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Association between body roundness index and risk of chronic kidney disease; a systematic review and meta-analysis

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ABSTRACT

Introduction: Chronic kidney disease (CKD) is a major global public health concern, and body roundness index (BRI) emerged as a potentially superior marker of visceral fat and cardiometabolic risk. This study aimed to evaluate the association between BRI and the risk of CKD.

Materials and Methods: Initial searches were conducted in the Cochrane Library, Scopus, Web of Science, Embase, and PubMed databases, as well as via Google Scholar. The search was updated through June 22, 2026. Data analysis was performed using STATA version 14.

Results: Higher BRI levels were associated with a significantly increased risk of CKD compared with lower levels (OR: 1.18, 95% CI: 1.12–1.25). Elevated BRI was linked to a higher risk of CKD in women (OR: 1.15, 95% CI: 1.07–1.24), men (OR: 1.18, 95% CI: 1.10–1.26), individuals with a mean age ≤60 years (OR: 1.14, 95% CI: 1.04–1.24), and those older than 60 years (OR: 1.12, 95% CI: 1.07–1.18). Similarly, higher BRI increased CKD risk in both cohort studies (OR: 1.18, 95% CI: 1.08–1.30) and cross-sectional studies (OR: 1.18, 95% CI: 1.10–1.27). Being in the second quartile of BRI, compared with the first quartile (OR: 1.03, 95% CI: 0.95–1.11), was not associated with a significant change in CKD risk. However, individuals in the third (OR: 1.14, 95% CI: 1.06–1.23) and fourth quartiles (OR: 1.37, 95% CI: 1.18–1.60) had a higher risk compared with those in the first quartile. Likewise, participants in the second (OR: 1.25, 95% CI: 1.14–1.38) and third tertiles (OR: 1.42, 95% CI: 1.28–1.57) of BRI exhibited a greater risk of CKD than those in the lowest tertile.

Conclusion: Higher BRI levels were associated with an increased risk of CKD, and women were at a lower risk compared to men. Additionally, the risk of CKD rose with increasing BRI levels. However, among individuals with elevated BRI, the risk of CKD decreased with advancing age.

Registration: This study was compiled using the PRISMA checklist, and its protocol was registered with PROSPERO (ID: CRD420261445875) and Research Registry (reviewregistry2120) websites.

Meta-analysis

Introduction

The global obesity epidemic has increased markedly over the past two decades (1). Obesity is a major public health challenge that significantly raises the risk of chronic kidney disease (CKD), hypertension, and diabetes (2-4). Through several pathophysiological mechanisms,

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Implication for health policy/practice/research/medical education:
This meta-analysis study indicated that elevated body roundness index (BRI) was linked to a higher likelihood of chronic kidney disease (CKD), with men demonstrating greater risk than women. The probability of CKD increased as BRI levels rose; however, this association appeared to weaken with increasing age among individuals with higher BRI.
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including insulin resistance, systemic inflammation, and altered renal hemodynamics, obesity contributes to the development of CKD (5-7). CKD is a broad term for disorders that impair kidney structure and function (8). Because of its high incidence, mortality, disease burden, and frequent coexistence with other common chronic conditions, CKD has a major impact on both public health and the economy (9,10). Patients with CKD often exhibit altered body composition, characterized by reduced muscle mass and increased visceral fat (11). However, conventional obesity measures such as body mass index (BMI) and waist circumference (WC) have important limitations in reflecting fat distribution patterns (12). Therefore, although BMI is widely used to assess obesity, its predictive accuracy in patients with CKD is limited (13).

In recent years, the body roundness index (BRI), a novel anthropometric measure derived from waist circumference and height, has attracted considerable attention as a potentially more sensitive indicator of obesity and visceral fat distribution (14). BRI conceptualizes body shape as an ellipse, with height representing the major axis and waist circumference the minor axis (14,15). It has been associated with increased risk of cardiovascular disease, hypertension, type 2 diabetes, and metabolic syndrome (16-19). However, evidence regarding its relationship with CKD has been inconsistent. Some observational studies reported that higher BRI is associated with greater CKD risk (20,21), whereas others found no significant association in the second and third BRI quartiles compared with the first quartile (22,23). Therefore, this systematic review and meta-analysis was conducted to examine the association between BRI and the risk of CKD.

Materials and Methods

Study design

The study protocol was prepared in accordance with the PRISMA reporting guideline (24), and the protocol was registered on the PROSPERO website.

Search strategy

An unrestricted search with no language or date limits was performed in the Cochrane Library, Scopus, Web of Science, Embase, PubMed, and Google Scholar up to June 22, 2026, to identify relevant primary studies. The search used standard keywords along with their MeSH synonyms, combined with Boolean operators such as AND and OR. In addition, the reference lists of eligible studies were manually reviewed to identify any additional records. A sample search strategy used in Scopus is shown below:
(TITLE-ABS-KEY (Body Roundness Index) AND TITLE-ABS-KEY ("Renal Insufficiency, Chronic" OR Chronic Kidney Insufficiency OR Chronic Kidney Disease))

PECO components

Population: Studies that examined the association between BRI and the risk of CKD.
Exposure: Higher BRI level.
Comparison: Lowest BRI level.
Outcome: Risk of CKD.

Inclusion and exclusion criteria

Studies were included if they examined the association between BRI and the risk of CKD. Studies were excluded if they were posters, duplicate reports, review articles, meta-analyses, lacked essential data for analysis, or were of poor methodological quality. In addition, studies whose full text could not be obtained despite contacting the authors were also excluded.

Quality assessment

The methodological quality of the included studies was assessed independently by two reviewers using the Newcastle-Ottawa Scale (NOS) (25). This tool contains nine items and uses a star-based scoring system. Only studies that received at least six stars were eligible for inclusion in the systematic review and meta-analysis.

Data extraction

Data extraction was carried out independently by two authors. The collected data included the first author's name, year of publication, study design, study location, sample size, BRI category, mean age of participants, and the risk of CKD in the total sample as well as in women and men.

Statistical analysis

To combine the findings from the included studies, the logarithmic forms of the hazard ratio (HR), odds ratio (OR), and relative risk (RR) were used. Between-study heterogeneity was evaluated with the I^2 statistic. A fixed-effects model was selected when heterogeneity was minimal, whereas a random-effects model was applied

when heterogeneity was moderate to high. All analyses were conducted using STATA version 14, and a PPP value of less than 0.05 was considered statistically significant.

Results

A total of 138 records were initially retrieved from the databases, and 78 duplicates were removed before screening. The remaining 60 records underwent title and abstract screening, during which 5 were excluded. Full-text retrieval was attempted for 55 reports, but 26 could not be obtained, leaving 29 articles for eligibility assessment. Of these, 18 were excluded because they were posters, review articles, meta-analyses, or studies with insufficient methodological quality. Ultimately, 11 studies fulfilled the inclusion criteria and were incorporated into the systematic review (Figure 1).

Eleven studies were included in this review, comprising cohort and cross-sectional designs conducted in China, Taiwan, Korea, the United States (US), and the United Kingdom. Across these studies, the participants were classified into two groups with high BRI and the comparison groups, including the lowest BRI categories or reference groups (Table 1).

The results showed that having a higher BRI, compared with a lower BRI, significantly increased the risk of CKD across all studies (OR: 1.18, 95% CI: 1.12–1.25). In other words, individuals with elevated BRI levels had an 18% higher risk of developing CKD than those with lower BRI levels (Figure 2).

Subgroup analysis showed that, compared with lower BRI, higher BRI increased the risk of CKD in both cohort studies (OR: 1.18, 95% CI: 1.08–1.30) and cross-sectional studies (OR: 1.18, 95% CI: 1.10–1.27) (Figure 3).

The findings also showed that being in the second BRI quartile, compared with the first quartile, was not associated with a statistically significant change in CKD risk (OR: 1.03, 95% CI: 0.95–1.11). However, individuals in the third (OR: 1.14, 95% CI: 1.06–1.23) and fourth BRI quartiles (OR: 1.37, 95% CI: 1.18–1.60) had a higher risk of CKD than those in the first quartile. Likewise, the risk of CKD was greater among those in the second (OR: 1.25, 95% CI: 1.14–1.38) and third BRI tertiles (OR: 1.42, 95%

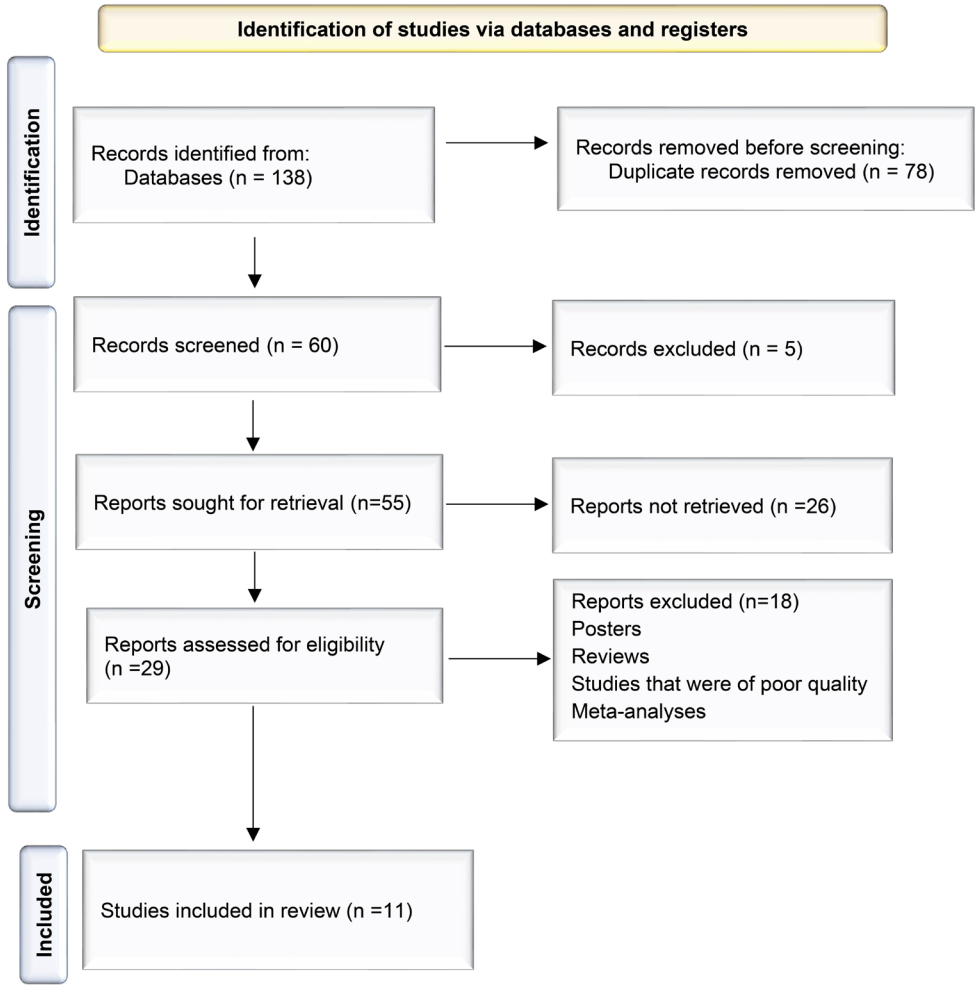

Figure 1. PRISMA flow chart of the study.

Table 1. Baseline characteristics of the included articles

Author, year	Country	Design	People with a high BRI		Comparison group		Level of BRI
			Samples	Mean age (year)	Samples	Mean age (year)	
Li CI, 2025 (21)	Taiwan	Cohort	2901	60.4	5544	56.08	Total
Su J, 2026 (23)	China	Cross-sectional	1132	≥18	7839	≥18	Q2
							Q3
							Q4
Yang EM, 2026 (20)	Korea	Cross-sectional	751	66.28	4316	58.21	Total
Cao H, 2025 (22)	USA	Cross-sectional	3123	71.51	38830	47.22	Q2
							Q3
							Q4
Chen M, 2025 (26)	China	Cross-sectional	5020	57	7211	54	T2
							T3
Chen X, 2025 (27)	USA	Cross-sectional	4134	60.39	20028	45.48	Q2
							Q3
							Q4
Fei S, 2025 (28)	USA	Cross-sectional	2382	66	4589	57	Total
Zhu F, 2025 (29)	**China**	Cohort	60	66	1560	58	Total
Gao S, 2025 (30)	China	Cohort	126109	NR	NR	NR	Q2
							Q3
							Q4
	UK		358918	NR	NR	NR	Q2
							Q3
							Q4
Zhang J, 2024 (31)	USA	Cross-sectional	29062	44	NR	NR	Q2
							Q3
							Q4
Sun Z, 2023 (16)	Taiwan, China	Cohort	1080	60.44	1579	55.9	Q2
							Q3
							Q4

NR: Not reported, Q2: Quartile2, Q3: Quartile3, Q4: Quartile4, T2: Tertile2, T3: Tertile3, BRI: Body round index.

CI: 1.28–1.57) compared with participants in the lowest tertile (Figure 4).

An increase in BRI significantly elevated the risk of CKD both in individuals with a mean age of 60 years or younger (OR: 1.14, 95% CI: 1.04–1.24) and in those with a mean age above 60 years (OR: 1.12, 95% CI: 1.07–1.18) (Figure 5).

In sex-stratified analyses among individuals with elevated BRI, women exhibited a modestly lower susceptibility to CKD (OR: 1.15, 95% CI: 1.07–1.24) compared with men (OR: 1.18, 95% CI: 1.10–1.26) (Figures 6 and 7).

The results indicated that the funnel plot asymmetry test was not statistically significant ($P=0.853$), suggesting an absence of publication bias. This finding implies that the literature search was conducted comprehensively and without selective inclusion, such that all studies relevant to the current topic, regardless of whether their findings were positive or negative, were considered (Figure 8).

Discussion

The findings of the present study indicated that higher BRI levels were associated with a substantially increased risk of CKD compared with lower BRI. This result aligns with the cross-sectional study by Cao et al, who identified membership in the highest BRI quartile as an independent risk factor for CKD (22). Likewise, Chen et al, in another cross-sectional study, reported that individuals in the second and third BRI tertiles had a markedly greater likelihood of CKD than those in the lowest tertile, further supporting the role of elevated BRI as a significant determinant of CKD risk (26). A cross-sectional study by Fei et al reported that higher BRI was independently associated with an increased risk of CKD (28). In another cross-sectional investigation, Su et al found that, relative to the lowest BRI quartile, individuals in the highest quartile had a significantly greater risk of developing CKD (23). Similarly, Zhang et al, in a cross-sectional study of US adults, observed that higher BRI levels were strongly related to an elevated prevalence of CKD, with the fourth BRI quartile showing a significantly greater burden of CKD compared with the lowest quartile after adjustment for potential confounders (31). These findings are consistent with the present meta-analysis, in which the pooled results from cross-sectional studies likewise

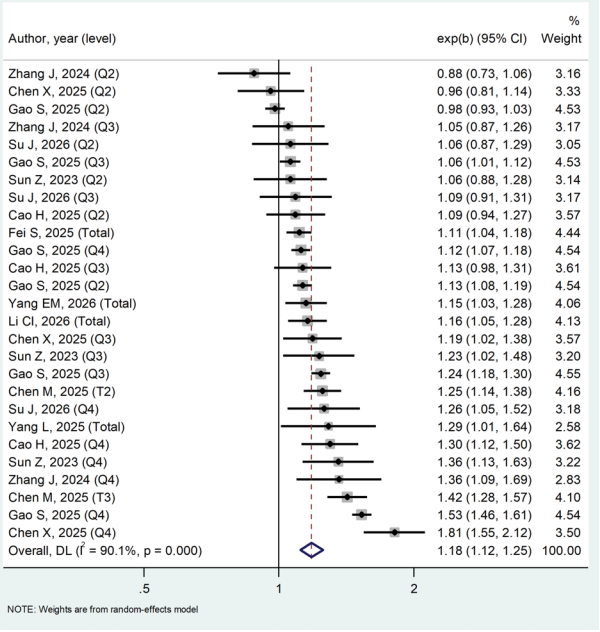

Figure 2. The association of body roundness index with risk of CKD.

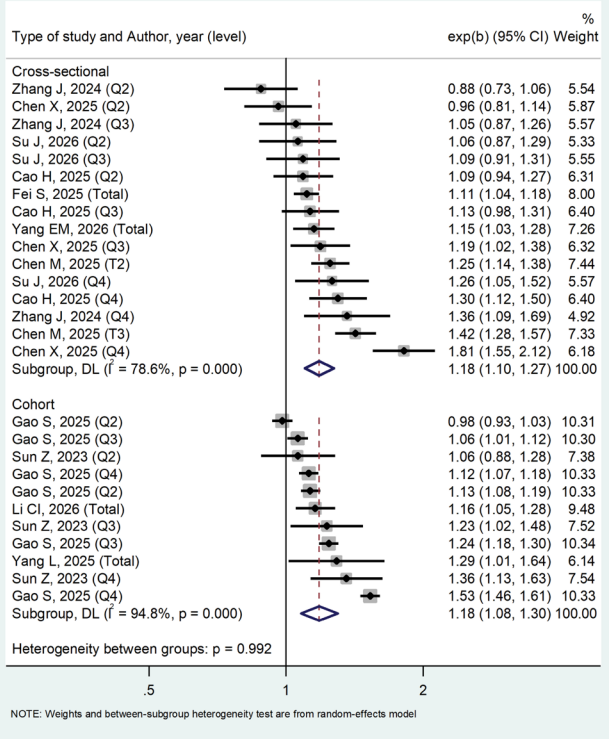

Figure 3. The association of body roundness index with risk of CKD by design.

indicated that elevated BRI represents an important risk factor for incident CKD.

In a cross-sectional study conducted by Zhang and colleagues among Chinese adults, multivariable-adjusted logistic regression analysis demonstrated a significant positive association between BRI and the risk of kidney

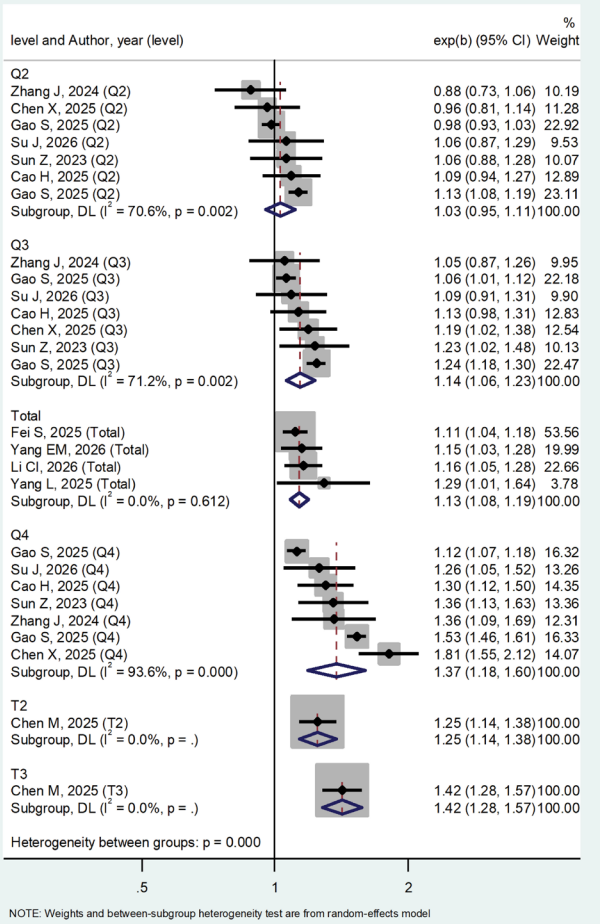

Figure 4. The association of BRI with risk of CKD by level of BRI.

stones in both women and men, with a stronger effect observed in men than in women (32). Similarly, in the present study, elevated BRI exerted a greater impact on CKD risk in men compared with women. These findings suggest that the relationship between higher BRI and the risk of kidney-related disorders, such as nephrolithiasis and CKD, may be modified by sex.

In a cohort study conducted by Cai et al in a Chinese population, higher BRI was associated with a progressively greater risk of incident hyperuricemia, with participants in the upper BRI quartiles having substantially higher hazards than those in the lowest quartile (33). This work highlighted elevated BRI as a particularly strong and clinically relevant risk factor for the development of hyperuricemia. Consistent with these observations, our current study likewise demonstrated a dose–response pattern, whereby increasing BRI levels were accompanied by a higher risk of CKD, suggesting that BRI may serve as a common obesity-related marker for adverse renal outcomes.

In a cohort study conducted by Mao and colleagues in the US, higher BRI levels were significantly associated with an increased risk of kidney stone formation, indicating

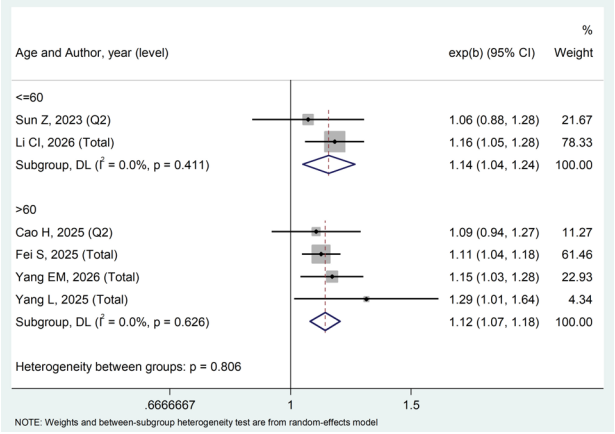

Figure 5. The association of body roundness index with risk of CKD by age.

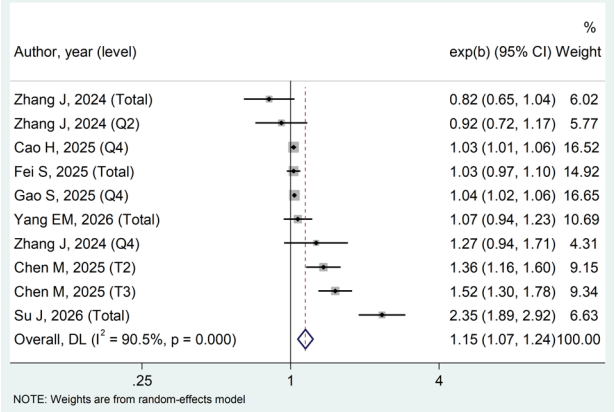

Figure 6. The association of body roundness index with risk of CKD in females.

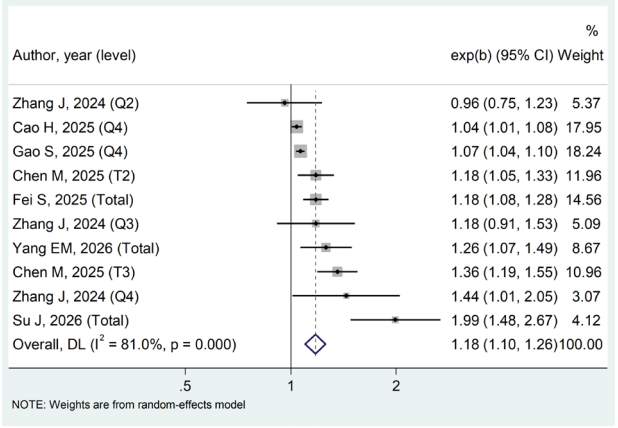

Figure 7. The association of body roundness index with risk of CKD in males.

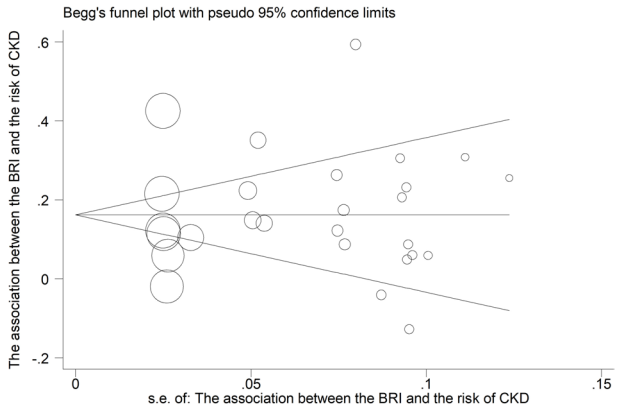

Figure 8. Publication bias plot.

that individuals with elevated BRI had a markedly greater likelihood of nephrolithiasis compared with those with lower BRI (34). Similarly, Lei et al reported in a US adult population that BRI was positively and significantly related to albuminuria, suggesting that greater body roundness is linked to early renal damage (35). In another study among Chinese adults, Zhang et al found that higher BRI was associated with reduced estimated glomerular filtration rate (eGFR), with those in the highest BRI quartile showing a substantially greater probability of low eGFR than those in the lowest quartile (36). Collectively, these studies support the notion that elevated BRI constitutes an important risk factor for various kidney disorders, consistent with our current findings that higher BRI is a significant determinant of CKD risk.

In a cross-sectional study by Qin et al that examined the relationship between BRI and albuminuria in children and adolescents, multivariable logistic regression analysis revealed a statistically significant inverse association between these two variables; this finding contrasts with the results of our study. However, this discrepancy may be partly explained by differences in the target populations and outcomes, as Qin et al focused on pediatric participants and evaluated albuminuria (37), whereas our investigation assessed CKD risk in adults.

Conclusion

Higher BRI levels were associated with an increased risk of CKD, and women appeared to be at lower risk than men. Moreover, the risk of CKD rose progressively with increasing BRI, whereas among individuals with elevated BRI, CKD risk tended to decline with advancing age. Given that only a limited number of studies reported results stratified by sex and age, future research should more thoroughly investigate the modifying roles of gender and age in the relationship between elevated BRI and CKD risk.

Limitations of the study

One limitation of this study was that some investigations reported BRI levels using tertiles, whereas others used quartiles, resulting in non-uniform categorization across

studies. In addition, only a small number of the original observational studies presented sex-stratified results, which constrained the robustness of gender-specific analyses.

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Authors' contribution

Conceptualization: Hanie Dahmardeh and Dadkhoda Soofi.
Data curation: Soheila Shahraki and Hanie Dahmardeh.
Formal analysis: Seyyede Zahra Sajjadian and Dilafruz Turaeva.
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Methodology: Amir Hossein Saeidi and Rasoul Jafari Arismani.
Project management: Soheila Shahraki and Dadkhoda Soofi.
Supervision: All authors.
Visualization: Dilafruz Turaeva and Kamola Urokova.
Writing–original draft: All authors.
Writing–review and editing: All authors.

Competing interests

The authors declare that they have no competing interests.

Declaration of generative artificial intelligence (AI) and AI-assisted technologies in the writing process

During the preparation of this work, the authors used AI tools (Perplexity) to refine grammar and language style. Subsequently, the authors thoroughly reviewed and edited the content as necessary, assuming full responsibility for the accuracy and content of the publication.

Ethical issues

This study has been compiled based on the PRISMA checklist, and its protocol was registered on the PROSPERO website (ID: CRD420261445875) website and Research Registry website with (Unique Identifying Number [UIN] reviewregistry2120). Besides, ethical issues (including plagiarism, data fabrication, and double publication) have been completely observed by the authors.

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