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ORIGINAL RESEARCH

A Hospital-Based, Single-Center, Cross-Sectional Study to Investigate the *Status Quo* of Hyperuricaemia in a Booming Seaside City with Young Population from 2020 to 2021 in China

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Background: This is a hospital-based, single-center, cross-sectional study to investigate the *status quo* of hyperuricaemia (HUA) in general adults in Shenzhen, a booming seaside city in the South China.

Methods: All health adults (≥18 years old) undergoing health examination from 2020 Oct 1 to 2021 September 30 in a general hospital were enrolled. Their medical records were investigated and analyzed.

Results: Total 4604 participants (2938 males and 1756 females) were included and analyzed. We found that although the participants in Shenzhen were younger than the people included the analogous study in the adjacent cities (total 38.41 ± 10.33 years, 39.11 ± 10.18 in males and 37.24 ± 10.47 in females), the prevalence of HUA reached to amazing 34.7% (43.5% in males and 20.1% in females). Moreover, great HUA-related gender difference was found in terms of age-related variation trends of HUA prevalence ($P < 0.001$), indices of laboratory examination ($P < 0.01$) and influence factors ($P < 0.001$).

Conclusion: These results raise alarm bells for the HUA problem in the booming seaside city with young population like Shenzhen in China (2020–2021). Effective measures are appealed to reduce the high prevalence of HUA of Shenzhen. In addition, during analyses of the data, we found that both the prevalence of HUA and age of the population need to be seriously considered. Accordingly, we propose a more representative index, namely "Prevalence-Age Index (PAI = Prevalence of HUA/Average age)" to be used in the future HUA-related investigations.

Keywords: hyperuricaemia, prevalence, gender difference, risk factors, protective factors

Introduction

Hyperuricaemia (HUA) is a common metabolic disorder characterized by elevated levels of uric acid in the body.[1] HUA is a precursor of gout, which is reportedly associated with a spectrum of severe clinical conditions, such as cardiovascular diseases,[2] stroke[3] and diabetes.[4] Moreover, it is reported that even asymptomatic HUA has the potential to progress to chronic kidney diseases.[5] HUA requires further attention to prevent development of severe diseases. The pathogenesis of HUA is complicated and not fully understood. It is a comprehensive result of interactions of many factors, such as

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gender, age, genetics, environment, and markedly, lifestyle.[1] In a sense, it is a kind of lifestyle-related disease. The onset of HUA is closely associated with excessive intake of purine-rich foods, such as beer, seafoods and meat. The prevalence of HUA varies among countries with rates of 20.1% in the United States (2015–2016),[6] 16.3% in Spain (2013),[7] and 25.0% among men and 24.1% among women in Ireland (2006–2014).[8] However, these studies reported an increasing trend over time. The situation in China is not optimistic. Due to the great economic growth in China, the lifestyle of Chinese people also fundamentally changed, particularly that of young people. The most noteworthy change is a great enhancement of intake of meat and alcohol and reduction of intake of rice and vegetable. Accordingly, the prevalence of HUA in adult Chinese is increasing. Liu et al reported the prevalence of HUA in Chinese adults in 2009–2010 was only 8.4%.[9] Han et al reported that the prevalence of HUA in the eastern cities in China in 2014–2015 was 11.3% (20.7% in males; 5.6% in females).[10] A later reported by Zhang et al reported that estimated prevalence of HUA in Chinese adults was increased to 14% in 2018–2019.[11] Song et al reported that the prevalence of HUA in 31 provinces in China was 17.7% in 2015–2017.[12] A study investigated the prevalence of HUA in 9 cities in the Pearl River Delta in 2018–2019, they found the prevalence of HUA was reached to amazing 34.05% (41.53% in males; 26.14% in females).[13] These documents verified an increasing tread of HUA prevalence in Chinese adults, which exhibits great regional disparity. Accordingly, the problems of HUA and HUA-related diseases have become an urgent public health problem in China, which should be faced by clinicians and the government. Interestingly, Shenzhen, is the most economically developed seaside city in the South China. People in Shenzhen are prone to consume more alcohol and purine-rich seafoods and meat than in the other cities. Moreover, people in Shenzhen commonly have more stress due to the tremendous work pressure, but the average age of people in Shenzhen is younger than that of the other cities. It is warrant investigated the prevalence of HUA in adults in Shenzhen. Unfortunately, the data in Shenzhen alone remain unreported.

For a better understanding of HUA and its related diseases, several variables should be considered. In addition to the aforementioned location and era which are closely related to lifestyle, gender difference and age are also important variables that cannot be ignored. Gender difference is a noteworthy variable in HUA research. Commonly, males have a higher risk of development of HUA.[11] Previous studies also reported that men have a higher prevalence of HUA than women,[10,11,13] which might be associated with the different biological and social factors, and lifestyles between men and women. Interestingly, in some countries where lifestyles between males and females are quite similar, the difference in the prevalence of HUA between males and females is also not large. The typical instance is the United States, and their prevalence of HUA was 20.2% among men and 20.0% among women (2015–2016).[6] Another important variable is age. The prevalence of HUA is closely associated with age, and older age groups are prone to have a higher prevalence of HUA.[6,8] Thus, when we compare the prevalence of HUA in coetaneous populations among regions, the age distribution of the certain population cannot be ignored. In this regard, Shenzhen is a booming city in China with young population. The prevalence of HUA along with the HUA-related gender difference in Shen is uncertain, which warrants further investigation.

Herein, we designed a hospital-based, cross-sectional study to investigate the prevalence and gender difference of HUA in Shenzhen, a representative city with economic prosperity and young population. In light of a previous study on the Pearl River Delta,[13] we hypothesized that prevalence of HUA in Shenzhen is high, although the population is young. In addition, a significant gender difference is also exhibited in this population. We believe the findings of this study may be helpful to understand the *status quo* of HUA in these young booming cities and take necessary measures to suppress the increasing trends of HUA worldwide.

Methods and Materials

Participants and Ethical Issues

This is a hospital-based, single-center, cross-sectional study to investigate the *status quo* of HUA in general adults (≥18 years old) who underwent health examination from 2020 Oct 1 to 2021 September 30. This 3000-bed hospital is a general medical center in eastern Shenzhen. Importantly, this hospital provided normal medical services during the investigation period (2020–2021) when many hospitals could not provide medical services during the COVID-19 pandemic. Accordingly, the participants' data had a certain degree of representativeness. Their medical records were

investigated and analyzed. All data used in this study were primary data, and no secondary data were used. Total 4700 medical records were included, of those, 6 subjects were excluded because their medical records were incomplete. Finally, 4694 participants were recruited in the present study. This study was designed and conducted complying with the guidelines of the Declaration of Helsinki of the World Medical Association (2013). The present study was approved and supervised by the Ethical Committee of the Shenzhen Third People's Hospital (approval number: 2023–049). This was a retrospective study; *ex post facto* informed consents were obtained to ensure that all participants agreed to use their medical records for inclusion in this study after the protocol of this study was approved by the ethical committee. All involved personal information is strictly protected and managed as per the Personal Information Protection Law of the People's Republic of China.

Data Collection

Three serial data, namely *i*) demographic data, *ii*) data of physical examination and *iii*) laboratory examination, were included in the database based on their medical records. All original data were acquired from the clinical routine methods for healthy examination. *i*) Demographic data were directly acquired from the medical records. *ii*) Acquisition of data for physical examination: All the participants were required to fast for 8–12 hours before their examination. Blood sampling was performed at 8:00 am to collect the venous blood for the laboratory examinations. Then, the body weight and height were measured to calculate the body mass index [BMI = body weight (kg)/height $(m)^2$]. Blood pressure was measured in a sitting position to get the diastolic blood pressure (DBP) and systolic blood pressure (SBP) (OMRON, HEM-1000, OMRON Ltd., Shanghai, China), data were acquitted by the mean of three measurements. *iii*) Acquisition of data of laboratory examination: Indices of laboratory examination data included the levels of and serum uric acid (202–-416 μmmol/L among males and 143–229 μmmol/L among females), low-density lipoprotein (LDL-C, 0–2.59 mmol/L), high-density lipoprotein (HDL-C, >1.04 mmol/L), triglyceride (TG, 0.7–2.30 mmol/L), biochemical indexes of total cholesterol (CHOL, 2.16–5.20 mmol/L), glutamic pyruvic transaminase (ALT, 0–45 U/L), glutamic oxaloacetic transaminase (AST, 0–45 U/L), and fasting blood glucose (FBG, 3.89–6.11 mmol/L). All the indices were measured in the same laboratory in this hospital as per the clinical routine using the same machine system (Cobas 8000 c702 analyzer, Roche Diagnostics (Shanghai) Ltd., Shanghai, China). No missing data occurred because there were routine data from medical records during a physical examination.

Evaluation Criteria

In light of the normal range of laboratory in this hospital, serum uric acid levels ≥417 μmol/L in male and ≥340 μmol/L in female were identified as HUA. BMIs of participants were classified as per the WHO recommendation for Asian population,[14] namely low weight: BMI < 18.5 kg/m^2, normal weight: 18.5 kg/m^2 ≤ BMI < 23.0 kg/m^2, overweight: 23 kg/m^2 ≤ BMI < 27.5 kg/m^2, and obese: BMI ≥ 27.5 kg/m^2. The normal ranges of the other indices were as follows: Blood pressure: SBP < 140 mmHg and DBP < 90 mmHg, LDL-C ≤ 4.1 mmol, HDL-C ≥ 1.04 mmol/L, TG ≤ 2.3 mmol/L, CHOL ≤ 6.2 mmol/L, ALT ≤ 45 U/L, AST ≤ 45 U/L, FBG ≤ 6.12 mmol/L.

Statistical Analysis

A SPSS software (V26.00, IBM, IL, USA) was used for statistical analysis. The normal distribution of continuous variables was checked by the Shapiro–Wilk test. They were presented as mean ± standard deviation (SD). Data were divided as hyperuricemic group and normouricemic group in males and females according to the baseline serum uric acid levels. The differences of indices between hyperuricemic group and normouricemic group were analyzed using a Student's *t*-test. A two-factor ANOVA was used to compare the differences in serum uric acid levels between males and females in different age groups. A multivariate logistic analysis was employed to estimate the potential influence (risky or protective) factors for HUA in different genders. Age, BMI, SUA, SBP, DBP, LDL-C, HDL-C, TG, CHOL, ALT, AST, and FBG were included in the analysis model. The multicollinearity was tested in advance. Serum uric acid levels were not included in the standard panel of laboratory variables determined during preventive check-ups. $P < 0.05$ was considered as the level of statistical significance.

Results

Table 1 presents the clinical characteristics of the involved participants. Total 4694 (2938 males and 1756 females) participants were included in this study, of those 1630 (34.7%) had HUA [1277 (43.5%) males and 353 (20.1%) females]. The average serum uric acid level in males was significantly higher than that of females (410.45 ± 87.65 vs 290.23 ± 66.81 mmol/L, $P < 0.001$). Overall, the indices of BMI, SBP, DBP, LDL-C, TG, CHOL, ALT, and AST in males were higher than those of females, whereas protective HDL-C level in males was lower than that of females (1.17± 0.28 vs 1.51± 0.34 mmol/L, $P < 0.001$), although there was no significant difference of age between male and female (39.11 ± 10.18 vs 37.24 ± 10.47, $P = 0.103$). These results indicate a better healthy status in female. However, interestingly, with the age increasing, the variation trends were opposite between male and female, namely males display a downtrend whereas females present a strong uptrend (Figure 1A). The differences in serum uric acid levels between males and females in different age groups are shown in Figure 1B. The serum uric acid levels in males were significantly higher than those in females (Figure 1B). The effects of each single factor and their interactions are reported in Table S1. With respect to the HUA-related factor analyses, results of the multicollinearity test of the relationship of independent variables (laboratory examination indices) and dependent variables (serum uric acid levels) are shown in Table S2. Serum uric acid levels were treated as the dependent variable. This model shows the relationships between several independent variables and serum uric acid levels. Most independent variables had a statistically significant relationship with serum uric acid levels, with BMI, SBP, LDLC, TG, ALT, and FBG having a more substantial impact (Table S2). BMI, TG levels, and ALT levels in HUA groups were significantly higher in both males and females. In addition, the HDL-C levels in HUA group were significantly lower than that of normouricemic group in male, while the age, SBP, DBP, LDL-C, and AST levels in HUA group were significantly higher than those of normouricemic group in female. It is noteworthy that the data of FBG exhibited opposite tendency between males and females. The FBG levels were lower in HUA males whereas higher in HUA females. These data indicated great discrepancies between male and female (Table 1).

In terms of analyses of influence factors, discrepancies are also found between male and female sex and age. As shown in Figure 2, the data of multivariate analysis in males indicated that the risk of HUA increased 0.14 times if the BMI increased 1 unit (OR=1.15, 95% CI: 1.120–1.182). Analogously, the risk of HUA increased 0.154 times if the TG levels increased 1 unit (OR=1.17, 95% CI: 1.09–1.25). Inversely, the risk of HUA might reduce 0.68 times if the HDL-C levels increased 1 unit (OR=0.51, 95% CI: 0.36–0.72). Interestingly, the risk of HUA might reduce 0.139 times if the FBG levels increased 1 unit (OR=0.87, 95% CI: 0.82–0.99) (Figure 2A). The data in females exhibited different tendencies. The risk of HUA increased 0.13, 0.03, 1.08, and 0.66 times if the levels of BMI (OR=1.14, 95% CI: 1.09–1.20), SBP (OR=1.03, 95% CI: 1.01–1.04), LDL-C (OR=2.95, 95% CI: 1.35–6.44) and TG (OR=1.94, 95% CI: 1.44–2.61) increased 1 unit, respectively. Inversely, risk of HUA decreased 0.03 and 0.86 times if the age (OR=0.97, 95% CI: 0.96–0.99) and CHOL (OR=0.43, 95% CI: 0.20–0.92) increased 1 unit, respectively (Figure 2B). In this regard, the potential risk factors for HUA were BMI and TG in males and females, and SBP and LDL-C in females. HDL-C might be a potential protective factor for HUA in males. CHOL might be a potential protective factor for HUA in females.

Discussion

In the present study, we conducted a hospital-based, single-center, cross-sectional study to investigate the status quo of HUA in general adults in Shenzhen City. The first important finding lied in the prevalence of HUA in this study reached to amazing 34.7% (43.5% in males and 20.1% in females), although the included participants were young (Total 38.41 ± 10.33 years, 39.11 ± 10.18 years in males, and 37.24 ± 10.18 in females) in 2020–2021. The second finding was we identified great gender difference of HUA level in terms of age-related variation trend, indices of laboratory examination, and influence factors. This study indicated that even in Shenzhen, such a booming city with young population, HUA has been an urgent public health concern, which requires great attention and urgent intervention. Moreover, the marked gender difference of HUA should be fully considered during the HUA study. To our knowledge, this is the first study reporting the HUA *status quo* in a booming city with young population. We believe that the findings of the present study raise alarm bells for the HUA problem, even in a city with young population. This study is also helpful for forming

Table 1 Clinical Characteristics of the Involved Participants

Variables	Male				Female				Total (M+F)
	Hyperuricemic	Normouricemic	*P* value (H vs. N)	Total	Hyperuricemic	Normouricemic	*P* value (H vs. N)	Total	
Cases	1277	1661		2938	353	1403		1756	4694
Age (years)	38.61 ± 9.83	39.49 ± 10.43	0.137	39.11 ± 10.18	38.69 ± 12.29	36.88 ± 9.93	<0.001***	37.24 ± 10.47	38.41 ± 10.33
BMI (kg/m^2)	26.00 ± 3.37	24.05 ± 3.39	<0.001***	24.89 ± 3.52	24.15 ± 3.61	21.87 ± 3.02	<0.001***	22.33 ± 3.28	23.94 ± 3.65
Low weight	12(13.5)	77 (86.5)		89 (3.0)	24(13.7)	151(86.3)		175 (10.0)	264 (5.6)
Normal	321(30.5)	731 (69.5)		1052 (35.8)	145(13.3)	944(86.7)		1089 (62.0)	2141 (45.6)
Overweight	636(48.9)	665 (51.1)		1301 (44.3)	134(34.6)	235(65.4)		387 (22.0)	1688 (36.0)
Obesity	308(62.1)	188 (37.9)		496 (16.9)	50(47.6)	55(52.4)		105 (6.0)	601 (12.8)
SBP (mmHg)	125.58 ± 14.02	121.64 ± 13.81	0.704	123.36 ± 14.04	120.92 ± 18.22	112.94 ± 16.68	<0.001***	114.54 ± 15.78	120.06 ± 15.31
DBP (mmHg)	79.61 ± 10.70	76.52 ± 10.12	0.201	77.86 ± 10.49	74.76 ± 10.92	70.82 ± 8.94	<0.001***	71.61 ± 9.50	75.29 ± 10.27
LDL-C (mmol/L)	3.31 ± 0.87	3.16 ± 0.86	0.612	3.22 ± 0.86	3.05 ± 0.87	2.81 ± 0.76	0.003**	2.86 ± 0.79	3.09 ± 0.86
HDL-C (mmol/L)	1.10 ± 0.25	1.21 ± 0.30	<0.001***	1.17± 0.28	1.38 ± 0.35	1.54 ± 1.02	0.195	1.51± 0.34	1.30 ± 0.35
TG (mmol/L)	2.25 ± 1.60	1.71 ± 1.37	<0.001***	1.94 ± 1.50	1.54 ± 1.17	1.02 ± 0.69	<0.001***	1.13 ± 0.83	1.64 ± 1.35
CHOL (mmol/L)	5.05 ± 0.95	4.86 ± 0.95	0.493	4.94 ± 0.96	4.83 ± 0.96	4.60 ± 0.87	0.050	4.65 ± 0.89	4.83 ± 0.94
ALT (U/L)	34.06 ± 28.00	27.81 ± 33.87	0.021*	30.53 ± 31.60	20.08 ± 18.25	14.72 ± 15.81	<0.001***	15.79 ±16.47	25.02 ± 27.87
AST (U/L)	24.52 ± 15.58	22.46 ± 20.42	0.126	23.35 ± 18.50	19.74 ± 10.16	17.75 ± 10.21	0.006**	18.15 ± 10.22	21.41 ± 16.11
FPG (mmol/L	5.39 ± 1.35	5.52 ± 1.88	<0.001***	5.47 ± 1.67	5.29 ± 1.12	5.03 ± 0.84	0.001***	5.08 ± 0.91	5.32 ± 1.44

Notes: Data are present as mean ± SD, * means $P < 0.05$, ** means $P < 0.01$, *** means $P < 0.001$.

Abbreviations: ALT, alanine transaminase; AST, aspartate transaminase; BMI, body mass index; CHOL, total cholesterol; DBP, diastolic blood pressure; FPG, fasting plasma glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; SBP, systolic blood pressure; TG, triglycerides.

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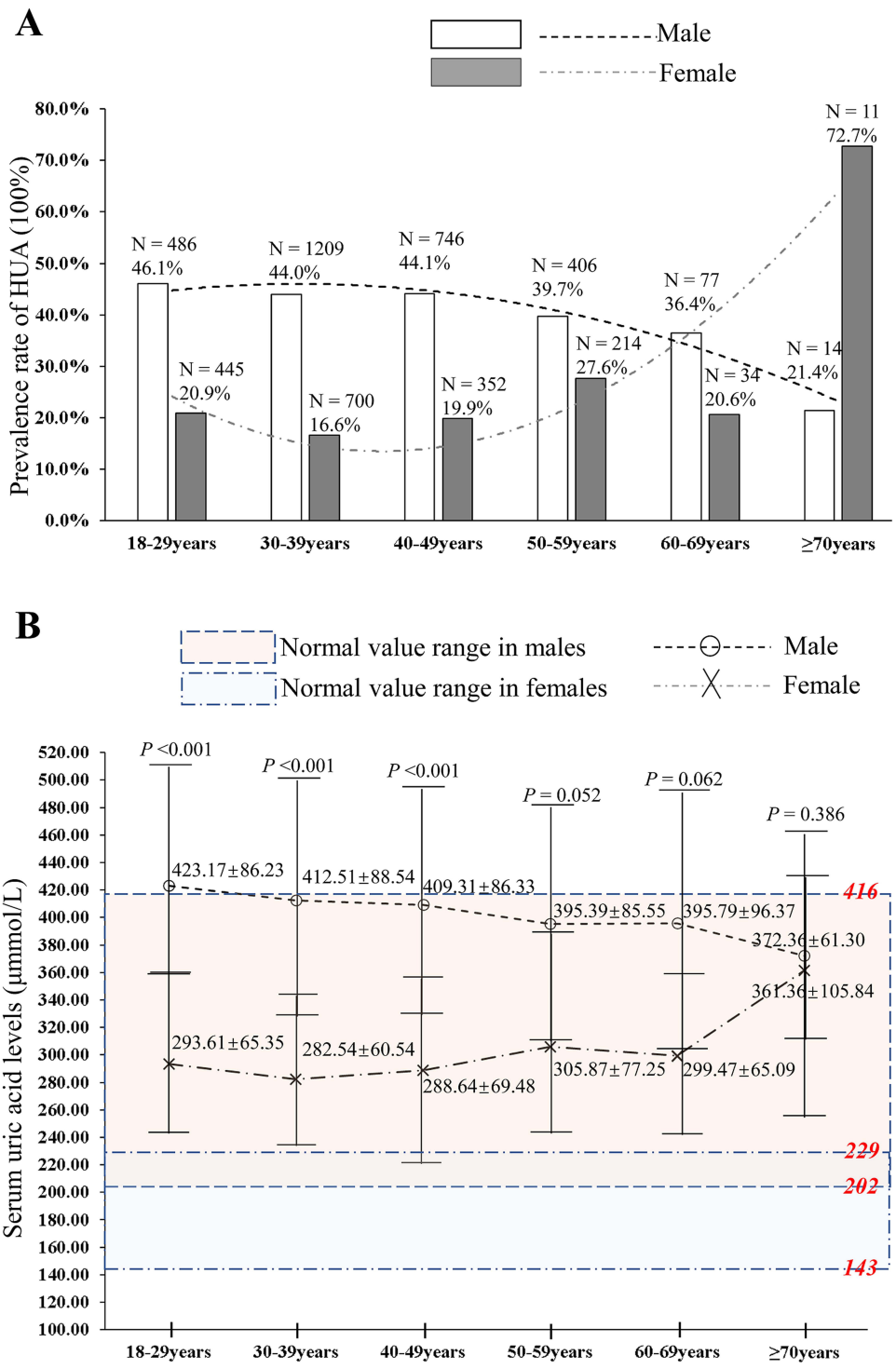

Figure 1 Gender difference in the HUA-related indices. (**A**) Age distribution of hyperuricemia in the participants. (**B**) The serum uric acid levels between males and females in different age group. The italicized numerical texts in red pen represent the range of normal value.

a better understanding of the *status quo* of HUA in China, and taking urgent measures to intervention of HUA to prevent the HUA-related clinical conditions.

The Prevalence of HUA Among Different Eras and Regions

It has been well reported that the prevalence of HUA is globally increasing with the changes of lifestyle in recent years, particularly in the country/city with rapid economic growth. Reviewing the published data of HUA prevalence, we can

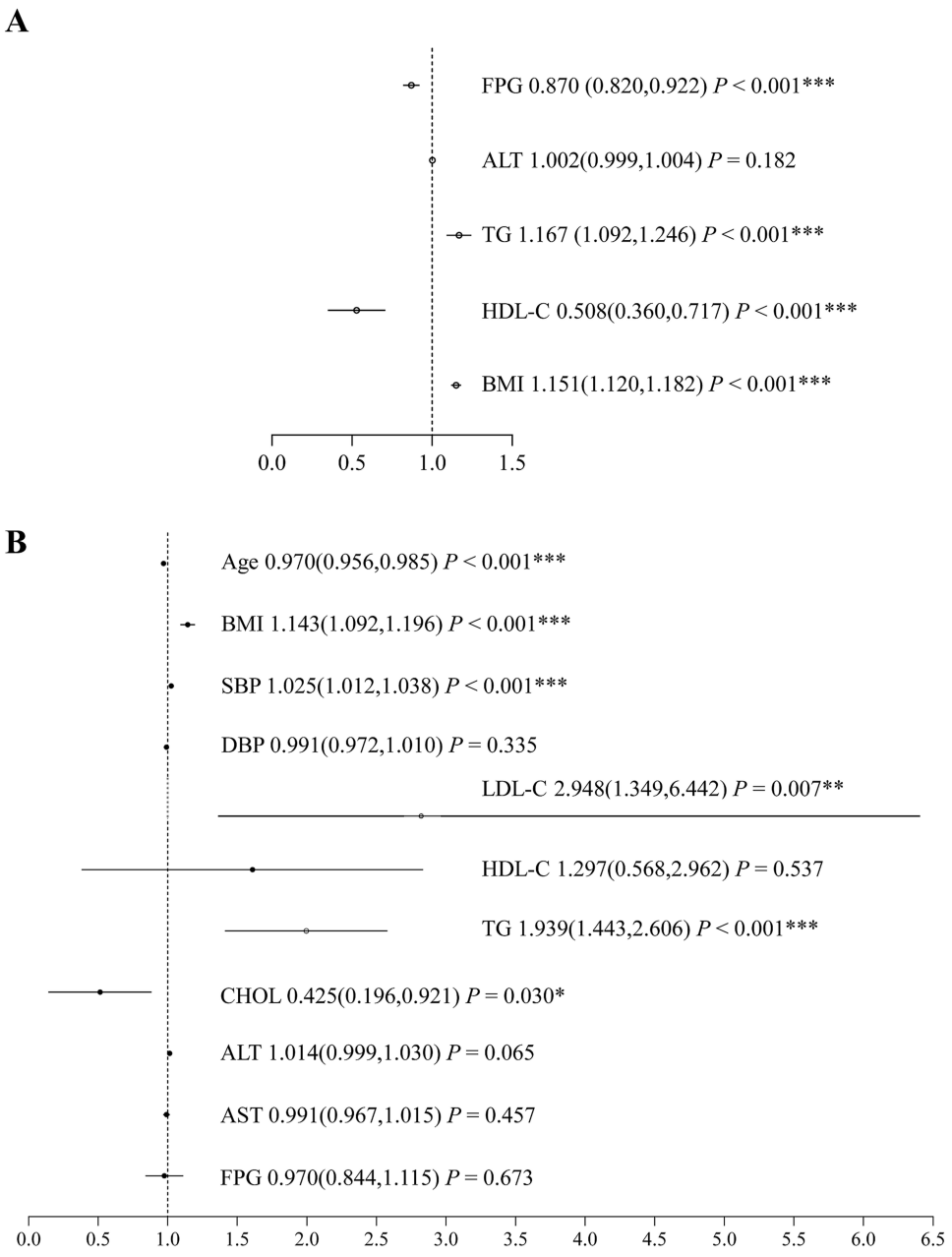

Figure 2 Forest plots of potential risk factors for hyperuricemia. (**A**) Potential risk factors for hyperuricemia in male participants. (**B**) Potential risk factors for hyperuricemia in female participants. Data present as adjusted OR (95% CI), * means $P < 0.05$, ** means $P < 0.01$, *** means $P < 0.001$.

Abbreviations: ALT, alanine transaminase; AST, aspartate transaminase; BMI, body mass index; CHOL, total cholesterol; CI, confidence interval; DBP, diastolic blood pressure; FBG, fasting plasma glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; OR, odds ratio; SBP, systolic blood pressure; TG, triglycerides.

imagine a sharp growth curve in China: 8.4% in 2009–2010,[9] 11.3% in 2014–2015,[10] 14% in 2018–2019.[11] However, as a lifestyle-related disease, prevalence of HUA is greatly impacted by the lifestyle, which therefore presents greatly regional divergence among countries, even among different areas in a large country such as China. For example, a meta-analysis reported that the prevalence of HUA in China was 13.3% (19.4% in males and 7.9% in females) in 2000–2014,[1] but the data were lower than the prevalence of HUA in some developed countries such as 21.2% in males and 21.6% in females in USA[15] and 25.8% (34.5% in males and 11.6% in females) in Japan,[16] and higher than the other developing countries such as 10.6% (18.4% in males and 7.8% in females) in Thailand[17] during the same period. Even in China, the

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prevalence of HUA also exhibited great regional disparity.[10] Thus, era and location, which are closely associated with socioeconomic level and lifestyle in a certain population, are the important variables for the HUA investigation.

Age is an Important Variable Which Could Not Be Ignored

Since the prevalence of HUA is closely associated with age,[6,8] the age distribution of the involved population cannot be ignored. In this study, our prevalence of HUA, 34.7% (43.5% in males and 20.1% in females, Table 1) is higher than these previous data in the large-scale study in China and the other countries but is in agreement with the data in the previous in 2018–2019 in Pearl River Delta (Shenzhen also belongs to the Pearl River Delta), namely 34.05% (41.53% in males; 26.14% in females).[13] However, the age distribution is quite different between this previous study in Pearl River Delta and the present study. The previous study included 6491 healthy participants including 9 cities (also included Shenzhen), where the population was older than the present study (45.63 ± 15.10 vs 39.11 ± 10.18 years in males and 45.25 ± 15.94 vs 37.24 ± 10.47 years in females).[13] In this regard, we believe that the *status quo* of HUA in Shenzhen is worse than that of the Pearl River Delta. We considered that solely using the prevalence of HUA might not be able to fully present the situation of HUA. Age is an important HUA-related variable which cannot be ignored. Thus, based on these findings, we propose using a more representative index, namely "Prevalence-Age Index (PAI)", which comprehensive considered the impact of age might be more applicable in comparing the *status quo* of HUA between different areas. PAI can be simply calculated as prevalence of HUA/average age. For example, the PAI in the present study is 34.7%/38.41 = 0.0090, in that study[13] is 34.05/45.45 = 0.0075. Figure 3 shows application of PAI to compare the data between the present study and the study in the Pearl River Delta.[13] PAI is set considering the potential impacts of age. Obviously, PAI can vividly present the severe situation of HUA prevalence in Shenzhen, which is therefore recommended for the future HUA-related research (Figure 3).

Gender Difference is Another Important Variable Needs to Be Considered

In line with the present HUA-related studies, we also found great difference between male and female. Main differences lied in four points: *i*) Difference of prevalence between males and females (43.5% in males vs 20.1% in females). This difference is in agreement with the other Asian countries such as Japan[16] and Thailand[17] but different with the data in the USA (21.2% in males vs 21.6% in females).[15] This difference might be due to the different lifestyles between male and female. A plausible interpretation is that men are more easily involved in unhealthy lifestyles, such as alcohol abuse, smoke, excessive intake of meat, and insufficient intake of vegetables. Furthermore, in the traditional Chinese culture, men have to withstand more social pressure than women.[18] Indeed, our data also present that most of the results of laboratory examination in males were worse than those of females (Table 1). Thus, it is not surprising that men are more susceptible to HUA than women because of the greater social burden-induced stress and relatively unhealthy lifestyle (smoking, alcohol abuse, and intake of meat and alcohol) in men. *ii*) Different attributions of the indices of laboratory examination between male and female (Figure 1B, Table 1). Overall, the serum uric acid levels in males were significantly higher than those in females in the younger age groups (under 49 years). However, no significant difference was found between men and women over 50 years of age, which might be due to the influence of menopause and changes in estrogen levels (Figure 1B). The values in older age groups (over 70 years) among males exhibited a downward trend. However, the data in older age (over 70 years) among females exhibit a sharp upward trend. These results showed a significant difference in serum uric acid levels between males and females (Figure 1B). In terms of the other indices, the most impressive data were the FBG levels, which exhibited an opposite trend between male and female. Reasons that these differences were produced as well as the clinical significance of these differences require further investigation. *iii*) The variation trends of HUA with age increasing exhibited opposite directions, namely reduction in males and increasing in females (Figure 1A). As shown in Figure 1A, the trend line in female after 50 years exhibited a sharp increasing, which is speculated to be associated with the changes of menopause and estrogen, which warrant further investigation. *iv*) The differences of the influence factors for HUA. Our results show that only BMI and TG were potential risk factors in males and females, SBP and LDL-C were potential risk factors in females, whereas HDL-C was a potential protective factor in males, CHOL was a potential protective factor in females. In terms of the FBG and age, whether they are potential risk or protective factors for HUA requires further investigation because results of FBG were

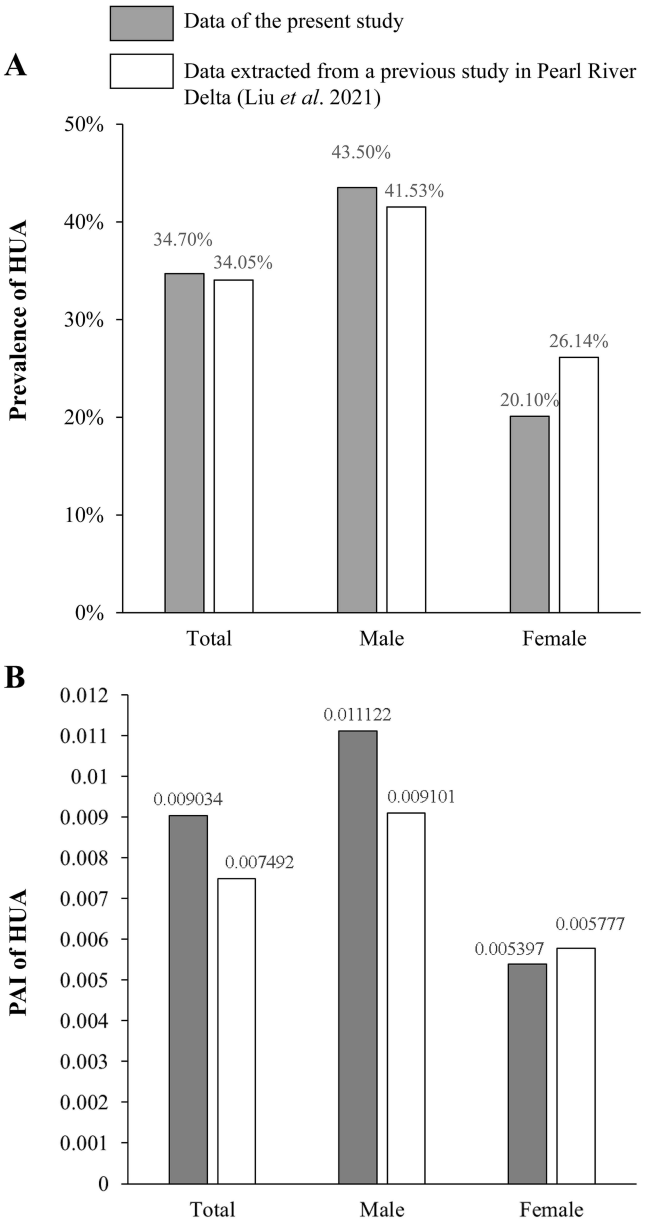

Figure 3 Comparison of the *status quo* of HUA between the present study and a previous study using prevalence and PAI. (**A**) Data of prevalence of HUA. (**B**) Data of PAI. **Abbreviations**: HUA, hyperuricaemia; PAI, Prevalence-Age Index.

heterogeneous in males and females, and data of age were contradictory between the trend analysis (Figure 1A) and multivariate analysis (Figure 2). Although due to the limitation of the present study, these data might have biases, undoubtedly, the great gender difference could not be ignored in the future HUA-related study.

Strengths and Limitations of the Present Study

This study has several strengths: *i*) This is the first study investigated the *status quo* of HUA in Shenzhen, an economically developed seaside city with young population. *ii*) We found an amazing high prevalence of HUA in relatively young population in such young booming city, which require great attention and urgent intervention. *iii*) To comprehensively considering the impact of age, we firstly proposed a novel index, namely PAI for comparison of the *status quo* of HUA. We believe that the findings of the present study are helpful for stakeholders facing the HUA problem, especially for young people. First, our findings may change the traditional concept that "HUA is a disease of the

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aged." Serials of health education should be planned for young people to live a healthy lifestyle. Second, periodic physical examination should include the uric acid level to achieve early detection of HUA, even in young people. We believe that the prevalence of HUA can be reduced if all measures are taken promptly.

This study is suffering from several limitations, which might lead a biased conclusion. *i*) This is a hospital-based, medical record-based study, the population involved in this study might lack of representativity of all people in Shenzhen. *ii*) As a cross-sectional study, the sample size was too small to obtain robust evidence, although the statistical power of an existing study can be calculated using a post-hoc power calculator. Accordingly, a large-scale, multi-center, epidemiological study for *status quo* of HUA in Shenzhen is anticipated.

Conclusion

The present study investigated the *status quo* of HUA in Shenzhen, a booming city with young population in China (2020–2021). First, we found that the prevalence of HUA reached amazing 34.7% (43.5% in males and 20.1% in females) albeit the population in Shenzhen remains young. Thus, this study raises alarm bells for the HUA problem in a booming city with many young migrants. All stakeholders must face the HUA problem and take effective measures to prevent/control HUA. Health education to maintain a healthy lifestyle and periodic physical examinations to enable early intervention may be a useful approach. Second, great gender difference of HUA study was also verified, which could not be ignored in the future HUA-related study. Moreover, based on the present results, we proposed a novel index, namely PAI, which comprehensively considered the impact of age, for comparison of the *status quo* of HUA in different populations. We believe that the findings of the present study are helpful to form a better understanding of the *status quo* of HUA in a young booming city like Shenzhen. Indeed, now, it is really an urgent task to take efficient measures to fight against HUA.

Institutional Review Board Statement

The present study was approved and supervised by the Ethical Committee of the Shenzhen Third People's Hospital (approval number: 2023-049). This was a retrospective study; *ex post facto* informed consents were obtained to ensure that all participants agreed to use their medical records for inclusion in this study after the protocol of this study was approved by the ethical committee. All involved personal information is strictly protected and managed as per the Personal Information Protection Law of the People's Republic of China.

Data Sharing Statement

The data will be available from the corresponding author Prof. Tetsuya Asakawa.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; 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.

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Disclosure

The authors report no conflicts of interest in this work.

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