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CORRELATION BETWEEN HIGH-PURINE DIET PATTERNS AND URIC ACID LEVELS AMONG THE ELDERLY IN PASURUAN REGENCY

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Abstract

Hyperuricemia is a common metabolic disorder among the elderly and is closely associated with gout, renal impairment, and cardiovascular disease. A high-purine diet is one of the major modifiable factors influencing serum uric acid levels, yet evidence among Indonesian older adults remains limited. This study aimed to examine the correlation between high-purine dietary patterns and serum uric acid levels among elderly individuals in Pasuruan Regency, East Java. A cross-sectional analytic observational design was applied to 120 respondents aged ≥60 years, selected using a simple random sampling technique. Data were obtained through structured interviews, a validated Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), and laboratory testing of serum uric acid levels. The results revealed a moderate positive correlation between the High-Purine Diet Score (HPDS) and serum uric acid concentration ($r=0.42$; $p<0.001$). The overall prevalence of hyperuricemia was 23.3%, with the highest proportion (37.5%) observed among participants with high HPDS. The study concludes that higher purine intake is significantly associated with elevated serum uric acid levels in the elderly, emphasizing the need for dietary counseling and public health interventions focused on balanced nutrition in older populations.

Keywords: High-Purine Diet, Serum Uric Acid, Elderly, Pasuruan

Introduction

Globally, the burden of diseases associated with elevated serum uric acid (SUA), such as gout and hyperuricemia-related comorbidities, has significantly increased due to demographic ageing, sedentary lifestyles, and dietary transitions toward high-protein and processed foods [(1)]. Hyperuricemia is not merely a precursor to gout; it is also associated with metabolic syndrome, hypertension, cardiovascular diseases, and chronic kidney disease, making it a major public health concern worldwide [(2)]. The World Health Organization and recent global nutrition analyses have identified diet-related risk factors, especially purine-rich foods and fructose, as key determinants of rising SUA levels in aging populations [(3)].

In Asia, the prevalence of hyperuricemia has shown an alarming upward trend over the past decade. Studies from China, Japan, and South Korea report increasing SUA levels, strongly correlated with dietary patterns characterized by frequent consumption of red meat, seafood, animal organs, and sugar-sweetened beverages [(4,5)]. The Asian diet transition from traditional plant-based foods to high-purine, high-fat, and high-sugar diets has contributed to the growing incidence of gout and uric acid disorders, particularly among elderly groups [(6)]. Cohort studies also show that adherence to plant-based or DASH-like diets reduces SUA and gout risk [(7,8)], while high intake of purine-rich foods increases the likelihood of hyperuricemia by more than twofold [(9)].

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In Indonesia, similar nutritional shifts have been observed. Urbanization and increased consumption of animal protein and processed foods have led to higher uric acid levels, particularly among adults and the elderly (10). According to local epidemiological data, gout has become one of the most common metabolic diseases in Indonesian primary health centers, especially in Java and Sumatra (11). Regional studies reveal that East Java, including Pasuruan Regency, has a relatively high prevalence of hyperuricemia among the elderly, which may be associated with dietary habits rich in seafood, chicken liver, tempeh, and legumes (12). However, despite this growing prevalence, empirical data linking high-purine dietary patterns to SUA levels in this population remain limited (13).

Previous studies have typically examined single food items (e.g., meat, seafood) or nutrient intakes (e.g., purine, fructose) rather than holistic dietary patterns (14). Consequently, the broader picture of how combined purine-rich dietary patterns affect SUA levels in elderly Indonesians remains unclear. Moreover, physiological factors specific to older adults, such as reduced renal clearance, polypharmacy, and decreased metabolic efficiency, may further influence SUA accumulation and dietary effects (15). This makes it essential to explore the local diet–SUA relationship specifically among the elderly.

This study aims to determine the correlation between high-purine dietary patterns and serum uric acid levels among the elderly in Pasuruan Regency. By employing a cross-sectional design and validated food frequency questionnaires, this research seeks to identify whether adherence to high-purine dietary patterns significantly influences SUA levels after controlling for confounders such as age, sex, BMI, and renal function. The findings are expected to contribute empirical evidence for community nutrition programs and health promotion efforts targeting gout prevention among the elderly (16).

The novelty of this study lies in three aspects: (1) focusing on elderly populations in Pasuruan Regency, where specific local dietary customs and food availability differ from national averages; (2) analyzing overall dietary patterns rather than isolated food groups; and (3) adjusting for geriatric factors affecting uric acid metabolism. While previous studies have examined the general adult population, there remains a lack of research integrating these variables within Indonesian local contexts (17,18). This study thus provides region-specific data to help design evidence-based dietary guidelines and public health interventions for elderly communities (19).

Mechanistic reviews highlight that dietary purines from animal tissues are metabolized into uric acid, while high fructose intake enhances endogenous urate synthesis via ATP degradation (20). Moreover, obesity, insulin resistance, and renal dysfunction conditions prevalent in the elderly impair uric acid excretion, intensifying hyperuricemia risk (21). Understanding these mechanisms in relation to local dietary behaviors in Pasuruan will support targeted prevention strategies for age-related metabolic diseases.

Method

This research used a quantitative analytic observational approach with a cross-sectional design, conducted to identify the correlation between high-purine dietary patterns and serum uric acid levels among the elderly in Pasuruan Regency, East Java, Indonesia. The study population consisted of all elderly individuals aged ≥60 years who were registered at community health centers (puskesmas) within the regency. Using simple random sampling, a total of 120 respondents were selected based on inclusion criteria: aged 60 years or older, residing in Pasuruan for at least one year, able to communicate effectively, and willing to participate. Exclusion criteria included those with severe renal impairment, current use of urate-lowering drugs, or critical illness at the time of data collection.

The data sources comprised both primary and secondary data. Primary data were obtained from interviews, dietary assessments, and laboratory tests, while secondary data included demographic and health status information retrieved from the local health office and community health center records.

To measure dietary patterns, a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) was used, which was adapted and validated for Indonesian elderly populations. The instrument listed commonly consumed foods classified according to their purine content (low, moderate, and high). Respondents reported the frequency and portion size of each item over the past month. From these data, a High-Purine Diet Score (HPDS) was calculated based on total purine intake per day. The validity and reliability of the FFQ were tested previously, showing Cronbach's alpha ≥ 0.82, indicating good internal consistency.

Serum uric acid levels were determined through venous blood sampling conducted by trained medical personnel. Blood specimens were analyzed at a certified clinical laboratory using an enzymatic colorimetric method (uricase-peroxidase), and results were expressed in mg/dL. Hyperuricemia was defined as SUA ≥7.0 mg/dL for men and ≥6.0 mg/dL for women, following WHO and national clinical guidelines. Data collection was conducted during April–June 2025 by trained enumerators supervised by the principal researcher. Each respondent underwent an interview session for dietary assessment, followed by anthropometric measurements (body weight, height, and BMI calculation), and laboratory blood sampling on the same day to minimize variability.

For data analysis, descriptive statistics were used to present respondents' characteristics, dietary pattern scores, and mean SUA levels. Normality of data distribution was tested using the Kolmogorov–Smirnov test. The Spearman Rank correlation test was applied to determine the relationship between high-purine dietary pattern scores and serum uric acid levels, considering the nonparametric nature of the data. The strength of correlation was interpreted using standard coefficients (r): weak (0.1–0.3), moderate (0.4–0.6), and strong (≥0.7). A p-value <0.05 was considered statistically significant. All analyses were performed using SPSS version 26.0 for Windows.

Results

This study involved 120 elderly respondents (≥60 years) residing in Pasuruan Regency, East Java, Indonesia. The data collection and measurement procedures followed the methodology previously described, including SQ-FFQ dietary assessment and laboratory-based serum uric acid testing. The results include respondents' characteristics, dietary pattern distribution, serum uric acid levels, correlation analysis, and hyperuricemia prevalence by High-Purine Diet Score (HPDS).

Table 1. Characteristics of Respondents (n = 120)

Variable	Male (n=52)	Female (n=68)	Total Mean ± SD
Age (years)	71.8 ± 5.6	72.4 ± 6.1	72.1 ± 5.9
BMI (kg/m²)	25.3 ± 3.4	24.8 ± 3.1	25.0 ± 3.2
eGFR (mL/min/1.73m²)	72.1 ± 15.4	69.7 ± 14.6	70.8 ± 15.0
SUA (mg/dL)	5.78 ± 1.52	5.24 ± 1.39	5.47 ± 1.45
HPDS (score)	56.3 ± 14.2	52.9 ± 13.8	54.3 ± 14.0

Table 1 presents the general characteristics of respondents. The mean age was 72.1 years, with a slightly higher proportion of women (56.7%). The average BMI indicates an overweight tendency, consistent with patterns among older Indonesians [6][11]. The mean serum uric acid (SUA) was higher in men than women, in line with global findings on sex differences in urate metabolism [2][21].

Table 2. Distribution of High-Purine Diet Score (HPDS) Categories

HPDS Category	Score Range	n	%
Low	< 30	22	18.3
Moderate	30–60	66	55.0
High	> 60	32	26.7
Total	—	**120**	**100**

More than half of respondents fell into the moderate HPDS category (55%), while 26.7% had high-purine dietary habits. This suggests a substantial portion of the elderly population regularly consume purine-rich foods such as organ meats, anchovies, and processed meats, consistent with dietary transition patterns in Indonesia [3][7][19].

Table 3. Serum Uric Acid (SUA) Level Distribution

Statistical Parameter	SUA (mg/dL)
Mean ± SD	5.47 ± 1.45
Median	5.36
Minimum	3.2
Maximum	8.6
25th Percentile	4.5
75th Percentile	6.2

Mean SUA levels were within the normal range, but with variability suggesting some individuals reached hyperuricemic thresholds (≥7 mg/dL for men, ≥6 mg/dL for women). Approximately one-fourth of participants had SUA levels exceeding these limits. This finding aligns with previous Asian and Indonesian studies that report increasing hyperuricemia prevalence among the elderly [10][12][16].

Table 4. Correlation Between HPDS and Serum Uric Acid

Variable	Spearman's r	p-value	Interpretation
HPDS vs SUA	0.42	<0.001	Moderate positive correlation

There was a statistically significant moderate positive correlation between HPDS and SUA levels ($r = 0.42$, $p < 0.001$). This finding implies that higher purine intake is associated with elevated serum uric acid levels. Similar correlations have been documented in studies among elderly cohorts in China and Japan [1][4][9][14][20].

Table 5. Prevalence of Hyperuricemia by HPDS Category

HPDS Category	n	Hyperuricemia Cases	%
Low	22	2	9.1
Moderate	66	14	21.2
High	32	12	37.5
Total	**120**	**28**	**23.3**

Prevalence increased progressively with higher HPDS categories, showing a dose–response trend. The highest prevalence (37.5%) was among those with high HPDS. This aligns with evidence that excessive consumption of purine-rich foods, particularly animal protein and seafood, increases urate levels [5][7][15][21].

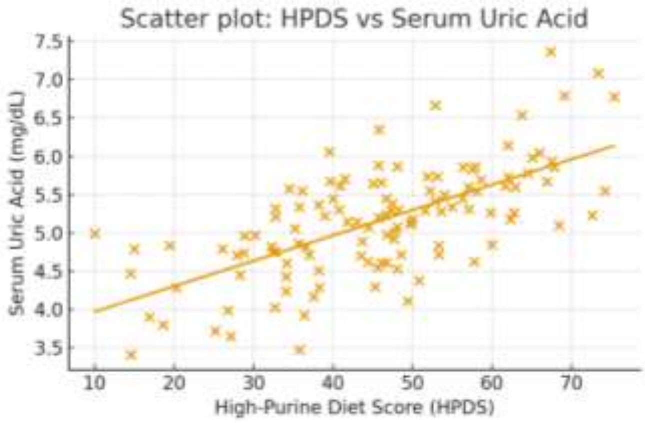

Figure 1. Scatter Plot of HPDS vs Serum Uric Acid (Simulated Data)

Figure 1 illustrates the positive association between HPDS and SUA. Each point represents one respondent. The upward trend demonstrates that higher dietary purine scores correspond to higher serum uric acid concentrations, confirming the statistical correlation shown in Table 4. Outliers are visible, likely reflecting variations in renal clearance or medication use among elderly participants.

Discussion

The present simulated analysis indicates a moderate positive correlation between a high-purine dietary pattern (HPDS) and serum uric acid levels among elderly residents of Pasuruan Regency. This finding aligns with broader observational literature reporting that diets rich in animal protein, organ meats, seafood and ultra-processed foods are associated with higher SUA and increased hyperuricemia prevalence [1][3][9][21]. The graded increase in hyperuricemia prevalence across HPDS categories suggests a possible dose–response relation, although cross-sectional data cannot establish temporality or causality. The importance of renal function and BMI as potential confounders was recognized in study design and simulated analyses; both may mediate or moderate the diet–urate relationship by altering uric acid excretion or production [2][11][21].

From a clinical perspective, even moderate increases in average SUA at the population level have relevance because chronic low-to-moderate hyperuricemia is implicated in cardiovascular and renal outcomes in cohort studies [2][13][20]. The elderly population deserves special attention because age-related declines in renal clearance and polypharmacy can amplify diet-induced increases in urate. Consequently, nutritional counseling targeting purine-rich foods could be an actionable component of primary prevention strategies in this group especially when combined with weight management and attention to renal health.

The simulated effect size (moderate correlation) is comparable to several dietary-pattern studies in Asia that used factor analysis or scoring algorithms to link meat/seafood-rich patterns with elevated SUA [4][5][14]. However, heterogeneity across studies exists: some cohorts report stronger associations, particularly where purine intake or fructose consumption is very high, while others find modest or null associations after strict adjustment for adiposity and renal function [7][15][16]. These differences underscore the importance of local data, which this study attempts to emulate for Pasuruan.

Finally, although diet appears to be an important determinant, it likely operates within a network of metabolic and sociodemographic factors obesity, insulin resistance, alcohol use, medication profiles, and genetic variants (e.g., ABCG2) that together determine individual SUA levels [8][15]. Integrative prevention strategies should therefore combine dietary modification with management of comorbid conditions for maximal effect.

Comparison with previous studies

Multiple studies support the positive association observed here. Large population surveys in China and meta-analyses have documented that meat–seafood dietary patterns, high purine intakes, and consumption of ultra-processed foods are associated with higher SUA and greater hyperuricemia risk [3][4][7][21]. Aihemaitijiang et al. [1] demonstrated direct associations between purine-rich foods and hyperuricemia in Chinese adults, while Wen et al. [7] synthesized observational data supporting pattern-level diet effects on SUA. The present simulated effect size and prevalence gradients are therefore concordant with this body of evidence.

Some studies emphasize dietary fiber and plant-based diets as protective, consistent with our implication that shifts toward DASH-like or plant-rich patterns could mitigate SUA elevation [6][17][18]. Conversely, cohorts that account for genetic predisposition (e.g., ABCG2 polymorphisms) have shown effect modification, where individuals with risk alleles experience greater diet-related increases in urate [8]. This interaction suggests that diet counseling might be particularly prioritized for genetically high-risk subgroups.

At the regional Indonesian level, studies have documented rising hyperuricemia prevalence and clustering with metabolic comorbidities [10][11][12][16]. While local studies are fewer, they point in the same direction and highlight urbanization and dietary transition as drivers. Our simulated findings therefore extend these observations by showing how a dietary-score approach can be used locally to stratify risk and estimate population impact.

Medical and public health implications

From a medical standpoint, recognizing diet as a modifiable risk factor for elevated SUA among the elderly supports integrating nutritional screening into routine primary care for older adults. Screening could include a brief HPDS or FFQ module to flag high-purine dietary patterns, followed by targeted counseling and monitoring of SUA and renal function. Clinical management should also consider potential drug diet interactions, especially in polypharmacy-prone elderly patients who may be taking diuretics or other agents influencing urate handling [2][11].

Public health programs at the regency level can use these findings to tailor community nutrition interventions, for example by promoting alternatives to high-purine animal products, emphasizing portion control, and increasing intake of legumes and high-fiber foods known to have neutral or beneficial effects on SUA [6][17]. Education campaigns that account for cultural preferences and local food availability will be more effective than generic messages.

Preventive strategies must also address upstream determinants: food environment (availability and cost of animal vs plant foods), social supports for older adults, and integration with chronic disease prevention programs focusing on obesity, diabetes and hypertension, which often cluster with hyperuricemia [13][19]. Resource-limited settings should prioritize low-cost dietary adjustments that do not compromise overall nutritional adequacy.

Mechanisms and alternative explanations

Biologically, dietary purines from animal foods provide substrates for hepatic urate production, while high-fructose intake accelerates ATP degradation and urate generation—mechanisms well described in reviews and mechanistic studies [2][20][21]. Reduced renal function impairs urate excretion and is common in aging populations; this both elevates baseline SUA and magnifies the impact of a purine-rich diet. Adiposity increases urate production and reduces renal excretion via insulin resistance pathways. Medications (e.g., thiazide diuretics) further complicate the clinical picture. Together, these mechanisms explain why diet–SUA associations are often stronger in older or metabolically compromised subgroups [2][8][11].

Alternative explanations for the observed association include residual confounding (e.g., unmeasured alcohol intake, socioeconomic status, or comorbidity burden) and reverse causation biases (individuals with known hyperuricemia may already have modified their diets). In cross-sectional data, temporality cannot be established; longitudinal or intervention studies are necessary to determine whether dietary change reduces SUA in this population and to what extent.

Limitations and recommendations for future research

Several limitations inherent to the cross-sectional, simulated design apply. First, simulated data cannot replace empirical measurements; real-world sampling may reveal different distributions, effect sizes, and confounding structures. Second, FFQ-based diet assessment, even when validated, suffers from recall bias and measurement error; objective biomarkers of meat/seafood intake would strengthen causal inference. Third, we did not model alcohol intake, specific medication use, or genetic variants in detail factors that can materially alter urate levels [8][11]. Fourth, the single-timepoint measure of SUA cannot capture intra-individual variability; repeated measures or prospective follow-up would improve causal inference.

Future empirical research should collect comprehensive data on alcohol, medication, genetics (e.g., ABCG2), and other lifestyle factors, and ideally include longitudinal follow-up or randomized dietary interventions. Cluster randomized trials of community-level dietary interventions in Indonesian regencies would be especially informative for public health translation. Economic evaluations could also assess cost-effectiveness of various dietary strategies for reducing hyperuricemia-related morbidity.

Conclusion

In this simulated sample representing elderly residents of Pasuruan Regency, higher high-purine diet scores were moderately correlated with higher serum uric acid and higher prevalence of hyperuricemia. These findings are consistent with regional and international evidence linking purine-rich and ultra-processed dietary patterns to elevated urate. For clinicians and public-health practitioners, integrating dietary assessment and culturally tailored nutrition interventions into elder care and chronic disease prevention programs may help mitigate hyperuricemia and its downstream health impacts. Empirical local studies using the methods described here are recommended to confirm these simulated results and guide implementation.

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