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Association between body roundness index and osteoarthritis; a systematic review and meta-analysis

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Abstract

Introduction: Osteoarthritis (OA) is the most common chronic joint disease. Since the body roundness index (BRI) is associated with various chronic diseases, our goal was to examine the relationship between ORI and the risk of OA using systematic review and meta-analysis methods.

Materials and Methods: Web of Science, Cochrane, Scopus, PubMed, Embase, and Google Scholar databases were used to find articles published until May 15, 2025. Data were entered into SPSS 19 and analyzed using STATA 14. Tests with *P* values lower than 0.05 were considered statistically significant.

Results: High BRI levels increased the risk of OA based on OR (1.49, 95%CI: 1.27, 1.75), HR (1.21, 95%CI: 1.07, 1.36), in China (OR: 1.14, 95%CI: 1.03, 1.26), in USA (OR: 1.54, 95%CI: 1.35, 1.76), among men (OR: 1.15, 95%CI: 1.11, 1.20), and women (OR: 1.12, 95%CI: 1.09, 1.14). Furthermore, the second quartile of BRI compared with the first quartile (OR: 1.29, 95%CI: 1.12, 1.49), the third BRI quartile compared with the first (OR: 1.36, 95%CI: 1.17, 1.58), and the fourth BRI quartile compared with the first (OR: 1.77, 95%CI: 1.41, 2.21) increased the risk of OA.

Conclusion: High BRI levels increased the risk of OA, and men were exposed to a higher risk than women, and the risk of OA in Americans was higher than in the Chinese population. Furthermore, the risk of OA occurrence increased at higher BRI levels.

Registration: This study has been compiled based on the PRISMA checklist, and its protocol was registered on the PROSPERO (ID: CRD420251061127) and Research Registry (UIN: reviewregistry2007(websites.

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Introduction

Osteoarthritis (OA) is the most common chronic joint disease, imposing a significant burden on public global healthcare systems (1,2). During the past 50 years, the global prevalence of obesity has increased, which led to an increase in the risk of associated diseases, including type 2 diabetes mellitus, hypertension, heart failure, and OA (3). In 2020, about 595 million people around the world had OA, and estimates suggest an upsurge in the number of OA patients until 2050 (4). Old age, joint damage, and chronic diseases, such as obesity, diabetes, and cardiovascular diseases, can cause OA by promoting systematic inflammation and metabolic disorders (5, 6). Osteoarthritis can affect multiple joints at once, with the hip, knee, and hand joints being the most susceptible (7).

Body mass index indicates a combination of weight and height, but it has limitations as it cannot evaluate the distribution of visceral fat, nor can it differentiate muscle mass and fat (8). Accordingly, the Body roundness index (BRI), introduced in 2013, effectively reflects abdominal fat accumulation and total body fat by combining waist circumference and height (9). Previous studies demonstrated that BRI level was associated with chronic diseases, including cardiovascular diseases, metabolic syndrome, depression, and cancer (10-12).

In the case of OA, however, several studies reported that the fourth quartile of BRI increased the risk of OA compared with the first quartile (13,14). On the other hand, other studies indicated that compared with

Key point

According to the present research results, high BRI levels significantly increased the risk of osteoarthritis (OA), and higher body roundness index (BRI) levels led to higher OA occurrence risks. In other words, individuals in the fourth BRI quartile were more prone to the risk of OA than those in the third quartile, those in the third quartile more than those in the second, and those in the second quartile more than those in the first.

the first quartile, the relationship between the third BRI quartile and the risk of OA was insignificant (15,16). Our research goal was to examine the relationship between BRI and the risk of OA using systematic review and meta-analysis methods.

Materials and Methods

Study design

The current study was based on Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) (17), and its protocol was registered at the websites PROSPERO (International Prospective Register of Systematic Reviews) and Research Registry.

Search strategy

The search was conducted on the databases Web of Science, Cochrane, Scopus, PubMed, Embase, and Google Scholar Search Engine for articles published by May 15, 2025. The search included no limitation in the language and time of the studies. The Medical Subject Heading (MeSH) keywords and their equivalents were used in the search, and operators (AND, OR) were used to combine them. This step included a manual search, and the search strategy in the database Scopus was as follows: [ALL (body AND roundness AND index) AND ALL (osteoarthritis OR degenerative AND arthritis OR arthrosis)]

PECO framework

- Population: Cross-sectional studies that examined the association between BRI and the risk of OA.
- Exposure: High BRI levels.
- Comparison: Individuals with low BRI levels.
- Outcome: Investigating the relationship between BRI and the risk of OA.

Inclusion criteria

Cross-sectional studies that investigated the relationship between BRI and OA risk.

Exclusion criteria

Reviews, low-quality studies, temporarily accepted articles, duplicate studies, studies without accessible full text, studies that lacked sufficient data, and abstracts published in conferences.

Quality assessment

Two authors assessed the quality of studies using the Newcastle-Ottawa Scale. This tool assigns a maximum of one star to each question, except for two questions. Accordingly, zero was the lowest score (indicating the lowest quality), and ten was the highest (showing the highest quality). Studies with scores lower than five were considered low-quality (18).

Data extraction

Two authors independently extracted data, including age, number of samples, indicator, country of origin, year, BRI quartile, author's name, and the relationship between BRI and OA risk in addition to the 95% confidence interval (total, among men, and women). Then, using an agreement solution, the two authors addressed the discrepancies.

Statistical analysis

The odds ratio (OR) and hazard ratio (HR) logarithms were used for data analysis, and the studies were combined. The I2 index was used to assess heterogeneity among studies, and a random-effects model was employed to combine the results. Meta-regression was used for additional analysis. Data was entered into SPSS 19, and data analysis was conducted using STATA 14. Tests with p-values lower than 0.05 were considered statistically significant.

Results

Overall, 87 articles were found in the search stage. Then, 35 duplicate studies were identified and removed. The abstracts were reviewed, and five studies without full text were excluded. Out of the remaining 47 studies, 26 articles that lacked the required data for analysis were removed. A total of 21 studies entered the next step and, 15 articles were excluded due to other exclusion criteria, and six studies remained (Figure 1).

As shown in Table 1, six cross-sectional studies were reviewed. One study was based on HR, and five were reported based on OR. Furthermore, two were conducted in China and four in the USA.

Figure 2 demonstrated that the association between BRI and OA in China (OR: 1.14, 95% CI: 1.03, 1.26) and the USA (OR: 1.54, 95% CI: 1.35, 1.76) was statistically significant, and in both countries, high BRI levels increased the risk of OA.

Figure 3 indicated that based on OR (OR: 1.49, 95% CI: 1.27, 1.75) and HR (HR: 1.21, 95% CI: 1.07, 1.36), high BRI levels increased OA risk.

The second BRI quartile compared with the first (OR: 1.29, 95% CI: 1.12, 1.49), the third BRI quartile compared with the first (OR: 1.36, 95% CI: 1.17, 1.58), and the fourth BRI quartile compared with the first (OR: 1.77, 95% CI: 1.41, 2.21) increased the risk of OA (Figure 4).

Moreover, high BRI in men (OR: 1.15, 95% CI: 1.11, 1.20) and women (OR: 1.12, 95% CI: 1.09, 1.14) increased the risk of OA (Figures 5 and 6).

Meta-regression revealed that the relationship between BRI and OA and the number of samples (p-value =

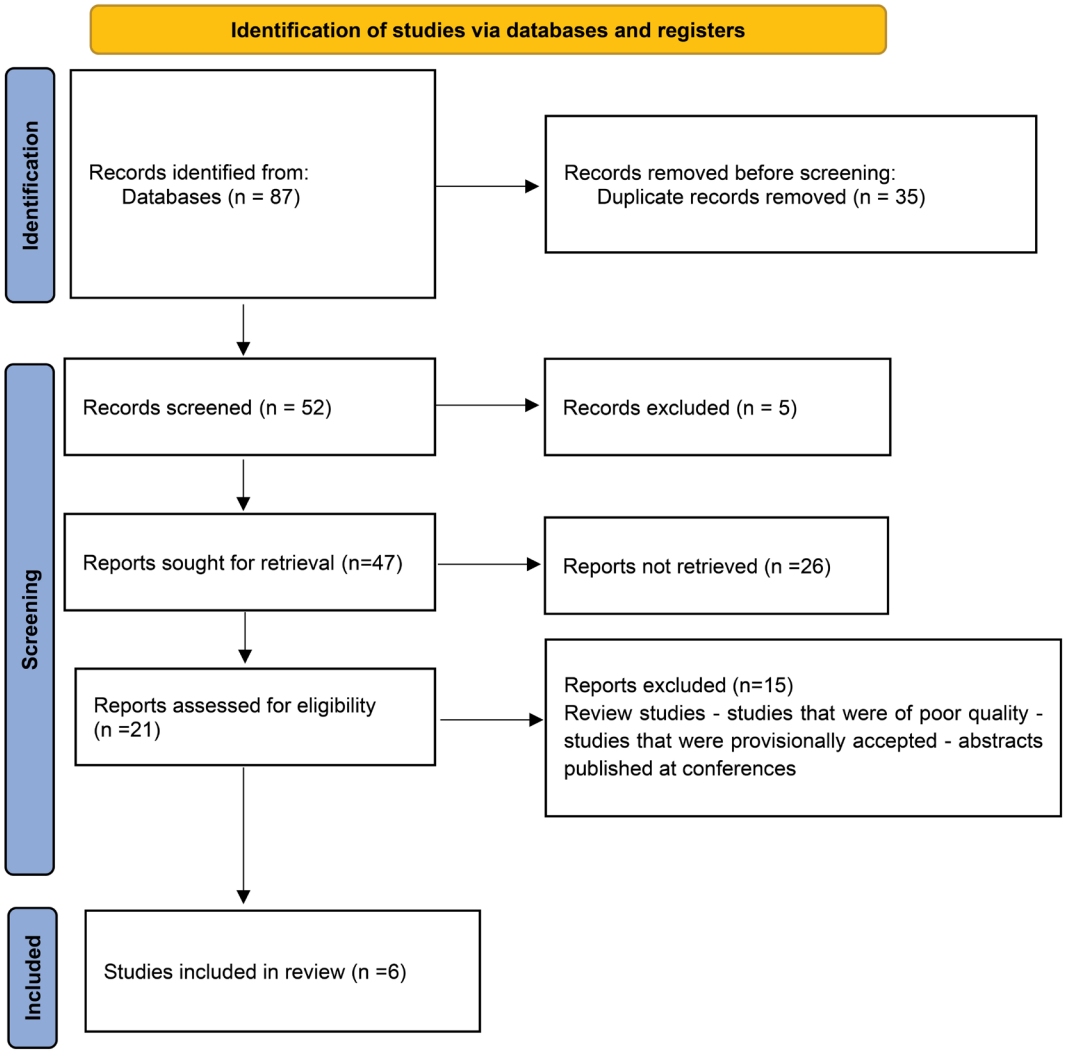

Figure 1. The PRISMA flow chart of study selection.

0.374) and publication year of the articles (P = 0.068) was statistically insignificant (Figures 7 and 8).

Discussion

High BRI levels increased the risk of OA based on OR (49%), HR (21%), in China (14%), in the USA (54%), among men (15%), and women (12%). Furthermore, the second BRI quartile compared with the first (29%), the third BRI quartile compared with the first (36%), and the fourth BRI quartile compared with the first (77%) increased the risk of OA.

Gao et al performed a cross-sectional investigation in 2025 and reported that high BRI levels increased the risk of OA (OR: 1.46, 95% CI:1.02, 2.08) (16). According to Jiang and colleagues' cross-sectional study, high BRI levels increased the risk of knee OA (HR: 1.08, 95% CI: 1.02, 1.13). Furthermore, higher BRI quartiles were associated with higher risks of knee OA (15). Ke et al conducted cross-sectional research and demonstrated that individuals with OA had higher BRI levels than those not affected with OA (OR: 1.18, 95% CI: 1.15, 1.21) (19). In Liang and colleagues' cross-sectional investigation in the USA, the findings indicated a positive and statistically significant association between BRI and OA (OR: 1.12, 95% CI: 1.09, 1.14) (14). The mentioned studies were consistent with the present study and demonstrated that a high BRI level is a risk factor for the occurrence of OA.

In a cross-sectional study, Lyu et al reported that a one-unit increase in the BRI was associated with a 64% increase in the risk of sarcopenia (OR: 1.64, 95% CI: 1.58, 1.71) (21). According to Xu and colleagues' cross-sectional research, a high BRI index was related to weakness in senior American adults (OR: 1.34, 95% CI: 1.28, 1.40) (22). Ding et al conducted a cross-sectional study and indicated that a higher BRI level can be associated with a reduction in the density of minerals in bone and an increased risk of osteoporosis (23). In another cross-sectional investigation by Xie et al, increased BRI levels increased the risk of psoriasis (OR: 1.09, 95% CI: 1.04, 1.13) (24). According to another cross-sectional research by Bai et al, higher BRI levels increased the risk of psoriasis (OR: 1.11, 95% CI: 1.05, 1.17) (25). Based on the results of Zhang et al in 2024,

Table 1. Summarized information of the studies

Index	Author, year	Country	Duration of study	Sample size	Mean age (year)	Stage	Association between BRI and OA in total			Association between BRI and OA in male			Association between BRI and OA in female		
							OR/HR	Low	Up	OR/HR	Low	Up	OR/HR	Low	Up
HR	Jiang Z, 2025 (15)	China	2015 to 2020	7318	60.76	Total	1.08	1.02	1.13	1.16	1.04	1.29	1.07	0.99	1.16
				1829	60.38	Q2	1.12	0.91	1.37	NR	NR	NR	NR	NR	NR
				1829	62.28	Q3	1.16	0.95	1.43	NR	NR	NR	NR	NR	NR
				1830	61.3	Q4	1.36	1.11	1.67	NR	NR	NR	NR	NR	NR
OR	Gao T, 2025(16)	USA	2015 to 2023	17544	>20	Q2	1.11	0.84	1.48	NR	NR	NR	NR	NR	NR
				NR	NR	Q3	1.21	0.9	1.62	NR	NR	NR	NR	NR	NR
				NR	NR	Q4	1.46	1.02	2.08	1.21	1.17	1.26	1.12	1.1	1.15
OR	Ke T, 2024 (19)	USA	2011 to 2018	19717	>20	Total	1.1	1.04	1.17	1.16	1.07	1.26	1.09	1.02	1.17
				NR	NR	Q2	1.59	1.2	2.1	NR	NR	NR	NR	NR	NR
				NR	NR	Q3	1.51	1.15	1.99	NR	NR	NR	NR	NR	NR
				NR	NR	Q4	1.78	1.24	2.54	NR	NR	NR	NR	NR	NR
OR	Liang H, 2024 (14)	USA	2011 to 2018	20232	>20	Total	1.12	1.09	1.14	1.12	1.08	1.16	1.11	1.09	1.14
				NR	NR	Q2	1.24	1.06	1.46	NR	NR	NR	NR	NR	NR
				NR	NR	Q3	1.3	1.11	1.53	NR	NR	NR	NR	NR	NR
				NR	NR	Q4	1.86	1.59	2.18	NR	NR	NR	NR	NR	NR
OR	Wang X, 2024 (13)	USA	1999 to 2018	12946	NR	Total	1.18	1.13	1.23	1.18	1.13	1.23	1.17	1.13	1.21
				NR	NR	Q2	1.58	1.22	2.03	NR	NR	NR	NR	NR	NR
				NR	NR	Q3	1.83	1.4	2.4	NR	NR	NR	NR	NR	NR
				NR	NR	Q4	2.7	1.99	3.66	NR	NR	NR	NR	NR	NR
OR	Lv H, 2024 (20)	China	2011 to 2016	7598	59.45	Total	1.07	1.01	1.12	1.03	0.93	1.14	1.07	1.01	1.14

BRI, body roundness index; OR, Odds ratio; HR, Hazard ratio; NR, Not reported; Q2, Quartile 2; Q3, Quartile 3; Q4, Quartile 4; OA, Osteoarthritis.

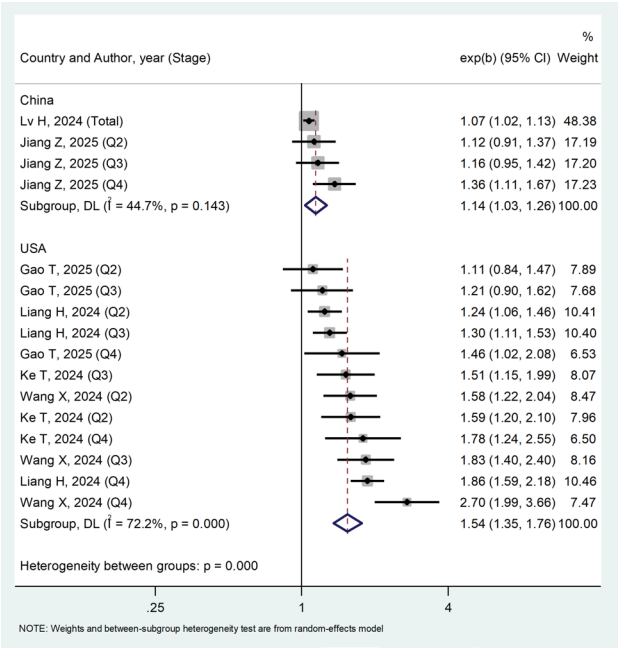

Figure 2. Forest plot showing the association between BRI and osteoarthritis by country.

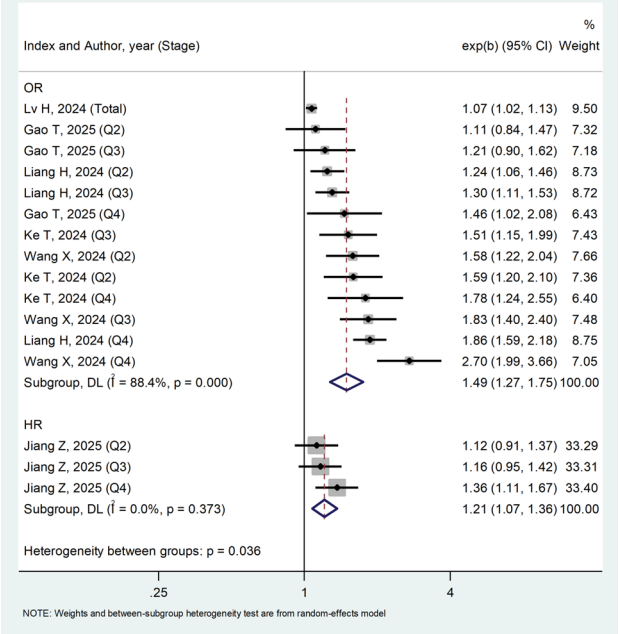

Figure 3. Forest plot showing the association between BRI and osteoarthritis by index.

higher BRI levels were associated with increased chronic kidney disease risks (OR: 1.36, 95% CI: 1.10, 1.70) (26). The findings of a cross-sectional study by Gao et al showed that the risk of colorectal cancer increased at higher BRI levels (Q3: 3.76 (95% CI: 2.13, 6.61), Q4: 5.97 (95% CI: 3.34, 8.47) (10). These studies were consistent with our research and indicated that higher BRI levels increased the risk of several diseases, including sarcopenia, decreased bone mineral density, psoriasis, chronic kidney disease, and colorectal cancer.

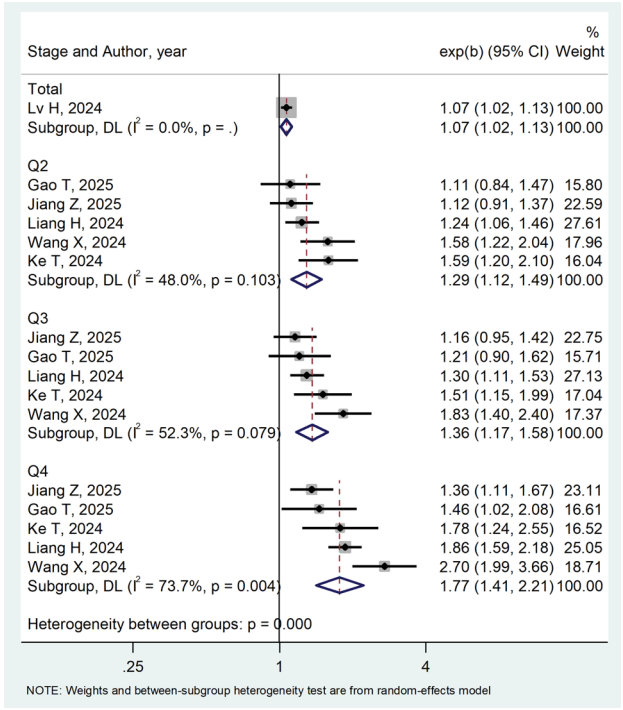

Figure 4. Forest plot showing the association between BRI and osteoarthritis by stage.

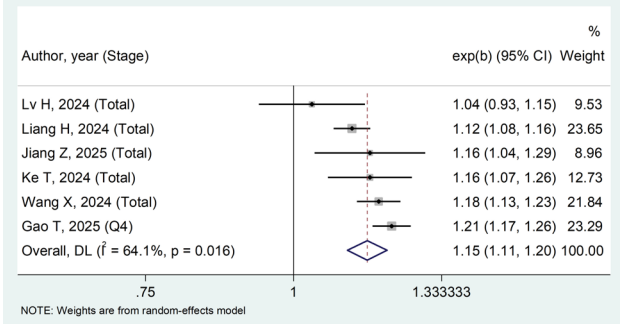

Figure 5. Forest plot showing the association between BRI and osteoarthritis in males.

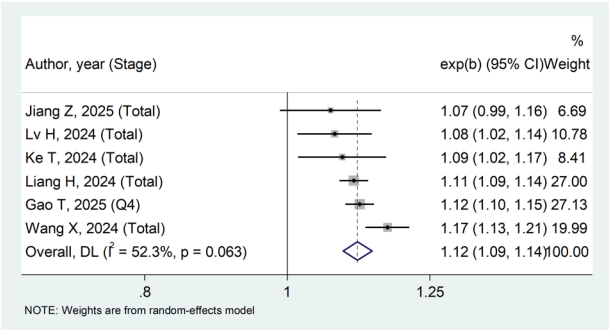

Figure 6. Forest plot showing the association between BRI and osteoarthritis in females.

Limitations of the study

Considering the data presented in the reviewed studies, it was not possible to conduct analyses based on age or the location of OA. Accordingly, we recommend that researchers report the results in more detail in future studies.

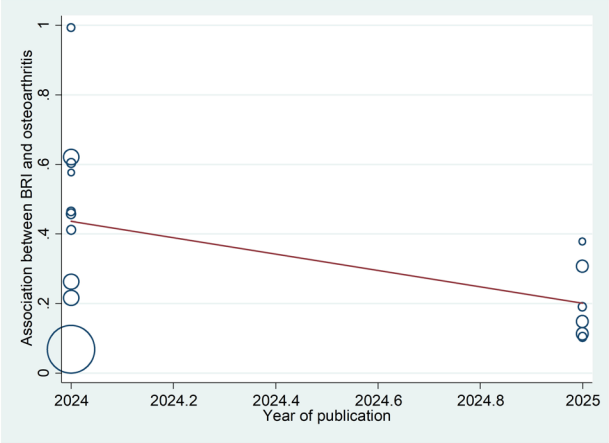

Figure 7. Meta-regression of the relationship between BRI and osteoarthritis by year of publication.

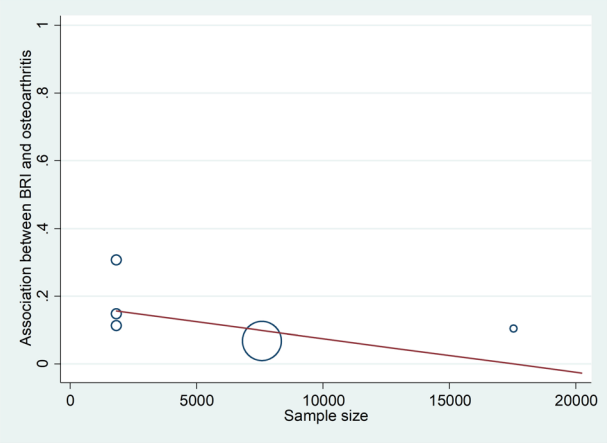

Figure 8. Meta-regression of the relationship between BRI and osteoarthritis by sample size.

Conclusion

According to the results of the present research, high BRI levels significantly increased the risk of OA, and higher BRI levels led to higher OA occurrence risks. In other words, individuals in the fourth BRI quartile were more prone to the risk of OA than those in the third quartile, those in the third quartile more than the second, and those in the second quartile more than the first. Furthermore, men faced a higher risk of OA than women. In terms of ethnicity, Americans were at higher risk of OA than the Chinese population. Hence, the male sex and the American race were among the risk factors for OA occurrence.

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Authors' contribution

Conceptualization: Yashar Shahbaz and Mobin Forghan.
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Formal analysis: Jalal Nourmohammadi and Hojjat Eghbali Jelodar
Investigation: Yashar Shahbaz and Mazaher Ebrahimian.
Methodology: Jalal Nourmohammadi and Fatemeh Hasanzadeh Sablouei.
Project management: Yashar Shahbaz.
Supervision: Rasoul Shirmohammadi.
Validation: Mazaher Ebrahimian and Kiarash Tohidi.
Visualization: Kiarash Tohidi and Hojjat Eghbali Jelodar.
Writing-original draft preparation: All authors.
Writing-review and editing: All authors.

Conflicts of interest

There are no competing interests.

Ethical issues

This study has been compiled based on the PRISMA checklist, and its protocol was registered on the PROSPERO website (ID: CRD420251061127) and the Research Registry website (Unique Identifying Number [UIN]; reviewregistry2007). Besides, ethical issues (including plagiarism, data fabrication, and double publication) have been completely observed by the author.

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