

SURVEY OF THE INCREASING RATE OF BLOOD URIC ACID IN PEOPLE UNDER 40 AGES

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ABSTRACT

Introduction: Hyperuricemia is known as a risk factor for gout and cardiovascular disease [1,2,3]. Economic development along with changes in lifestyle, diet of people ≤ 40 years old are the risks of hyperuricemia. We conducted this study to investigate the hyperuricemia rate, the correlation between hyperuricemia and certain foods and pre-existing conditions. **Methods:** A cross-sectional study describing 285 subjects with general health check-ups at the University Medical Center 2 from May to July 2022. The results were collected and divided into groups related to age, gender, BMI, pre-existing conditions, lifestyle, and diet for correlation analysis. **Results:** The overall rate of hyperuricemia was 41.40%, the rate in men was higher than women ($p < 0.001$). Hyperuricemia and BMI, pre-existing condition, smoking, drinking alcohol, drinking milk with were correlated. The rate of increasing blood uric acid levels and this correlation were respectively: obesity 49.39% (BMI ≥ 23), OR=2.22, 95% CI: 1.32-3.75; pre-existing conditions 75%, OR=8.5, 95% CI: 1.79-79.68; smoking 50.57%, OR=1.71, 95% CI: 1.00-2.95 and drinking alcohol 52.94%, OR=1.72, 95% CI: 1.31-2.25. The rate of hyperuricemia in the group who drank milk (31.78%) was lower than the group who did not (47.19%), $p = 0.011$, and reduced the risk of hyperuricemia by 48% compared to the people who did not (OR = 0.52, 95% CI: 0.30-0.89).

Conclusions: The rate of hyperuricemia in people ≤ 40 years old was 41.40%. The factors affecting blood uric acid levels were BMI, pre-existing conditions, smoking, and drinking alcohol increased the risk; drinking milk reduced the risk.

Key words: uric acid, hyperuricemia, obesity, drinking alcohol.

I. INTRODUCTION

Several decades ago, hyperuricemia was mentioned as a risk factor for gout. Nowadays, many studies have shown that hyperuricemia is also related to metabolic syndrome, hypertension, coronary artery disease, diabetes, and kidney stone disease... [4,5,6,7]. In addition to pathological factors, an unreasonable lifestyle is also the leading cause of increased blood uric acid. Currently, with the strong development of the economy, the need to eat protein-rich foods is increasing, leading to hyperuricemia in the population, which tends to rejuvenate [1,8]. There are many reasons leading to increased blood uric acid such as: eating a lot of protein-rich foods (red meat, animal viscera, ...), drinking alcohol, being inactive, not exercising, ... [9,10,11]. Early detection of hyperuricemia as well as some related factors will help medical facilities provide useful information in community health care management [12]. This helps us minimize unnecessary health consequences, as well as reduce the risk of metabolic and cardiovascular diseases.

According to Somchai Uaratanawong et al., the rate of hyperuricemia in Bangkok residents was 24.4% [13]. In Vietnam,

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according to author Huynh Ngoc Linh, the rate of hyperuricemia in patients ≥ 35 years old was 21.67% [14]. But the subjects of the above studies were mainly middle-aged or older subjects, or people with pre-existing conditions. In the world, there were also a few studies conducted on adolescents. For example, in a study of US children and adolescents aged 12 to 17 years, serum uric acid concentrations were strongly associated with the prevalence of metabolic syndrome, the proportion of children and 4.2% of US adolescents had this syndrome [15].

Hyperuricemia in young people was often a sign of metabolic syndrome [16]. Research by Kieu Hong Nhung et al. [7] also showed that the rate of hyperuricemia was related to metabolic diseases, with a common rate of 1/3 of young adults. In Vietnam, young adults (18 - 40 years old) make up a high proportion of the workforce. They are the main human resource in the country's economic development. Most studies on hyperuricemia focus on older people [17,12,18,19], but on young adults ≤ 40 years old were limited.

Our study objectives were:

- Determine the rate of increased blood uric acid concentration in subjects ≤ 40 years old.

- Investigate the correlation between blood uric acid levels and some factors such as types of food, drinks, and pre-existing conditions in young adult subjects ≤ 40 years old.

Thereby, we will have specific scientific data to help communication and health control programs be implemented better.

II. MATERIALS AND METHOD

2.1. Study design and participants:

A cross-sectional study was conducted with 285 participants/subjects, including men

and women aged 18 to 40 years old, who came for a general health check-up and were ordered to test for uric acid at the University Medical Center 2 from May 2022 to July 2022. All these participants/subjects were working at companies that coordinate with hospitals to organize annual health checks for them. They did not intentionally go to the hospital because of illness or for a general health check-up. They were all prescribed uric acid tests. They were asked to completely fast before blood collection for at least 6 hours.

The study's exclusion criteria include people who do not fully answer the survey questions, do not agree to participate in the study, or are being treated at a medical facility.

We calculated the sample size according to this formula:

$$n = \frac{Z_{1-\frac{\alpha}{2}}^2 \cdot \alpha p(1-p)}{d^2}$$

With: $Z_{1-\alpha/2} = 1.96$; $p = 0.212$; $d = 0,05$; $n = 257$ (p is the rate of hyperuricemia from Al Shanableh's study [20]). During sampling, we collected 285 samples that met the criteria.

2.2. Ethical clearance:

We met participants directly to discuss and clearly explain research-related issues such as: purpose and benefits of participating in research. They participated completely voluntarily and had the right to refuse if they did not want to participate. Through the consent form to participate in the study, we committed that all related information will be kept confidential. Our study was reviewed and approved by the Ethics Committee of the University of Medicine and Pharmacy at Ho Chi Minh City (approval number: 440/HĐĐĐ- ĐHYD, May 9th, 2022).

2.3. Data collection:

Blood uric acid test results were collected and compiled daily based on Labconn software connected to the AU480 - Beckman Coulter automatic biochemical analyser system at the Laboratory Department of University Medical Center 2. Quality control process was carried out with at least 2 levels in accordance with current regulations.

We combined the corresponding survey questionnaire with each patient's blood uric acid test result to divide into survey groups. Survey groups related to gender (male/female), age, BMI (overweight, obesity / no overweight, obesity), pre-existing conditions such as gout, cardiovascular disease, diabetes, hypertension (yes / no), habits such as

smoking, drinking alcohol, milk, soft drinks, eating red meat, animal viscera (yes / no).

2.4.Data analysis

We used descriptive and analytical statistical methods for variables, Student's test (T-test), ANOVA to test for quantitative variables with normal distribution and non-parametric tests for quantitative variables without normal distribution. We also used Chi-square or Fisher to test qualitative variables and the odds ratio OR to find associations in variables.

III. RESULTS

2.5.General characteristics of the research sample

Table 1: General characteristics of the research sample

Characteristics	Number of cases (n)	Rate (%)
Age	32.66 ± 4.8* (20 - 40)	
Age group		
< 25	16	5.61%
25 – 30	58	20.35%
30 – 35	100	35.09%
35 – 40	111	38.95%
Gender		
Male	236	82.81%
Female	29	17.19%
BMI	23.65 ± 3.68*	
No overweight, obesity	121	42.46%
Overweight, obesity	164	57.54%
Male	152	64.41%
Female	12	24.49%
Pre-existing conditions		
None	257	90.18%
Gout	7	2.46%
Cardiovascular disease,	3	1.05%
Hypertension	13	4.56%
Diabetes	5	1.75%
Habits		
Smoking		
Yes	87	30.53%
No	198	69.47%
Drinking alcohol		
No, rarely	132	46.32%
Monthly	64	22.46%
Weekly	83	29.12%
Daily	6	2.11%

Characteristics	Number of cases (n)	Rate (%)
Drinking milk		
Yes	107	37.54%
No	178	62.46%
Drinking soft drinks		
Yes	101	35.44%
No	184	64.56%
Eating red meat		
Yes	275	96.49%
No	10	3.51%
Eating animal viscera		
Yes	56	19.65%
No	229	80.35%

* Average value ± standard deviation

Among 285 subjects in our study, we obtained the following results:

Gender: the proportion of men was larger than women (82.81% compared to 17.19%).

Age: average age was 32.66 years old. The number of patients by age group gradually increases, more than 70% of patients were in the 30 - 40-year-old group, the youngest age was 20 years old, the oldest age was 40 years old.

BMI: the average value of the research group was 23.65 ± 3.68 , more than 50% of the study sample were overweight or obese. The rate of overweight and obesity in men was twice as high as in women.

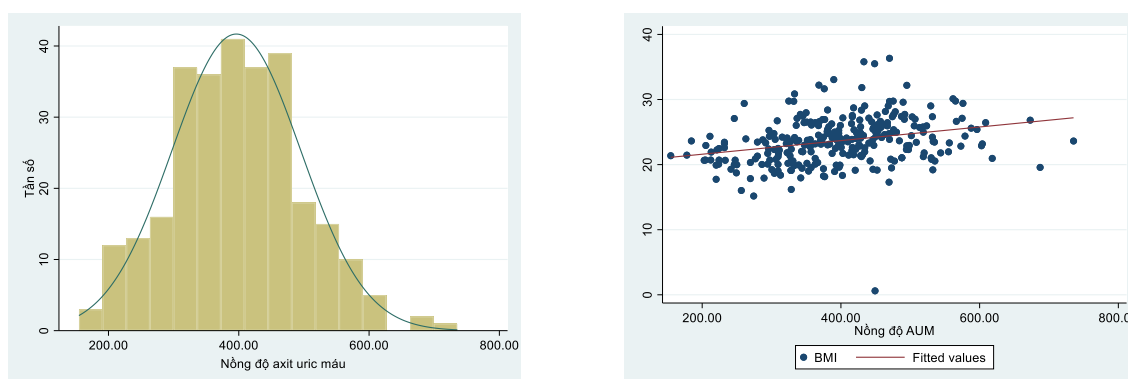
Pre-existing conditions: more than 90% of the surveyed population had no pre-existing disease, only 9.82% had a disease.

Among them, hypertension had the highest rate (4.56%), and cardiovascular disease had the lowest rate (1.05%).

For some habits such as smoking, drinking alcohol, milk, soft drinks, eating red meat, and animal viscera of research participants:

Nearly 70% of participants were non-smokers. However, the number of people drinking alcohol was high, with more than half of the participants drink alcohol to varying degrees. The percentage of people drinking milk, soft drinks and eating animal viscera was low (37.54%, 35.44% and 19.65% respectively). More than 90% of participants consumed red meat weekly.

2.6. Rate of increased blood uric acid concentration in subjects ≤ 40 years old



Picture 1. Distribution of blood uric acid concentration and relationship with BMI

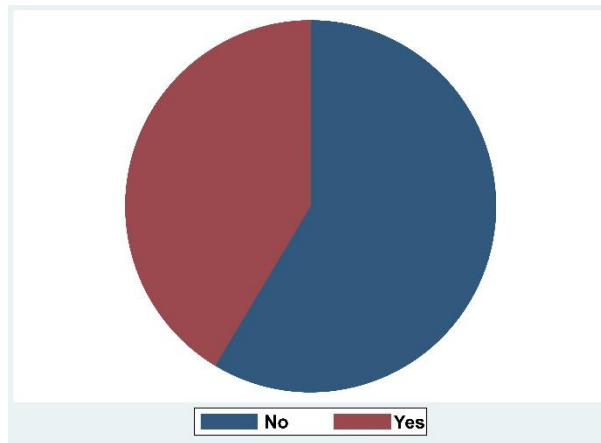
The average blood uric acid concentration was $396.3 \pm 99 \mu\text{mol/L}$, higher in men ($420.51 \pm 86.94 \mu\text{mol/L}$) than in women ($279.73 \pm 65.00 \mu\text{mol/L}$).

The correlation between blood uric acid concentration and BMI was a positive, weak,

and incomplete correlation, according to the linear regression equation:

$$\text{Blood uric acid concentration} = 217.97 + 7.54 \times \text{BMI} \quad (p < 0.001).$$

There were 118/285 participants ≤ 40 years old with increased blood uric acid levels, accounting for 41.40%.



Picture 2. Percentage of participants with increased blood uric acid levels

3.3. The correlation between blood uric acid levels and some factors

Table 2: The correlation between blood uric acid levels and some factors

Characteristics	Hyperuricemia		p	OR (KTC 95%)
	Yes	No		
Gender				
Male	114 (48.31%)	122 (51.69%)	< 0.001	0.095 (0.024-0,27)
Female	4 (8.16%)	45 (91.84%)		
Age			0.323	
< 25	6 (37.5%)	10 (62.5%)	0.317	1.79 (0.57-5.56)
25 – 30	30 (51.72%)	28 (48.28%)		
30 – 35	37 (37.00%)	63 (63.00%)		
35 - 40	45 (40.54%)	66 (59.46%)		
BMI			0.001	2.22 (1.32-3.75)
Overweight, obesity	81 (49.39%)	83 (50.61%)	0.001	2.22 (1.32-3.75)
No overweight, obesity	37 (30.58%)	84 (69.42%)		
Pre-existing conditions			< 0.001	4.95 (1.93-12.23)
Yes	21 (75.00%)	7 (25.00%)	< 0.001	4.95 (1.93-12.23)
No	97 (37.74%)	160 (62.26%)		
Smoking				
Yes	44 (50.57%)	43 (49.43%)	0.037	1.71 (1.00-2.95)
No	74 (37.37%)	126 (62.63%)		
Drinking alcohol				
No, rarely	37 (28.03%)	95 (71.95%)	< 0,001	1.72 (1.31-2.25)
Monthly	32 (50.00%)	32 (50.00%)		
Weekly	46 (52.42%)	37 (44.58%)		
Daily	3 (50.00%)	3 (50.00%)		

Characteristics	Hyperuricemia		p	OR (KTC 95%)
	Yes	No		
Drinking milk				
Yes	34 (31.78%)	73 (68.22%)	0.011	0,52 (0.30-0.89)
No	84 (47.19%)	94 (52.81%)		
Drinking soft drinks				
Yes	47 (46.53%)	54 (53.47%)	0.193	1.39 (0.82-2.33)
No	71 (38.59%)	113 (61.41%)		
Eating red meat				
Yes	114 (41.45%)	161 (58.55%)	0.927	1.062 (0.25-5.24)
No	4 (40.00%)	6 (60.00%)		
Eating animal viscera				
Yes	22 (39.29%)	34 (60.71%)	0.720	0.90 (0.47-1.69)
	96 (41.92%)	133 (58.08%)		

The proportion of participants with blood uric acid levels was higher in men than in women. This showed that the risk of increased blood acid uric concentrations in women was 90.5% lower than in men ($p < 0.001$).

Survey results also showed that the proportion of participants with blood uric acid levels in the overweight and obese group was higher than in the non-overweight group. Overweight and obese people were 2.22 times more likely to have hyperuricemia than the non-overweight group ($p = 0.001$).

There was a relationship between the pre-existing conditions and hyperuricemia. The risk of hyperuricemia in the group with pre-existing disease was 4.95 times, higher than the group without the disease ($p < 0.001$).

We did not find an association between age group and hyperuricemia ($p = 0.323$).

Smokers had a higher rate of hyperuricemia than non-smokers. This result showed that smokers had 1.71 times higher risk of hyperuricemia than non-smokers ($p = 0.037$).

The group of people drinking alcohol had a higher rate of hyperuricemia than the group that did not drink. When increasing one level

of alcohol use, their rate of hyperuricemia increased 1.72 times ($p < 0.001$).

We also found an association between drinking milk and hyperuricemia. In people who drank milk, the risk of hyperuricemia would be reduced by 48% compared to the group who did not drink milk ($p = 0.011$).

We did not find a statistically significant association for habits such as drinking soft drinks, eating red meat, and eating animal viscera with the rate of hyperuricemia ($p > 0.05$).

III. DISCUSSION

4.1 Blood uric acid concentration of research subjects

In our study, the average blood uric acid concentration of subjects ≤ 40 years old was $396.30 \mu\text{mol/L}$. We also found that there was a difference in uric acid levels between the two sexes: in which men ($420.51 \mu\text{mol/L}$) were higher than women ($279.73 \mu\text{mol/L}$) with statistical significance ($p < 0.001$). Our results were higher than Pham Thi Dung's study, the average serum uric acid concentration of adults in this study was $280.9 \mu\text{mol/L}$, in which men were also higher than women [21].

4.2 The hyperuricemia rate of study subjects

Uric acid concentration values $> 420 \mu\text{mol/L}$ for men and $> 360 \mu\text{mol/L}$ for women were considered hyperuricemia [22]. Through our study, the rate of increased blood uric acid levels in subjects ≤ 40 years old was 41.40%, of which men (48.31%) were higher than women (8.16%). Differences in uric acid concentrations between men and women were probably best explained by gonadal hormones [23]. The hormone testosterone stimulates xanthine oxidase enzyme activity, increasing uric acid levels [24].

The rate of hyperuricemia in our study was lower than some results of other studies. According to author Pham Van Tu, the rate of increased blood uric acid concentration was 43.2% [25]. According to author Nguyen Thi Thuy Hang, it was 42.7%, of which men were higher than women: 45.6% for men, 36.0% for women [26]. According to Pham Thu Hang, the rate of asymptomatic hyperuricemia was 45.2% [18]. The rate of hyperuricemia in the studies was different, possibly due to differences in the study subjects. Author Pham Van Tu conducted on male subjects < 40 years old, author Pham Thu Hang's research was on male patients > 40 years old with primary hypertension. Meanwhile, our study was conducted on both sexes.

Compared to some other studies, our results showed a higher rate of hyperuricemia. According to author Huynh Ngoc Linh conducted among people ≥ 35 years old in Ca Mau, this rate was 14.83%, of which 20.13% in men and 9.7% in women [14]. In Trinh Kien Trung's study conducted in people over 40 years old, the rate of hyperuricemia was 12.6% [27]. A cross-

sectional study on young men aged 18 - 40 years without any comorbidities in Qatar showed that the rate of hyperuricemia was 21.2% [20]. Studies with this significant difference may be due to differences in population sample size, subjects, gender ratio, nutrition, and ethnic customs.

4.3 The relationship between increased blood uric acid levels and some risk factors

Age: In our study, the highest uric acid concentration was found in the age group under 25 years old ($419.77 \mu\text{mol/L}$), this result was similar to the research results of author Pham Van Tu [25], the group under 25 years old had the highest blood acid uric concentration ($440.09 \mu\text{mol/L}$). The highest rate of hyperuricemia was in the 25–30-year-old group (51.72%), however this difference was not statistically significant, with $p > 0.05$. Some other studies had also shown a correlation between age and uric acid concentration [19,21]. This was explained that as people get older, the glomerular filtration function and the ability to eliminate uric acid also decrease, causing stagnation and increasing blood uric acid levels.

BMI: Results from our study showed that there was a positive correlation between BMI and blood uric acid concentration. According to our survey, 57.54% of the subjects examined were overweight and obese, of which 49.39% had hyperuricemia. The overweight and obese group had 2.22 times higher risk of hyperuricemia than the normal weight group ($p = 0.001$). Some previous studies also had similar results to ours. According to author Pham Van Tu, the positive correlation of BMI with blood uric acid concentration followed the equation: $\text{uric acid} = 204.03 + \text{BMI} \times 9.002 \mu\text{mol/L}$ [25]. Pham Thi Dung's research showed that

the rate of increased blood uric acid in the overweight and obese group was 23%, higher than the normal group (9.2%). Overweight and obese subjects had a 2.9 times higher risk of increased uric acid than the normal group ($p < 0.05$) [21]. Author Trinh Kien Trung showed that the results in this group were 17.2% higher than the normal group (9.1%, $p < 0.001$) [27]. The study by Kieu Hong Nhung et al. also showed similar results: the overweight and obese group had a 2.6-fold risk of hyperuricemia [7]. Fernanda Thomazini also demonstrated a significant correlation between BMI and hyperuricemia [28]. Honggang Wang also determined that the rate of hyperuricemia was about 2.98 times higher in overweight people [29].

Smoking: our research results had shown that smoking was associated with blood uric acid levels and the rate of hyperuricemia. In the smoking group, this rate was higher than the non-smoking group (50.57% and 37.37%). Smokers had 1.71 times higher risk of hyperuricemia than non-smokers ($p = 0.037$). The research by Seong-Kyu Kim and colleagues also found that women who smoked had 2.7 times higher risk of uric acid elevation than those who had never smoked [30]. In addition, an experimental study in mice for 60 days of exposure to tobacco smoke showed a significant increase in uric acid levels compared to non-contact mice, which explained the mechanism of increasing uric acid levels in this study that tobaccos degenerate the centrifugal cells in nearby tubes, thereby reducing kidney function leading to an increase in blood uric acid concentration [31].

Drinking alcohol: Among the surveyed subjects, we found that more than 50% of subjects used alcohol at different levels.

Increased blood uric acid concentration in people who used alcohol was 52.94%, higher than in the group who did not use alcohol (28.03%). We also analysed the relationship between hyperuricemia and frequency of alcohol using through groups: never or rarely, monthly, weekly, daily. The results showed that the risk of hyperuricemia gradually increased with the frequency of people's alcohol using. For each level of alcohol consumption, the rate of hyperuricemia increased 1.72 times ($p < 0.001$). This result was consistent with the results of previous studies: the group of people who used alcohol had higher risk of hyperuricemia [14, 21], 42.07% higher than the group of people who did not drink alcohol [14]. Although alcohol is not a rich source of purines, it reduces the function of the liver and kidneys, causing an imbalance in the body's uric acid metabolism.

Pre-existing conditions: We conducted a survey on subjects with non-communicable diseases including gout, hypertension, cardiovascular disease, and diabetes. The results showed that people with these diseases had a higher rate of increased blood uric acid concentration than the group without the disease (75.00% compared to 37.74%). Among them, people with hypertension had the highest rate of increased uric acid concentration (84.62%).

Drinking milk: Unlike the independent factors mentioned above, milk consumption had a negative correlation with increased blood uric acid levels. Milk proteins (casein and lactalbumin) cause an increased uricosuric effect, increasing urate clearance thereby reducing uric acid levels in the blood. The rate of hyperuricemia in the group drinking milk was lower than the group not drinking milk (31.78% compared to 47.19%).

People who drank milk will reduce the risk of increased blood uric acid by 48% compared to the group who do not drink milk ($p = 0.011$). This result was also consistent with the study of Kieu Hong Nhung et al. The group that regularly used milk had lower uric acid concentrations than the group that did not use it regularly, and this difference was statistically significant ($p < 0, 05$) [7].

Eating red meat, animal viscera, soft drinks: In this study, we did not find a correlation between eating red meat, animal viscera, and drinking soft drinks. But many other studies showed a positive relationship between hyperuricemia and red meat and animal viscera. This result could be explained by the fact that we only surveyed the frequency of use: never or rarely, monthly, weekly, daily without assessing the amount of red meat or animal viscera in their diet. Red meat is one of the foods associated with increased blood uric acid levels. Pham Thi Dung's research results also showed that the habit of regularly using (daily, weekly) red meat and animal viscera increased the risk of hyperuricemia by about 9 times ($p < 0.001$) [21].

IV. CONCLUSION

Our research showed that the average blood uric acid concentration in adults ≤ 40 years old was $396.3 \pm 99 \mu\text{mol/L}$. The rate of hyperuricemia was 41.40%, higher in men than in women.

Habits that increase the risk of hyperuricemia in people were BMI, pre-existing conditions, smoking, and drinking alcohol. People who had the habit of using milk will reduce the risk of hyperuricemia. We did not find a correlation between hyperuricemia and drinking soft drinks, eating red meat and animal viscera. Foods

with specific usage amounts need to be studied further in future studies.

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