5)	0.559
RF & HU status				
RF (-)/HU (-)	331(90.2)	239(90.9)	92(88.5)	0.730
RF (+)/HU (-)	19(5.2)	13(4.9)	6(5.8)	
RF (+)/HU (+)	17(4.6)	11(4.2)	6(5.8)	
Chronic co-morbidities present	8(2.2)	6(2.30	2(1.9)	0.832
Symptoms of joint pain present	250(68.1)	179(68.1)	71(68.3)	0.969
Family history of gout or arthritis	83(22.6)	66(25.1)	17(16.4)	0.071

Notes: [a]All n (%) unless otherwise stated. p<0.05 is bolded to indicate statistical significance. Between-group medians were compared using the Wilcoxon rank sum tests whilst between group proportions were compared using the Chi-square tests.
Abbreviations: IQR, interquartile range; CRP, c-reactive protein; RF, rheumatoid factor; HU, hyperuricemia; (-), negative; (+), positive.

was no significant difference in median serum uric acid levels according to gender (p = 0.620). Overall, 3.3% (n = 12) and 9.8% (n = 36) of the participants were CRP and RF positive respectively and of these 36 RF-positive participants, only 4.6% (n = 17) were hyperuricemic (Table 2).

As shown in Table 3, the laboratory and clinical parameters were stratified into five age categories. The results showed that the median serum uric acid levels increased progressively peaking in patients aged above 75 years (p = 0.033). Similarly, the proportions of participants with a positive serum CRP varied substantially by age group (p = 0.003), with the highest frequency observed in participants aged 46–55 years. However, there was no significant difference in the proportions of hyperuricemic individuals, RF positivity, co-existing hyperuricemia, or RF positivity according to the age groups.

Table 4 shows the evaluated factors related to the hyperuricemic phenotype. It was observed that females (p = 0.001), older age (p = 0.045), and sedentary lifestyle (p = 0.030) were mostly associated with the hyperuricemic phenotype, while infrequent consumption of meat (p = 0.013) and CRP positivity (p = 0.004) were negatively associated with hyperuricemia. There was no significant association observed between hyperuricemia and family history of gout or arthritis, alcohol consumption, or cigarette smoking among the participants. (All p > 0.05).

Table 3 Laboratory and Clinical Findings According to Age Group

Variable[a]	**Age categories in years**					**p-value**
	35–45 n=69	**46–55 n=80**	**56–65 n=87**	**66–75 n=86**	**>75 n=45**	
Uric acid (μmol/L) median (IQR)	351.0(273.6–416.4)	309.3(244.0–398.5)	333.1(267.7–404.5)	356.9(267.7–446.1)	392.6(297.4–487.7)	**0.033**
Hyperuricemic	27(39.1)	23(28.8)	30(34.5)	37(43.0)	23(51.1)	0.108
CRP positive	1(1.5)	8(10.0)	3(3.5)	0	0	**0.003**
RF positive	4(5.8)	8(10.0)	7(8.1)	10(11.6)	7(15.6)	0.467
RF & HU status						
RF (-)/HU (-)	65(94.1)	72(90.0)	80(91.0)	76(88.4)	38(84.4)	0.563
RF (+)/HU (-)	1(1.5)	6(7.5)	3(3.5)	5(5.8)	4(8.9)	
RF (+)/HU (+)	3(4.4)	2(2.5)	4(4.5)	5(5.8)	3(6.7)	
Symptoms of joint pain	49(71.0)	51(63.8)	56(64.4)	64(74.4)	30(66.7)	0.533
Family history of gout/arthritis	19(27.5)	18(22.5)	18(20.7)	17(19.8)	11(24.4)	0.804

Notes: [a]All n (%) unless otherwise stated. p<0.05 is bolded to indicate statistical significance. Between-group medians were compared using the Wilcoxon rank sum tests whilst between group proportions were compared using the Chi-square tests.
Abbreviations: IQR, interquartile range; CRP, c-reactive protein; RF, rheumatoid factor; HU, hyperuricemia; (-), negative; (+), positive.

Table 4 Association of Various Factors with Hyperuricemia

Variable[a]	**Serum uric acid level status**		**P-value**
	Hyperuricemic n=143	**Normal n=224**	
Age (years) median (IQR)	63(51–72)	59(48–68)	**0.045**
BMI median (IQR)	22.7(20.8–26.6)	22.6(20.4–25.5)	0.352
Gender			
Female	117(81.8)	146(65.2)	**0.001**
Male	26(18.2)	78(34.8)	

(*Continued*)

Table 4 (Continued).

Variable[a]	Serum uric acid level status		P-value
	Hyperuricemic n=143	Normal n=224	
CRP			
Negative	143(100.0)	212(94.6)	**0.004**
Positive	0	12(5.4)	
RF			
Negative	126(88.1)	205(91.5)	0.285
Positive	17(12.0)	19(8.5)	
Joint pain symptoms			
No	49(34.3)	68(30.4)	0.433
Yes	94(65.7)	156(69.6)	
Family history of gout or arthritis			
No	113(79.0)	171(76.3)	0.549
Yes	30(21.0)	53(23.7)	
Alcohol consumption status			
No	94(65.7)	138(61.6)	0.424
Yes	49(34.3)	86(38.4)	
Cigarette smoking status			
No	134(93.7)	205(91.9)	0.525
Yes	9(6.3)	18(8.1)	
Meat consumption			
Never	133(93.0)	183(81.8)	**0.007**
Once a Week	9(6.3)	35(15.6)	
More than once a week	1(0.7)	6(2.6)	
Engaging in sports activities			
Never	124(86.7)	173(77.2)	**0.030**
< 3 times a week	9(6.3)	15(6.7)	
≥ 3 times a week	10(7.0)	36(16.1)	

Notes: [a]All n (%) unless otherwise stated. p<0.05 is bolded to indicate statistical significance. Between-group medians were compared using the Wilcoxon rank sum tests whilst between group proportions were compared using the Chi-square tests.
Abbreviations: IQR, interquartile range; CRP, c-reactive protein; RF, rheumatoid factor.

Discussion

This study determined the prevalence of hyperuricemia, RF positivity, and CRP positivity in patients aged 35 years and above at both Huye and Matyazo Health Centers. Notably, in our study population, the prevalence of hyperuricemia was significantly higher in females compared to males, while the median age of hyperuricemic individuals was significantly higher than that of normouricemic individuals. Paradoxically, regular consumption of any type of meat was inversely

associated with hyperuricemia. Although no significant association was observed between hyperuricemia and RF positivity, 12% of hyperuricemic participants had positive RF results.

The overall prevalence of hyperuricemia of 38.9% reported in the current study was in concordance with the findings from other studies conducted in Seychelles (35.2% in males, and 8.7% in females), and Ethiopia (31%), although there were some sex-specific differences in the frequencies with some studies.[20,21] However, a slightly lower prevalence of hyperuricemia (25%) was reported in studies conducted in Eastern Europe and Black Angolans.[22,23] This disparity could be attributable to underlying sociodemographic and dietary differences in study populations. For instance, the current study recruited middle-aged patients aged 35 and above, who are more susceptible to developing metabolic syndrome and kidney dysfunction, both of which predispose individuals to elevated serum uric acid levels.[24] In agreement with these findings, the participants of the present study were recruited from middle-aged and elderly patients seeking healthcare services at the recruitment centers. It is, therefore, possible that they might have had other predisposing factors, such as chronic diseases, contributing to hyperuricemia, since participants were not tested for chronic diseases but only self-reported the absence of preexisting medical conditions. Finally, the present study's findings showed both concordance and discordance with previous research. Notably, studies conducted in Seychelles, Angola, and Ethiopia targeted the general population, whereas European studies focused on hypertensive patients, differing from the present study's population.

To investigate the association between hyperuricemia, RF positivity, and inflammatory status, we evaluated the presence of RF and CRP. These markers are usually detectable before the onset of disease symptoms and are predictive of a more severe disease course, indicating a pathogenetic role in RA.[10] Although not definitive, the RF test serves as a serological marker of rheumatoid arthritis, while CRP is an established marker of inflammation.[5,10,13] Our findings revealed RF and CRP positivity rates of 9.8% and 3.3%, respectively, which align with other studies on non-rheumatoid arthritis individuals.[11,25] However, these rates are lower than the commonly reported ranges of 70–80% for RF and higher CRP levels in RA patients, indicating a potentially lower overall inflammatory burden in our study population or differences due to the underlying characteristics and source of the study population.[5,9,18,26] Notably, 68.1% of participants in the present study reported articulatory pain symptoms that might have included arthritis. However, it is important to emphasize that the screening tests employed were not definitive for rheumatoid arthritis.[9,10]

Age was significantly associated with hyperuricemia. The median age for hyperuricemic participants was significantly higher compared to that of normouricemic individuals. This finding is consistent with other studies conducted in Poland, and Taiwan, which also reported increasing serum uric acid levels with advancing age.[24,27] The higher prevalence of hyperuricemia in older adults could be attributed to a decline in renal function, physical inactivity, and potential comorbid metabolic syndromes.[28,29] In addition to aging joints, individuals aged 35 and above are at a higher risk of impaired renal uric acid excretion, as kidney function declines progressively after the age of 40. This decline leads to the accumulation of uric acid in the serum.[21]

The frequency of hyperuricemic individuals was significantly higher in female participants (44.4%) compared to males (25%), which contrasts with findings from studies conducted in Seychelles, China, and Taiwan.[1,20,27,30] However, this study's finding is in concordance with other studies conducted in Poland and Saudi Arabia, which identified obesity, elevated triglyceride levels, and kidney diseases as predisposing factors.[24,31] The median age of participants in the current study was 60 years, which could explain this shift of hyperuricemia burden towards females, as most of them were potentially in menopause. The reduced role of sex hormones, especially estrogen, which is thought to have protective properties against the accumulation of uric acid in the blood, may contribute to this shift.[32,33] Consistent with the observed findings, a significantly higher proportion of males in the present study participated in regular physical activities compared to females. This might further partially explain the higher burden of hyperuricemia in females, as enhanced physical activity reduces the risk of both metabolic syndrome and hyperuricemia.[34]

The current study also evaluated the coexistence of hyperuricemia and RF positivity. Overall, 12% of hyperuricemic subjects showed positive RF results. Other studies have reported a higher frequency of hyperuricemia and RA comorbidity. However, it is unclear whether uric acid is a proinflammatory marker or a direct source of joint inflammation in rheumatoid arthritis patients, despite strong preclinical evidence supporting the latter idea.[26,35] According to the latter study, people with both conditions were 60% to 70% times more likely to die from CVD. This was further

substantiated by the findings of Murugan et al, who observed that 56% of subjects with coexisting hyperuricemia and RA manifested severe illness.[36] However, these studies enrolled individuals with confirmed RA. Although there was no statistically significant association observed between hyperuricemia and RF positivity in our study, the clinical burden and potential long-term repercussions of this comorbidity warrant further investigation. Therefore, a larger study may be necessary to elucidate this association, allowing timely intervention in severe conditions.

There was an inverse association between the frequency of meat consumption and serum uric acid levels. This finding is in discordance with findings from different studies that reported that meat consumption is a risk factor for hyperuricemia.[37] Interestingly, 86.1% of the participants from the present study did not eat meat regularly, suggesting that they potentially consumed alternative sources of proteins such as beans, which among other legumes is a primary staple food for many Rwandans. Most of these protein-rich foods whether animal-based or plant-based are mostly rich in purines as well, with their metabolism potentially able to increase serum uric acid levels.[38] Although several studies reported a negative relationship between a plant-based diet and hyperuricemia, other studies have reported that the consumption of beans could considerably increase serum uric acid levels.[39]

Conclusion

In conclusion, this study reveals a high burden of hyperuricemia in patients aged 35 years and above presenting at both Huye and Matyazo Health Centers, particularly among females and older individuals. Although the co-occurrence of hyperuricemia and RF positivity was not statistically significant in our study, the use of more specific diagnostic tests in conjunction with RF is necessary to enhance awareness and screening for rheumatological disorders in this population. The low CRP positivity suggests that inflammation may not be a primary driver of disease in this context. Further research is warranted to explore the metabolic and lifestyle factors contributing to hyperuricemia in this population and to inform targeted interventions to mitigate its health impacts. Ultimately, based on these findings, longitudinal studies are needed to investigate this issue among Rwandans, which might have important implications for the development of strategies to prevent and manage metabolic and rheumatological disorders in Rwanda's aging population.

Abbreviations

BMI, body mass index; CRP, c-reactive protein; CVD's, cardiovascular diseases; IQR, interquartile range; MSU, monosodium urate; RA, rheumatoid arthritis; RF, rheumatoid factor; SD, standard deviation.

Data Sharing Statement

The data used in this study is presented in the paper but any additional data requests will be made available through the corresponding author upon reasonable request.

Ethics Approval and Informed Consent

In accordance with the Declaration of Helsinki, ethical approval was obtained from the Institutional Review Board of the University of Rwanda (CMHS/IRB/365/2023). Additionally, written permission to collect samples at Huye and Matyazo Health Center sites was provided by Kabutare district hospital administration (REF 330/10/Hop.Kab/2023).

Acknowledgments

The authors gratefully acknowledge the material support from the University of Rwanda through the Department of Biomedical Laboratory Sciences in the School of Health Sciences, College of Medicine and Health Sciences.

Author Contributions

All authors made a significant contribution to the work reported, in the conception, study design, execution, acquisition of data, analysis, and interpretation. All authors took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The author(s) reported no conflicts of interest in this work.

References

1. Huang XB, Zhang WQ, Tang WW. et al. Prevalence and associated factors of hyperuricemia among urban adults aged 35–79 years in southwestern China: a community-based cross-sectional study. *Sci Rep*. 2020;10(1):15683. doi:10.1038/s41598-020-72780-3
2. Liu R, Han C, Wu D, et al. Prevalence of Hyperuricemia and Gout in Mainland China from 2000 to 2014: a Systematic Review and Meta-Analysis. *BioMed Res Int*. 2015;2015:1–12. doi:10.1155/2015/762820
3. Bardin T, Richette P. Definition of hyperuricemia and gouty conditions. *Curr Opin Rheumatol*. 2014;26(2):186–191. doi:10.1097/BOR.0000000000000028
4. Richette P, Perez-Ruiz F, Doherty M, et al. Improving cardiovascular and renal outcomes in gout: what should we target? *Nat Rev Rheumatol*. 2014;10(11):654–661. doi:10.1038/nrrheum.2014.124
5. De Rycke L. Rheumatoid factor and anticitrullinated protein antibodies in rheumatoid arthritis: diagnostic value, associations with radiological progression rate, and extra-articular manifestations. *Ann Rheum Dis*. 2004;63(12):1587–1593. doi:10.1136/ard.2003.017574
6. Myasoedova E, Crowson CS, Kremers HM, Therneau TM, Gabriel SE. Is the incidence of rheumatoid arthritis rising? Results from Olmsted County, Minnesota, 1955–2007. *Arthritis Rheum*. 2010;62(6):1576–1582. doi:10.1002/art.27425
7. Mikuls TR. Rheumatoid arthritis incidence: what goes down must go up? *Arthritis Rheum*. 2010;62(6):1565–1567. doi:10.1002/art.27432
8. Ingegnoli F, Castelli R, Gualtierotti R. Rheumatoid Factors: clinical Applications. *Dis Markers*. 2013;35:727–734. doi:10.1155/2013/726598
9. Mun S, Lee J, Park M, Shin J, Lim MK, Kang HG. Serum biomarker panel for the diagnosis of rheumatoid arthritis. *Arthritis Res Ther*. 2021;23(1):31. doi:10.1186/s13075-020-02405-7
10. De Brito Rocha S, Baldo DC, Andrade LEC. Clinical and pathophysiologic relevance of autoantibodies in rheumatoid arthritis. *Adv Rheumatol*. 2019;59(1):2. doi:10.1186/s42358-018-0042-8
11. Simard JF, Holmqvist M. Rheumatoid factor positivity in the general population. *BMJ*. 2012;345(sep06 2):e5841–e5841. doi:10.1136/bmj.e5841
12. Nishimura K, Sugiyama D, Kogata Y, et al. Meta-analysis: diagnostic Accuracy of Anti–Cyclic Citrullinated Peptide Antibody and Rheumatoid Factor for Rheumatoid Arthritis. *Ann Intern Med*. 2007;146(11):797. doi:10.7326/0003-4819-146-11-200706050-00008
13. Nielsen SF, Bojesen SE, Schnohr P, Nordestgaard BG. Elevated rheumatoid factor and long-term risk of rheumatoid arthritis: a prospective cohort study. *BMJ*. 2012;345(sep06 2):e5244–e5244. doi:10.1136/bmj.e5244
14. Aletaha D, Neogi T, Silman AJ, et al. Rheumatoid arthritis classification criteria: an American College of Rheumatology/European League Against Rheumatism collaborative initiative. *Arthritis Rheum*. 2010;62(9):2569–2581. doi:10.1002/art.27584
15. Kuwabara M, Niwa K, Nishi Y, et al. Relationship between serum uric acid levels and hypertension among Japanese individuals not treated for hyperuricemia and hypertension. *Hypertens Res*. 2014;37(8):785–789. doi:10.1038/hr.2014.75
16. Nagahama K, Inoue T, Kohagura K, Ishihara A, Kinjo K, Ohya Y. Hyperuricemia predicts future metabolic syndrome: a 4-year follow-up study of a large screened cohort in Okinawa, Japan. *Hypertens Res*. 2014;37(3):232–238. doi:10.1038/hr.2013.137
17. Wang S, Shu Z, Tao Q, Yu C, Zhan S, Li L. Uric acid and incident chronic kidney disease in a large health check-up population in Taiwan. *Nephrology*. 2011;16(8):767–776. doi:10.1111/j.1440-1797.2011.01513.x
18. Pawłowska J, Smoleńska Ż, Daca A, Witkowski JM, Bryl E. Older age of rheumatoid arthritis onset is associated with higher activation status of peripheral blood CD4+ T cells and disease activity. *Clin Exp Immunol*. 2011;163(2):157–164. doi:10.1111/j.1365-2249.2010.04294.x
19. Al-Eid M, Shoukri MM. On the Index of Repeatability: estimation and Sample Size Requirements. *Open J Stat*. 2019;09(04):530–541. doi:10.4236/ojs.2019.94035
20. Conen D, Wietlisbach V, Bovet P, et al. Prevalence of hyperuricemia and relation of serum uric acid with cardiovascular risk factors in a developing country. *BMC Public Health*. 2004;4(1):9. doi:10.1186/1471-2458-4-9
21. Molla MD, Bekele A, Melka DS, et al. Hyperuricemia and Its Associated Factors Among Adult Staff Members of the Ethiopian Public Health Institute, Ethiopia. *Int J Gen Med*. 2021;14:1437–1447. doi:10.2147/IJGM.S308158
22. Redon P, Maloberti A, Facchetti R, et al. Gender-related differences in serum uric acid in treated hypertensive patients from central and east European countries: findings from the Blood Pressure control rate and CArdiovascular Risk profilE study. *J Hypertens*. 2019;37(2):380–388. doi:10.1097/HJH.0000000000001908
23. Moulin SR, Baldo MP, Souza JB, et al. Distribution of Serum Uric Acid in Black Africans and Its Association With Cardiovascular Risk Factors. *J Clin Hypertens*. 2017;19(1):45–50. doi:10.1111/jch.12863
24. Winder M, Owczarek AJ, Mossakowska M, et al. Prevalence of Hyperuricemia and the Use of Allopurinol in Older Poles—Results from a Population-Based PolSenior Study. *Int J Environ Res Public Health*. 2021;18(2):387. doi:10.3390/ijerph18020387
25. Yang T, Ding X, lun WY, et al. Association between high-sensitivity C-reactive protein and hyperuricemia. *Rheumatol Int*. 2016;36(4):561–566. doi:10.1007/s00296-016-3429-z
26. Nada D, Gaber R, Mahmoud AS, Elkhouly R, Alashkar D. Hyperuricemia Among Egyptian Rheumatoid Arthritis Patients. Is It an Association or an Inflammatory Marker? A Cross-Sectional Observational Study. *Open Access Rheumatol Res Rev*. 2021;13:305–314. doi:10.2147/OARRR.S331488
27. Lee MS, Lin SC, Chang HY, Lyu LC, Tsai KS, Pan WH. High prevalence of hyperuricemia in elderly Taiwanese. *Asia Pac J Clin Nutr*. 2005;14(3):285–292.
28. Ndrepepa G, Braun S, Haase HU, et al. Prognostic Value of Uric Acid in Patients With Acute Coronary Syndromes. *Am J Cardiol*. 2012;109(9):1260–1265. doi:10.1016/j.amjcard.2011.12.018
29. Nejatinamini S, Ataie-Jafari A, Qorbani M, et al. Association between serum uric acid level and metabolic syndrome components. *J Diabetes Metab Disord*. 2015;14(1):70. doi:10.1186/s40200-015-0200-z
30. Lin X, Wang X, Li X, et al. Gender- and Age-Specific Differences in the Association of Hyperuricemia and Hypertension: a Cross-Sectional Study. *Int J Endocrinol*. 2019;2019:1–9. doi:10.1155/2019/7545137

31. Eljaaly Z, Mujammami M, Nawaz SS, Rafiullah M, Siddiqui K. Risk Predictors of High Uric Acid Levels Among Patients with Type-2 Diabetes. *Diab Metab Syndr Obes Targets Ther*. 2021;14:4911–4920. doi:10.2147/DMSO.S344894
32. Yokokawa H, Fukuda H, Suzuki A, et al. Association Between Serum Uric Acid Levels/Hyperuricemia and Hypertension Among 85,286 Japanese Workers. *J Clin Hypertens*. 2016;18(1):53–59. doi:10.1111/jch.12627
33. Gordon T, Kannel WB. Drinking and its relation to smoking, BP, blood lipids, and uric acid. The Framingham study. *Arch Intern Med*. 1983;143 (7):1366–1374.
34. Yuan H, Yu C, Li X, et al. Serum Uric Acid Levels and Risk of Metabolic Syndrome: a Dose-Response Meta-Analysis of Prospective Studies. *J Clin Endocrinol Metab*. 2015;100(11):4198–4207. doi:10.1210/jc.2015-2527
35. Roble HY, Sultana R, Moniruzzaman M, Hassan MZ. Assessment of serum uric acid level among patients with rheumatoid arthritis. *Int J Community Med Public Health*. 2022;9(2):647. doi:10.18203/2394-6040.ijcmph20220222
36. Murugan K, Ananthan VA, Veeranan A. A Cross-Sectional Hospital Based Study on Correlation between Serum Uric Acid Levels and Disease Activity in Recently Diagnosed Rheumatoid Arthritis in Chennai, Tamilnadu. *J Evid Based Med Healthc*. 2021;8(38):3372–3377. doi:10.18410/jebmh/2021/612
37. Villegas R, Xiang YB, Elasy T, et al. Purine-rich foods, protein intake, and the prevalence of hyperuricemia: the Shanghai Men's Health Study. *Nutr Metab Cardiovasc Dis*. 2012;22(5):409–416. doi:10.1016/j.numecd.2010.07.012
38. Blair MW, González LF, Kimani PM, Butare L. Genetic diversity, inter-gene pool introgression and nutritional quality of common beans (Phaseolus vulgaris L.) from Central Africa. *Theor Appl Genet*. 2010;121(2):237–248. doi:10.1007/s00122-010-1305-x
39. Zhang M, Lin L. Acute effect of soy and soy products on serum uric acid concentration among healthy Chinese men. *Asia Pac J Clin Nutr*. 2018;27 (6). doi:10.6133/apjcn.201811_27(6).0010