Age-related and gender-stratified differences in the association between high triglyceride and risk of hyperuricemia

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Abstract

Background: Elevated serum uric acid is commonly associated with high triglyceride. However, the relation of triglyceride and hyperuricemia in different gender and age groups is currently not well understood. This study aimed to evaluate age- and gender-related association of high triglyceride with hyperuricemia in a subgroup of Chinese population.

Methods: We retrospectively analyzed physical examination data of 24,438 subjects (12,557 men and 11,881 women) in Kaifeng, China. The alanine aminotransferase, γ-glutamyl transpeptidase, serum creatinine, blood urea nitrogen, total cholesterol, high-density lipoprotein cholesterol, triglyceride and serum uric acid were measured in all subjects. The triglyceride was categorized into < 1.21, 1.21 ~, 1.7 ~, 2.83 ~ and > 5.6 mmol/L subgroups, and odds ratio (OR) and 95% confidence interval (CI) of hyperuricemia were calculated by logistic regression analysis.

Results: Univariate and age-adjusted analyses showed that high triglyceride was positively associated with hyperuricemia (p < 0.01). Further age-stratified analysis showed that the positive association was significant in the 20 ~, 30 ~, 40 ~, 50 ~, 60 ~ and 80 ~ age groups in men. In women, no statistically significant was found in 60 ~ and 70 ~ age groups.

Conclusion: High triglyceride is positively associated with hyperuricemia in both men and women, and this association is age-related, especially in women.

Keywords: Hyperuricemia, Triglyceride, Risk, Age-related
age-groups. Therefore, this study aimed to investigate the association of high triglyceride with the risk of hyperuricemia in different genders and age-groups using physical examination data from a hospital-based physical examination center in Kaifeng, China.

Methods

Subjects
This study was approved by Ethics Committee of Huaihe Hospital of Henan University and all subjects provided written consent. The subjects were participants of physical examination at the Physical Examination Center of Huaihe Hospital of Henan University. Total number of the subjects were 38,475 consecutive participants from 2003 to 2017. After excluding subjects without available data on age, gender, total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), alanine aminotransferase (ALT), γ-glutamyl transpeptidase (γ-GT), blood urea nitrogen (BUN) and serum creatinine (SCr), a total of 24,438 eligible subjects (12,557 men and 11,881 women) were included in the final analysis (Fig. 1).

Serum uric acid and lipids measurements
Blood samples from participants undergoing an overnight fasting were collected in the morning and analyzed within an hour in hospital. Blood sample was tested using an autoanalyzer (Model 7600, HITACHI, Japan). Hyperuricemia was defined by the following criteria: men: serum uric acid ≥440 μmol/L, women: serum uric acid ≥360 μmol/L and categorized all the variables as follows: the plasma triglyceride were categorized into <1.21 (normal), 1.21~ (above normal), 1.7~ (slightly damaged), 2.83~(moderately damaged) and >5.6 mmol/L (severely damaged) subgroups, and we combined the slightly, moderately, and

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Fig. 1 Flow chart of participants

Fig. 2 Changes of triglyceride levels with age in men
severely damaged TG into a Damaged TG group; age was categorized into <20, 20 ~, 30 ~, 40 ~, 50 ~, 60 ~, 70 ~, and 80 ~ years age subgroups; ALT was dichotomized into normal (≤40 U/L) and abnormal (>40 U/L) subgroups; γ-GT was categorized into low (<16 U/L), normal (16 ~ 73 U/L) and high (>73 U/L) subgroups; SCr was categorized into low (men: < 54 mmol/L, women: < 44 mmol/L), normal (men: 54 ~ 106 mmol/L, women: 44 ~ 97 mmol/L) and high (men: > 106 mmol/L, women: > 97 mmol/L) subgroups; BUN was categorized into low (<2.86 µmol/L), normal (2.86 ~ 7.14 µmol/L) and high (>7.14 µmol/L) subgroups; TC was categorized into low (<2.8 mmol/L), normal (2.8 ~ 5.17 mmol/L) and high subgroups (>5.17 mmol/L); plasma glucose was categorized into low FPG (<3.9 mmol/L), normal FPG (3.9 ~ mmol/L), impaired FPG (6.1 ~ mmol/L) and diabetic FPG (>7.0 mmol/L) subgroups; and HDL-C was categorized into low (<0.9 mmol/L), normal (0.9 ~ 2.19 mmol/L) and high (>2.19 mmol/L) subgroups.

Results

We observed an increasing trend in the proportion of the Damaged TG group when the age increased from 20 to 40 years; thereafter, the proportion of the Damaged TG group started to decrease with age in men (Fig. 2). There was a growing trend of the proportion of the Damaged TG group among women with a flat plateau from 60 years of age (Fig. 3).

In Table 1, the Damaged TG group (1.7 ~, 2.83 ~ and > 5.6 mmol/L subgroups) had a higher proportion to have high levels of serum ALT, γ-GT, TC and hyperuricemia (all \( p < 0.05 \)), but had a lower proportion to have high level of serum HDL-C (\( p < 0.001 \)) in both genders.

Univariate logistical regression analysis (Model 1) in men showed that the above normal, slightly damaged, moderately damaged and severely damaged TG subgroups had an OR of 1.61 (95% CI: 1.34 ~ 1.94), 2.37 (95% CI: 2.00 ~ 2.82), 4.35 (95% CI: 3.62 ~ 5.23), and 6.53 (95% CI: 4.96 ~ 8.59), respectively; age-adjusted logistical regression analysis (Model 2) and multivariate logistical regression model (Model 3) showed a similar trend (Table 2). In all three models, the OR of hyperuricemia was positively associated with an increase in TG (all \( p < 0.001 \)). In women, age-adjusted logistic regression analysis showed a similar trend to that of univariate logistic regression model, in accordance with the results in men. Moderately damaged and severely damaged TG subgroups in Model 3 showed an OR of 5.42 (95% CI: 4.03 ~ 7.28) and 4.01 (95% CI: 2.13 ~ 7.55), respectively. In women, all the three models showed that TG was positively associated with risk for hyperuricemia (all \( p < 0.001 \)).

Multivariate logistic regression model showed that the positive association between hyperuricemia and TG was significant in men of 20 ~, 30 ~, 40 ~, 50 ~, 60 ~ and 80 ~ age subgroups (\( p < 0.05 \), Table 3). Increase in hyperuricemia in the severely damaged TG group was more significant for the 60 ~ age subgroup (OR = 12.07; 95%
### Table 1: Characteristics of the participants of physical examinations by fasting plasma triglyceride categories (mmol/L) in men and women

|                | Men, fasting plasma triglyceride (mmol/L) | Women, fasting plasma triglyceride (mmol/L) |
|----------------|------------------------------------------|--------------------------------------------|
|                | No. of participants | < 1.21 | 1.21 ~ 1.7 | 1.7 ~ 2.83 | > 2.83 | P-value | No. of participants | < 1.21 | 1.21 ~ 1.7 | 1.7 ~ 2.83 | > 2.83 | P-value |
| Age (years), n (%) | | | | | | | | | | | | |
| < 20           | 43 | 33 (76.7) | 4 (9.3) | 5 (11.6) | 0 (0.0) | 1 (2.3) | < 0.001 | 22 | 17 (77.3) | 3 (13.6) | 2 (9.1) | 0 (0.0) | 0 (0.0) | < 0.001 |
| 20 ~           | 1325 | 609 (46.0) | 324 (24.5) | 244 (18.4) | 125 (9.4) | 23 (1.7) | 1880 | 1335 (77.3) | 324 (24.5) | 244 (18.4) | 125 (9.4) | 23 (1.7) | 10 (0.5) |
| 30 ~           | 2348 | 702 (29.9) | 540 (23.0) | 669 (28.5) | 342 (14.6) | 95 (4.1) | 2485 | 1582 (63.7) | 473 (19.0) | 324 (13.0) | 89 (3.6) | 17 (0.7) |
| 40 ~           | 3133 | 858 (27.4) | 704 (22.5) | 938 (28.5) | 505 (16.1) | 128 (4.1) | 2652 | 1496 (56.4) | 578 (21.8) | 436 (16.4) | 128 (4.8) | 10 (0.5) |
| 50 ~           | 2735 | 879 (32.1) | 680 (24.9) | 764 (27.9) | 349 (12.8) | 68 (2.3) | 2492 | 904 (36.3) | 679 (27.3) | 654 (26.2) | 224 (9.0) | 31 (1.2) |
| 60 ~           | 1848 | 684 (37.0) | 474 (25.7) | 510 (27.6) | 157 (8.5) | 23 (1.2) | 1509 | 424 (28.1) | 441 (29.2) | 480 (31.8) | 146 (9.7) | 18 (1.2) |
| 70 ~           | 848 | 386 (45.5) | 233 (27.5) | 166 (19.6) | 56 (6.6) | 7 (0.8) | 679 | 214 (31.5) | 172 (25.3) | 222 (32.7) | 64 (9.4) | 7 (1.0) |
| 80 ~           | 277 | 142 (51.3) | 81 (29.2) | 39 (14.1) | 12 (4.3) | 3 (1.1) | 162 | 51 (31.5) | 51 (31.5) | 45 (27.8) | 15 (9.3) | 0 (0.0) |

#### Alanine Aminotransferase (U/L), n (%)

|                | Men | Women |
|----------------|-----|-------|
| <= 40          | 10,864 | 5856 (51.9) | 2514 (22.3) | 2172 (19.2) | 661 (5.9) | 86 (0.8) | < 0.001 |
| > 40           | 1693 | 167 (28.2) | 147 (24.8) | 181 (30.6) | 86 (14.5) | 11 (1.9) |

#### γ-Glutamyl Transpeptidase (U/L), n (%)

|                | Men | Women |
|----------------|-----|-------|
| < 16           | 1722 | 4088 (65.9) | 1253 (20.2) | 716 (11.5) | 138 (2.2) | 12 (0.2) | < 0.001 |
| 16 ~ 73        | 9724 | 1892 (34.5) | 1364 (24.9) | 1578 (28.8) | 575 (10.5) | 79 (1.4) |
| > 73           | 1111 | 43 (23.1) | 44 (23.7) | 59 (31.7) | 34 (18.3) | 6 (3.2) |

#### Serum Creatinine (mmol/L), n (%)

|                | Men | Women |
|----------------|-----|-------|
| Men < 54 or Women < 44 | 719 | 688 (49.8) | 311 (22.5) | 261 (18.9) | 107 (7.7) | 16 (1.2) | < 0.001 |
| Men: 54~106 or Women: 44~97 | 11,715 | 5325 (50.9) | 2339 (22.4) | 2085 (19.9) | 632 (6.0) | 80 (0.8) |
| Men > 106 or Women > 97 | 123 | 10 (27.0) | 11 (29.7) | 7 (18.9) | 8 (21.6) | 1 (2.7) |

#### Blood Urea Nitrogen (μmol/L), n (%)

|                | Men | Women |
|----------------|-----|-------|
| < 2.86         | 101 | 5300 (57.4) | 110 (210) | 81 (15.5) | 30 (5.7) | 2 (0.4) | 0.027 |
| 2.86 ~ 7.14    | 11,465 | 5570 (50.6) | 2469 (22.4) | 2196 (19.9) | 690 (6.3) | 91 (0.8) |
| > 7.14         | 991 | 153 (44.7) | 82 (24.0) | 76 (22.2) | 27 (7.9) | 4 (1.2) |
Table 1 Characteristics of the participants of physical examinations by fasting plasma triglyceride categories (mmol/L) in men and women (Continued)

| Fasting plasma triglyceride (mmol/L) | Men, No. of participants | Women, No. of participants | Total Cholesterol (mmol/L), n (%) | Fasting plasma glucose (mmol/L), n (%) | High Density Lipoprotein Cholesterol (mmol/L), n (%) | Hyperuricemia (men > 440 μmol/L or women > 360 μmol/L) |
|-------------------------------------|--------------------------|----------------------------|-----------------------------------|----------------------------------------|-----------------------------------------------|-----------------------------------------------------|
|                                     | < 1.21                   | 1.21 ~                     | 1.7 ~                             | 2.83 ~                                 | > 5.6                                         | No                                                 |
| < 2.8                              | 82                       | 66 (80.5)                  | 12 (14.6)                         | 3 (3.7)                                | 1 (1.2)                                      | 0 (0.0)                                            |
| 2.8 ~ 5.17                         | 7665                     | 3252 (42.4)                | 1878 (24.5)                       | 1777 (23.2)                            | 671 (88)                                      | 87 (1.1)                                           |
| > 5.17                             | 4810                     | 975 (20.3)                 | 1150 (23.9)                       | 1555 (32.3)                            | 874 (18.2)                                    | 256 (5.3)                                          |
|                                     |                          |                            |                                   |                                       |                                              | P-value                                            |
| < 1.21                             | 44                       | 34 (77.3)                  | 6 (13.6)                          | 4 (9.1)                                | 0 (0.0)                                      | 0 (0.0)                                            |
| 2.8 ~ 5.17                         | 7273                     | 4561 (62.7)                | 1425 (19.6)                       | 970 (13.3)                             | 287 (40)                                      | 30 (0.4)                                           |
| > 5.17                             | 4564                     | 1428 (31.3)                | 1230 (27.0)                       | 1379 (30.2)                            | 460 (10.1)                                    | 67 (1.5)                                           |
| < 3.9                              | 20                       | 9 (45.0)                   | 6 (30.0)                          | 2 (10.0)                               | 3 (15.0)                                      | 0 (0.0)                                            |
| 3.9 ~ 6.1                          | 9833                     | 3591 (36.5)                | 2447 (24.9)                       | 2521 (25.6)                            | 1062 (108)                                    | 212 (2.2)                                          |
| > 6.1                              | 1370                     | 368 (26.9)                 | 309 (22.6)                        | 416 (30.4)                             | 218 (15.9)                                    | 59 (4.3)                                           |
| > 7.0                              | 1334                     | 325 (24.4)                 | 278 (20.8)                        | 396 (29.7)                             | 263 (19.7)                                    | 72 (5.4)                                           |
| < 0.9                              | 2274                     | 371 (16.3)                 | 465 (20.5)                        | 775 (34.1)                             | 502 (22.1)                                    | 161 (7.1)                                          |
| 0.9 ~ 2.19                         | 10,262                   | 3904 (38.0)                | 2573 (25.1)                       | 2559 (24.9)                            | 1044 (102)                                    | 182 (1.8)                                          |
| > 2.19                             | 21                       | 18 (85.7)                  | 2 (9.5)                           | 1 (4.8)                                | 0 (0.0)                                      | 0 (0.0)                                            |
| No                                 | 11,305                   | 4068 (36.0)                | 2791 (24.7)                       | 2948 (26.1)                            | 1246 (110)                                    | 252 (2.2)                                          |
| Yes                                | 1252                     | 225 (18.0)                 | 249 (19.9)                        | 387 (30.9)                             | 300 (24.0)                                    | 91 (7.3)                                           |
|                                     |                          |                            |                                   |                                       |                                              | P-value                                            |
| Hyperuricemia                       |                          |                            |                                   |                                       |                                              |                                                    |
| No                                 | 4647                     | 1246 (26.8)                | 1355 (29.3)                       | 1059 (22.8)                            | 514 (10.9)                                    | 102 (2.2)                                          |
| Yes                                | 1724                     | 225 (13.1)                 | 285 (16.6)                        | 333 (19.4)                             | 300 (17.5)                                    | 83 (4.8)                                           |

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| Men, fasting plasma triglyceride (mmol/L) | Women, fasting plasma triglyceride (mmol/L) | P for trend of triglyceride | Model 1, OR (95% CI) | Model 2, OR (95% CI) | Model 3, OR (95% CI) |
|----------------------------------------|----------------------------------------|---------------------------|---------------------|---------------------|---------------------|
| < 1.21 | 1.21–2.0 | 2.1–2.5 | > 2.8 | < 1.21 | 1.21–2.0 | 2.1–2.5 | > 2.8 |<p>Logistic regression. Model 1, univariate; Model 2, adjusted with age; Model 3, adjusted with age, alanine aminotransferase (U/L), γ-glutamyl transpeptidase (U/L), serum creatinine (mmol/L), blood urea nitrogen (μmol/L), total cholesterol (mmol/L), plasma glucose (mmol/L), and high density lipoprotein cholesterol (mmol/L). OR Odds ratio, CI Confidence interval</p><p>Hyperuricemia: (men > 440 μmol/L or women > 360 μmol/L)</p>
Table 3  Odds ratio of hyperuricemia among fasting plasma triglyceride (mmol/L) and age in men and women

| Age Group | Men, fasting plasma triglyceride (mmol/L) | Women, fasting plasma triglyceride (mmol/L) |
|-----------|------------------------------------------|-------------------------------------------|
|           | No. of participants | Case Rate (%) | No. of participants | Case Rate (%) |
|           | < 1.2 | 1.21 ~ 1.7 | > 2.8 | > 5.6 | P for trendb | < 1.2 | 1.21 ~ 1.7 | > 2.8 | > 5.6 | P for trendb |
| < 20 yrs  | 43    | 10        | 23.3  | 1.00  | (--) | 22 | 3   | 13.6  | 1.00  | (--) |
| 20~ yrs   | 1324  | 175       | 13.2  | 1.00  | 1.02 (0.63–1.64) | 2485 | 107 | 4.31  | 1.00  | 3.01 (1.74–5.20) |
| 30~ yrs   | 2348  | 304       | 12.9  | 1.00  | 1.70 (1.11–2.59) | 2652 | 74  | 2.81  | 1.00  | 3.48 (1.76–6.86) |
| 40~ yrs   | 3133  | 288       | 9.2   | 1.00  | 1.80 (1.10–2.93) | 2492 | 159 | 6.41  | 1.00  | 1.58 (0.94–2.66) |
| 50~ yrs   | 2735  | 241       | 8.8   | 1.00  | 1.38 (0.88–2.15) | 204  | 407 | 7.48  | 1.00  | 1.58 (0.94–2.66) |
| 60~ yrs   | 1848  | 123       | 6.7   | 1.00  | 2.20 (1.16–4.15) | 417  | 543 | 12.07 | 1.00  | 1.00 (0.38–1.76) |
| 70~ yrs   | 848   | 81        | 9.6   | 1.00  | 1.12 (0.58–2.16) | 1.07 (2.29–7.59) | 1.48 (2.57–11.45) | 4.64 (0.70–28.41) | 0.96 | 679  | 78  | 11.5  | 1.00  | 1.53 (0.68–3.41) |
| 80~ yrs   | 277   | 30        | 10.8  | 1.00  | 4.80 (1.58–14.56) | 5.04 (1.26–20.19) | 10.13 (1.58–64.80) | 0.018 | 162 | 28  | 17.3  | 1.00  | 1.70 (0.32–8.87) |

aLogistic regression model adjusted with alanine aminotransferase (U/L), γ-glutamyl transpeptidase (U/L), serum creatinine (mmol/L), blood urea nitrogen (μmol/L), total cholesterol (mmol/L), plasma glucose (mmol/L), and high density lipoprotein cholesterol (mmol/L)

bContrasts of marginal linear predictions from 3.9~ though > 7.0 groups after logistic regression with Stata13

cHyperuricemia: (men > 440 μmol/L or women > 360 μmol/L)
in TG. These results suggest that TG levels independently affect the incidence of hyperuricemia. However, in multivariate logistic regression analysis, the positive association between hyperuricemia and TG showed a gender and age differences and the positive association was the lowest in the 50~ age group. Whether decreasing level of estrogen after menopause is responsible for the differences needs further studies.

Stelmach et al. investigated 607 Polish adults with hyperuricemia and demonstrated that the upper tertile of serum uric acid levels had higher TG values in males but not in females [19]. In contrast, Lippi et al. retrospectively enrolled a large cohort of unselected adult outpatients and showed that triglycerides were independently associated with serum UA in women but not in men [20]. Notably, in this study our data showed that high TG level was positively associated with the incidence of hyperuricemia in both men and women. This is consistent with a prospective study which demonstrated that hypertriglyceridemia in men might strengthen the effect of serum UA on the development of gout [21]. Chinese diet is characterized with a high-fat diet, particularly the overconsumption of cooking oil may be a significant risk factor for obesity [22, 23].

To investigate lipid abnormalities in acute myocardial infarction (AMI) patients, Wei et al. retrospectively analyzed 1213 AMI patients in East China and showed a significant difference in triglycerides for male but not for female AMI patients [24]. Xu et al. found that older Chinese people had moderate and high levels of unbalanced diets [25]. Significant differences were influenced by many factors, such as gender, marital status, work status, education levels. These findings highlight complex interaction between hyperuricemia and TG.

**Table 4** Odds ratio of hyperuricemia among triglyceride-glucose index in men and women\(^a\)

|                | Men, triglyceride-glucose index (TyG) | Women, triglyceride-glucose index (TyG) | P for trend\(^b\) |
|----------------|--------------------------------------|----------------------------------------|------------------|
| 0 ~            | 3165                                 | 3034                                   |                  |
| 1st quartile   | 3410                                 | 3057                                   |                  |
| 2nd quartile   | 3944                                 | 2701                                   |                  |
| 3rd quartile   |                                      |                                        |                  |
| No. of cases   |                                      |                                        |                  |
| Hyperuricemia  |                                      |                                        |                  |
| Cases          | 103                                  | 67                                     |                  |
| Rate (%)       | 4.7                                  | 1.7                                    |                  |
| Model 1, OR (95% CI) | 1.40 (1.10–1.79)               | 1.00 (1.64–3.33)                        | < 0.001          |
|                | 2.16 (1.72–2.72)                     | 4.53 (3.41–6.71)                       |                  |
|                | 3.72 (3.00–4.62)                     | 9.41 (7.19–12.33)                      |                  |
| Model 2, OR (95% CI) | 1.47 (1.15–1.88)               | 1.00 (1.61–2.98)                       | < 0.001          |
|                | 2.26 (1.80–2.85)                     | 4.39 (3.29–5.86)                       |                  |
|                | 3.90 (3.14–4.84)                     | 9.08 (6.85–12.72)                      |                  |
| Model 3, OR (95% CI) | 1.32 (1.03–1.72)               | 1.00 (1.39–2.61)                       | < 0.001          |
|                | 1.85 (1.46–2.35)                     | 1.90 (2.44–4.52)                       |                  |
|                | 2.68 (2.11–3.41)                     | 3.32 (4.43–8.34)                       |                  |

\(^a\)Logistic regression. Model 1, univariate; Model 2, adjusted with age; Model 3, adjusted with age, alanine aminotransferase (U/L), γ-glutamyl transpeptidase (U/L), serum creatinine (mmol/L), blood urea nitrogen (μmol/L), total cholesterol (mmol/L), and high density lipoprotein cholesterol (mmol/L). OR Odds ratio, CI Confidence interval

\(^b\)Contrasts of marginal linear predictions after logistic regression with Stata13

\(^c\)Hyperuricemia: men > 440 μmol/L, or women > 360 μmol/L
Table 5  Odds ratio of hyperuricemia among triglyceride-glucose index and age in men and women

| Age group | No. of participants | No. of participants | Case Rate (%) | 0 ~ | 1st quartile ~ | 2nd quartile ~ | 3rd quartile ~ | P for trendb | No. of participants | No. of participants | Case Rate (%) | 0 ~ | 1st quartile ~ | 2nd quartile ~ | 3rd quartile ~ | P for trendb |
|-----------|---------------------|---------------------|---------------|-----|---------------|---------------|---------------|--------------|---------------------|---------------------|---------------|-----|---------------|---------------|---------------|--------------|
| < 20 yrs  | 43                  | 10                  | 23.3          | 1.00| 4.98 (0.37–66.42) | 73.31 (1.18–45.29.68) | 7.78 (0.20–297.59) | 0.135 | 22                  | 3                  | 13.6          | 1.00 | (−)            | (−)            | (−)            | (−)          |
| 20~ yrs   | 1325                | 175                 | 13.2          | 1.00| 1.19 (0.70–2.77) | 1.29 (0.76–2.18) | 2.44 (1.41–4.24) | 0.002 | 1880                | 116                | 6.2           | 1.00 | 2.77 (1.50–5.97) | 2.49 (1.23–5.23) | 5.72 (2.82–11.61) | < 0.001 |
| 30~ yrs   | 2348                | 304                 | 12.9          | 1.00| 1.30 (0.77–2.21) | 1.83 (1.11–3.32) | 2.27 (1.36–3.78) | < 0.001| 2485                | 107                | 4.3           | 1.00 | 1.89 (0.96–3.69) | 4.15 (2.18–7.89) | 5.95 (2.92–12.11) | < 0.000 |
| 40~ yrs   | 3133                | 288                 | 9.2           | 1.00| 0.98 (0.51–1.89) | 2.03 (1.13–3.65) | 3.77 (2.12–6.72) | < 0.001| 2652                | 74                 | 2.8           | 1.00 | 3.61 (1.29–13.86) | 9.42 (3.42–25.97) | 11.42 (3.87–33.73) | < 0.001 |
| 50~ yrs   | 2735                | 241                 | 8.8           | 1.00| 1.54 (0.81–2.93) | 1.92 (1.04–3.54) | 3.31 (1.80–6.75) | < 0.001| 2492                | 159                | 6.4           | 1.00 | 0.91 (0.46–1.79) | 1.64 (0.87–3.57) | 2.86 (1.51–5.42) | 0.002  |
| 60~ yrs   | 1848                | 123                 | 6.7           | 1.00| 3.17 (1.06–9.46) | 4.90 (1.67–14.37) | 6.46 (2.19–19.53) | < 0.001| 1509                | 123                | 8.2           | 1.00 | 2.27 (0.62–8.31) | 3.98 (1.18–13.47) | 10.67 (3.17–35.98) | < 0.001 |
| 70~ yrs   | 848                 | 81                  | 9.6           | 1.00| 1.48 (0.62–3.54) | 1.35 (0.54–3.36) | 1.34 (0.53–3.41) | 0.600 | 679                 | 78                 | 11.5          | 1.00 | 0.97 (0.30–3.14) | 1.60 (0.53–4.78) | 2.25 (0.74–6.83) | 0.198  |
| 80~ yrs   | 277                 | 30                  | 10.8          | 1.00| 1.39 (0.29–6.72) | 6.16 (1.51–25.72) | 3.68 (0.72–18.71) | 0.035 | 162                 | 28                 | 17.3          | (−) | 1.00 | 3.08 (0.67–14.27) | 5.24 (1.10–24.87) | 0.321 |

aLogistic regression model adjusted with alanine aminotransferase (U/L), γ-glutamyl transpeptidase (U/L), serum creatinine (mmol/L), blood urea nitrogen (μmol/L), total cholesterol (mmol/L), and high density lipoprotein cholesterol (mmol/L)

bContrasts of marginal linear predictions from 3.9~ though > 7.0 groups after logistic regression with Stata13

cHyperuricemia: men > 440 μmol/L or women > 360 μmol/L

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Differences in dietary patterns such as the proportion of carbohydrate or fat may be responsible for the variability in the relationship between serum uric acid and triglyceridemia.

TyG index is proposed as a marker of moderate insulin resistance. Therefore, we analyzed the association of TyG with hyperuricemia. We found that TyG could be a better index of hyperuricemia in females than in males. However, a recent study indicated that TyG index presented the significant risks for chronic kidney disease in both men and women [26]. The reason for the disparities is unclear and need additional investigations.

Our study has two main limitations. First, our study was conducted in a special group, so the generalizability of our findings to other population needs confirmation in future studies. Second, confounding factors such as diet patterns and health concerns among people of different ages were not included in our analysis, which may have an impact on the results. Further studies are required to elucidate the association between triglyceride and hyperuricemia in different gender and age groups.

Conclusions

Our study demonstrated that high triglyceride was positively associated with hyperuricemia in both men and women, and this association was age-related, especially in women.

Abbreviations

ALT: Alanine aminotransferase; BUN: Blood urea nitrogen; HDL-C: High-density lipoprotein cholesterol; SCr: Serum creatinine; TC: Total cholesterol; ALT: Alanine aminotransferase; BUN: Blood urea nitrogen; HDL-C: High-density lipoprotein cholesterol; gamma-glutamyl transpeptidase

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Authors’ contributions

GC and YL designed the study. LZ, QW, YZ, JX, CY, YM, MX, RH collected the data. VL and XZ analyzed the data. LZ and GC wrote the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

All data and material are available upon request.

Ethics approval and consent to participate

This study was approved by Ethics Committee of Huaile Hospital of Henan University and all subjected provided written consent.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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