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REVIEW ARTICLE

Prevalence and risk factors associated with varicose veins among medical personnel in Saudi Arabia: A systematic review and meta-analysis

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ABSTRACT

Background: Varicose veins (VV) are a prevalent vascular pathology with significant occupational implications. Despite being recognized as a health concern among healthcare workers (HCWs), data in Saudi Arabia remain fragmented. This study aimed to systematically review and quantitatively synthesize the prevalence of VV among HCWs in Saudi Arabia and identify associated risk factors.

Methods: Following PRISMA guidelines, a comprehensive search of PubMed, Scopus, and Web of Science was conducted for studies published up to June 2026. Eligible studies included observational research on HCWs in Saudi Arabia reporting VV prevalence. Two reviewers independently screened records, extracted data, and assessed methodological quality using the NHLBI tool. A meta-analysis was performed using a random-effects model to calculate pooled prevalence, with heterogeneity assessed via I^2 statistics.

Results: Five cross-sectional studies involving 1381 HCWs were included. The meta-analysis revealed a pooled prevalence of VV among HCWs in Saudi Arabia of 12% (95% CI: 8%–16%). Substantial heterogeneity was observed (I^2 = 82.4%). Risk factors across studies included female sex, prolonged standing, positive family history, and occupational roles involving long durations in the operating room or heavy lifting.

Conclusion: The pooled prevalence of 12% indicates that VV is a notable occupational health concern for HCWs in Saudi Arabia. Preventive strategies, including ergonomic workplace adjustments, staff education, and routine screening for high-risk individuals, are recommended to mitigate disease progression and improve workforce well-being. Future longitudinal research is required to clarify causal associations.

Keywords: Varicose veins, healthcare personnel, Saudi Arabia, systematic review, meta-analysis, occupational health, chronic venous disease.

Introduction

Varicose veins (VV) represent a pervasive vascular pathology with profound socioeconomic implications, categorized under the spectrum of chronic venous disorders. According to the Clinical, Etiological, Anatomical, and Pathophysiological (CEAP) classification, VV are defined as C2 disease, specifically subcutaneous veins dilated to 3 mm in diameter when measured in an upright position[1]. Anatomically, VV result from a failure in the venous return system, where incompetent valves allow deoxygenated blood to flow in a retrograde direction – a phenomenon known as venous reflux. This valvular failure leads to increased intravenous pressure, causing the veins to become elongated, tortuous, and palpable[2].

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The global prevalence of VV is characterized by significant variability, influenced by both geographical factors and study methodologies. Estimates generally suggest that 10% to 30% of the world's population is affected. Analysis of demographic shifts indicates that prevalence increases with age. Furthermore, a distinct gender disparity is observed: while females are twice as likely to be clinically affected, males are nearly twice as likely to present with visible disease[3]. Beyond the physical manifestation, the condition imposes significant morbidity; patients frequently report pain (35%) and restlessness (33.4%), symptoms that interfere with daily functionality and increase healthcare costs[4].

In the Kingdom of Saudi Arabia, historical literature has estimated the occurrence of this condition to be as high as 62%, with a yearly incidence increase of 5% in females and 2% in males[5]. These elevated rates are often exacerbated by regional lifestyle factors and high susceptibility among specific workforce sectors. Understanding these regional specificities is vital for developing targeted screening protocols that can mitigate the progression from simple varicosities to more severe stages of chronic venous insufficiency, such as skin pigmentation and ulceration. Al Wahbi et al. 2021 identified a prevalence of 47.6% among adult females in Riyadh[4], while Al Shammeri et al. 2014 reported 61.1% in the Qassim region[6]. In contrast, Qari et al. 2024 observed a lower prevalence of 14.6% among surgeons in Makkah[5]. This discrepancy likely reflects a "healthy worker effect" or gender-based risk distribution, as the general female population faces significantly higher risks related to multi-parity and hormonal factors. Furthermore, obesity remains a critical modifiable risk factor; obese surgeons in Makkah demonstrated a 55.6% prevalence compared to only 7.8% in those with average weight[5]. A positive family history, reported in approximately 33.4% of Saudi participants, further highlights the genetic predisposition prevalent in the region[4].

Despite the growing recognition of VV as an important occupational health problem among healthcare workers (HCWs), the available evidence in Saudi Arabia remains fragmented and limited to individual cross-sectional studies conducted in specific hospitals, regions, or professional groups. These studies have reported varying prevalence estimates and have identified several potential risk factors, including prolonged standing, age, female sex, family history, years of professional experience, and workload-related factors. However, differences in study populations, methodologies, and sample sizes have resulted in inconsistent findings and have hindered the generation of a comprehensive national estimate of the burden of VV among healthcare personnel. Therefore, the present study aims to systematically review and quantitatively synthesize the existing literature to estimate the pooled prevalence of VV among healthcare professionals, including nurses and physicians, in Saudi Arabia and to identify the factors associated with its occurrence. The findings of this review may contribute to a better understanding of the occupational burden of VV and support the development of targeted preventive strategies and workplace health policies for HCWs.

Methods

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[7].

Literature search and keywords

A comprehensive literature search was performed in PubMed, Scopus, and Web of Science for studies published from inception up to June 2026. The search strategy aimed to identify studies reporting the prevalence of VV and associated risk factors among HCWs in Saudi Arabia. The search strategy used in the databases was:

("Varicose Veins" OR varicose vein* OR lower limb varicose OR venous insufficiency OR chronic venous disease)

AND

("Health Personnel" OR nurse* OR physician* OR doctor* OR surgeon* OR "health care worker*" OR "healthcare worker*" OR "medical staff" OR "hospital staff")

AND

("Saudi Arabia" OR Riyadh OR Jeddah OR Makkah OR Dammam OR KSA)

In addition, the reference lists of included studies and relevant reviews were manually screened to identify any additional eligible publications.

Eligibility criteria

Studies were eligible for inclusion if they met the following criteria:

- Observational studies.
- Studies conducted among healthcare professionals working in Saudi Arabia, including nurses, physicians, surgeons, and other hospital-based clinical staff (collectively referred to as "healthcare personnel").
- Studies reporting the prevalence of VV (or chronic venous disease) and/or evaluating associated risk factors.

There was no specific language restriction.

Exclusion criteria

Studies were excluded if they met any of the following criteria:

- Non-original publications (e.g., reviews, editorials, commentaries, protocols, theses, or conference abstracts).
- Studies not conducted in Saudi Arabia or lacking country-specific extractable data.

- Studies not reporting prevalence data for VV or not providing sufficient information on associated risk factors.
- Studies in which healthcare personnel data could not be separated from other occupational groups.

Study selection and data extraction

After removing duplicates, all records were imported into Rayyan software for blinded screening[8]. Two reviewers independently screened titles and abstracts according to the eligibility criteria, followed by full-text assessment of potentially relevant studies. Any disagreements were resolved through discussion and consensus.

- Data extraction was performed independently by two reviewers using a standardized electronic data extraction form. The following data were collected:
- Study characteristics: first author, year of publication, study design, setting, sample size, and region within Saudi Arabia.
- Participant characteristics: mean age and sex distribution.
- Outcomes: prevalence of VV or chronic venous disease and reported risk factors (e.g., prolonged standing, obesity, parity, duration of employment, and work shift patterns).

Risk of bias assessment

The methodological quality of included studies was independently assessed by two reviewers using the National Heart, Lung, and Blood Institute (NHLBI) Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies[9]. This tool evaluates multiple domains including clarity of study objectives, definition and selection of the study population, participation rate, exposure and outcome measurement validity, temporal relationship between exposure and outcome, and adjustment for confounding variables. Based on the overall assessment, each study was categorized as "Good," "Fair," or "Poor." Any discrepancies were resolved through consensus.

Statistical analysis

All statistical analyses were conducted using RStudio with the "meta" package[10]. Pooled prevalence estimates of VV were calculated using a random-effects model with corresponding 95% confidence intervals (CIs). Statistical heterogeneity was assessed using Cochran's Q test and quantified using the I^2 statistic, with I^2 values ≥50% or $p < 0.10$ indicating substantial heterogeneity. Publication bias was assessed using the Luis Furuya-Kanamori (LFK) index and Doi plot[11]. An LFK index within ±1 indicated no asymmetry, between ±1 and ±2 indicated minor asymmetry, and values greater than ±2 suggested major asymmetry. Doi plots were generated using the MetaXL add-in for Microsoft Excel.

Sensitivity analysis

Sensitivity analyses were performed using a leave-one-out approach to evaluate the robustness of the pooled prevalence estimate and to assess the influence of individual studies on overall results.

Results

Literature search

The electronic database search across PubMed, WOS, and Scopus yielded a total of 114 records. Following the removal of 30 duplicate records, 84 unique studies were screened based on their titles and abstracts. Subsequently, 28 full-text articles were assessed for eligibility against the predefined inclusion criteria. After a rigorous evaluation process, five cross-sectional studies met the final inclusion criteria for this systematic review and meta-analysis. The comprehensive study selection process is illustrated in Figure 1.

Study and population characteristics

A total of five studies were included in this systematic review[5,12–15], all of which employed a cross-sectional design and were conducted within various healthcare settings across Saudi Arabia. The cumulative sample size across these studies was 1381 healthcare personnel. Individual study sample sizes showed moderate variation, ranging from 91 participants to 482 participants. The studies primarily investigated the prevalence of VV and explored associated risk factors, such as prolonged standing, family history, and occupational roles. Detailed information regarding the location, participant demographics, and key findings for each study is presented in Table 1.

Quality assessment

The methodological quality of the five included studies was systematically evaluated using the NHLBI Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies. Upon review, all five studies were classified as "Fair" quality. While the studies consistently demonstrated strength in clearly defining their research objectives (Q1) and study populations (Q2), they shared several common limitations. The full breakdown of the quality appraisal is detailed in Table 2.

Prevalence of varicose veins

The meta-analysis of the five included studies revealed a pooled prevalence of VV among health personnel in Saudi Arabia of 12% (95% CI: 8%–16%), as shown in **Figure 2A**. Analysis of the data revealed substantial between-study heterogeneity, with an I^2 value of 82.4% ($p = 0.0001$). A leave-one-out sensitivity analysis was performed to determine if any single study disproportionately influenced the pooled result; the analysis indicated that the prevalence remained consistent, ranging between 10% and 14%, as shown in **Figure 2B**. The exclusion of the study by Baghdadi 2023[12] resolved the heterogeneity the best ($I^2 = 32\%$). Finally, an assessment of publication bias using a Doi plot yielded an LFK index of -1.24, which suggests the presence of minor asymmetry in the included literature, as shown in Figure 3.

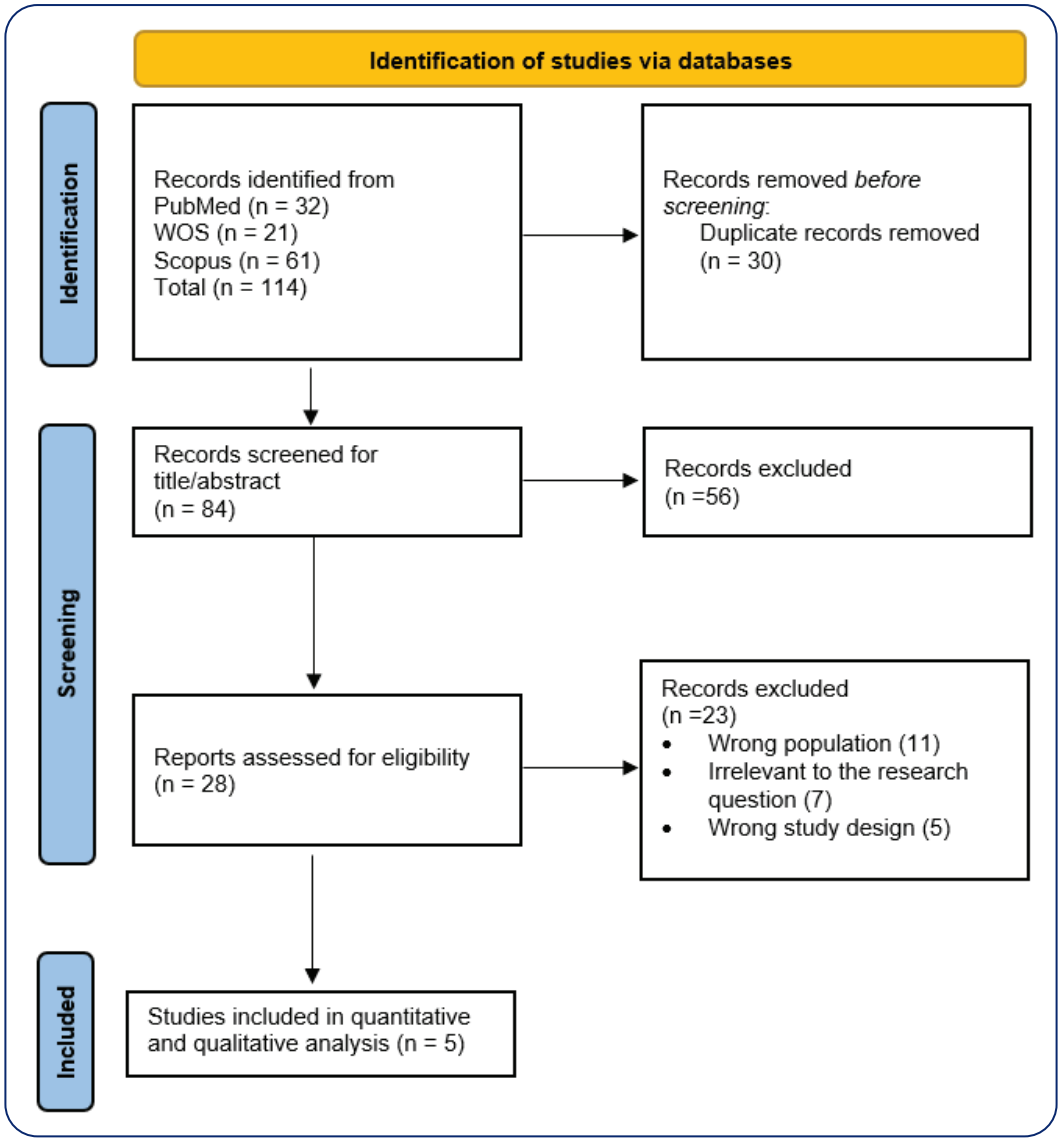

Figure 1. *PRISMA flowchart of study selection.*

Factors associated with varicose veins

Qari et al. 2024[5] reported that VV were significantly associated with several occupational, clinical, and lifestyle factors among surgeons in Saudi Arabia. The prevalence varied significantly across specialties, being highest in thoracic surgeons (50%) and lower in ENT surgeons (18.2%) (P = 0.002). Longer surgical experience was associated with higher VV prevalence, with surgeons having ≥20 years of experience showing a significantly higher rate (44.4%) compared with those with 1–4 years (13.8%) (P = 0.002). Occupational strain also played a role, as heavy lifting (≥23 kg) was associated with increased VV (P = 0.049). In addition, several medical conditions and risk factors were significantly associated with VV, including positive family history, deep vein thrombosis, hypertension, rheumatoid arthritis, and contraceptive use. Conversely, regular light exercise and maintaining ideal body weight were associated with lower VV prevalence.

Almutiri et al. 2024[14] found that demographic variables such as age, gender, and ethnicity were not significantly associated with VV among HCWs. However, occupational exposure showed important associations, as being a surgical physician, operating room staff, or nurse was significantly linked to VV (P = 0.009). Longer duration of work in the operating room and prolonged standing were also significantly associated with higher VV prevalence. In addition, contraceptive pill use and vaginal delivery were significantly associated with VV, while factors such as smoking, body mass index, exercise, and heavy lifting were not significant predictors.

Baghdadi et al. 2023[12] demonstrated that a positive family history and other chronic medical conditions

Table 1. *Summary of the included studies and populations characteristics.*

Study	Location	Design	Sample size	Age (years), mean (SD) and/or range	Nationality, *n* (%)	Sex (male), *n* (%)	Marital status (single), *n* (%)	Key findings
Qari 2024[5]	Different specialties in the public hospitals of Makkah, Saudi Arabia	Cross-sectional	192	33.8 (7.0)	Saudi: 171 (89.1%) Non-Saudi: 21 (10.9%)	136 (70.8%)	Single: 84 (43.8%) Married: 100 (52.1%) Divorced: 8 (4.2%)	Varicose veins (VV) are a frequent condition, especially in individuals with risk factors such as prolonged standing, smoking, pregnancy, and obesity. Surgeons – particularly those in thoracic and pediatric specialties – and female surgeons appear to be at higher risk. Preventive strategies such as minimizing long periods of standing, using compression stockings, and adopting a healthy lifestyle are advised to reduce the risk.
Almutiri 2024[14]	Buraidah Central Hospital, Qassim Region, Saudi Arabia	Cross-sectional	91	25–30: 18 (19.8) 31–40: 24 (26.4) 41–50: 33 (36.3) >50: 16 (17.6)	NA	53 (58.2%)	Single: 20 (22%) Married: 70 (76.9%) Widow/Widowed: 1 (1. 1%)	The study reported a low prevalence of diagnosed varicose veins (VV), with similar rates observed in both male and female participants. Several factors were associated with increased risk, including the number of days spent working in the operating room, surgical role, family history of VV, use of oral contraceptives, and mode of delivery.
Baghdadi 2023[12]	King Khalid University Hospital (KKUH) in Riyadh, Saudi Arabia	Cross-sectional	250	36.54 (7.53)	Saudi: 36 (14.4%) Non-Saudi: 214 (85.6%)	15 (6%)	Single: 78 (31.2%) Married: 172 (68.8)	The study found that working in outpatient clinics, having a positive family history of varicose veins, longer duration of nursing practice, and the presence of chronic comorbidities were associated with an increased risk of varicose veins. In contrast, engaging in activities such as race-walking or running appeared to have a protective effect.
Ali 2022[13]	King Fahd Central Hospital and Prince Muhammad bin Nasser Hospitals in Jazan province, Saudi Arabia	Cross-sectional	482	30.57 (5.50)	NA	67 (13.9%)	Single: 217 (45%) Married: 254 (52.7%) Widowed: 2 (0.4%) Divorced: 9 (1.9%)	The findings suggest that preventive efforts should focus on improving nurse staffing levels, promoting regular physical activity, and considering earlier retirement policies, as these measures may help reduce the onset and progression of varicose veins among nurses.
AlBader 2020[15]	King Abdulaziz Medical City (KAMC), a large tertiary care center in Riyadh, Saudi Arabia	Cross-sectional	366	36 (8)	NA	44 (12%)	Single: 158 (43.8%) Married: 191 (52.9%) Widow/Widower: 4 (1.1%) Divorced: 8 (2.2%)	The study found that a positive family history, older age, marital status, prolonged standing, and frequent heavy lifting were significant factors associated with an increased risk of varicose veins among nurses. Despite these associations, the overall prevalence of varicose veins across the four nursing departments remained low.

Table 2. *Quality assessment of the included studies.*

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Quality
AlBader 2020	Y	Y	NR	Y	N	NA	NA	NA	Y	NA	Y	NR	NA	Y	Fair
Ali 2022	Y	Y	NR	Y	N	NA	NA	NA	Y	NA	Y	NR	NA	Y	Fair
Almutiri 2024	Y	Y	NR	Y	N	NA	NA	NA	Y	NA	Y	NR	NA	Y	Fair
Baghdadi 2023	Y	Y	NR	Y	N	NA	NA	NA	Y	NA	Y	NR	NA	Y	Fair
Qari 2024	Y	Y	NR	Y	N	NA	NA	NA	Y	NA	Y	NR	NA	Y	Fair

Y, yes; N, no; CD, cannot determine; NR, not reported; NA, not applicable.
NHLBI Tool for Observational Cohort and Cross-Sectional Studies
Q1, Was the research question or objective in this paper clearly stated?
Q2, Was the study population clearly specified and defined?
Q3, Was the participation rate of eligible persons at least 50%?
Q4, Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?
Q5, Was a sample size justification, power description, or variance and effect estimates provided?
Q6, For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?
Q7, Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?
Q8, For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome?
Q9, Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?
Q10, Was the exposure(s) assessed more than once over time?
Q11, Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?
Q12, Were the outcome assessors blinded to the exposure status of participants?
Q13, Was loss to follow-up after baseline 20% or less?
Q14, Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?

were significant risk factors for VV among nurses. Physical activity, particularly running or race-walking, showed a protective effect. Occupational duration as a staff nurse was also significantly associated with VV. In multivariable analysis, family history remained the strongest predictor of increased risk, while regular physical activity significantly reduced the odds of developing VV.

Ali et al. 2022[13] identified multiple significant risk factors for VV, including ethnicity, heavy lifting, lack of exercise, family history, hormonal and contraceptive use, reproductive factors, and several comorbidities such as diabetes, hypertension, and deep vein thrombosis. However, variables such as gender, smoking, workplace setting, and years of experience were not significantly associated with VV.

AlBader et al. 2020[15] reported significant associations between VV and social status, heavy lifting, family history, number of childbirths, and menopause. Interestingly, hypertension and diabetes showed a paradoxical protective association. Other factors, including gender, smoking, exercise, hormonal therapy, and type of delivery, were not significantly associated, while VV prevalence varied across departments but was not statistically significant overall.

Discussion

Our meta-analysis found a pooled varicose vein prevalence of 12% (95% CI 8%–16%) among HCWs (doctors and nurses). This is substantially lower than global HCW rates (25%)[16] and suggests differences in populations or methods. Heterogeneity was high (I^2 = 82%), likely due to study design and population differences. Notably, female sex and prolonged standing emerged as key risk factors in other studies. A leave-one-out sensitivity analysis showed the pooled prevalence remained between 10% and14% when each study was omitted. The estimated prevalence of 12% should be interpreted cautiously given the substantial heterogeneity and limited number of available studies. The high heterogeneity indicates real differences between studies. Potential sources include population differences (different regions, hospital departments, and staff compositions), and measurement methods (some used clinical exam or Doppler, others self-report questionnaires). For example, one study focused on surgeons, another on nurses, with differing gender ratios and age profiles. Occupational factors likely varied (e.g., length of standing shifts, heavy lifting duties). The limited number of studies precluded subgroup analyses. Leave-one-out testing showed robustness of the 12% estimate, yet we could not stratify by gender or role due to insufficient detail.

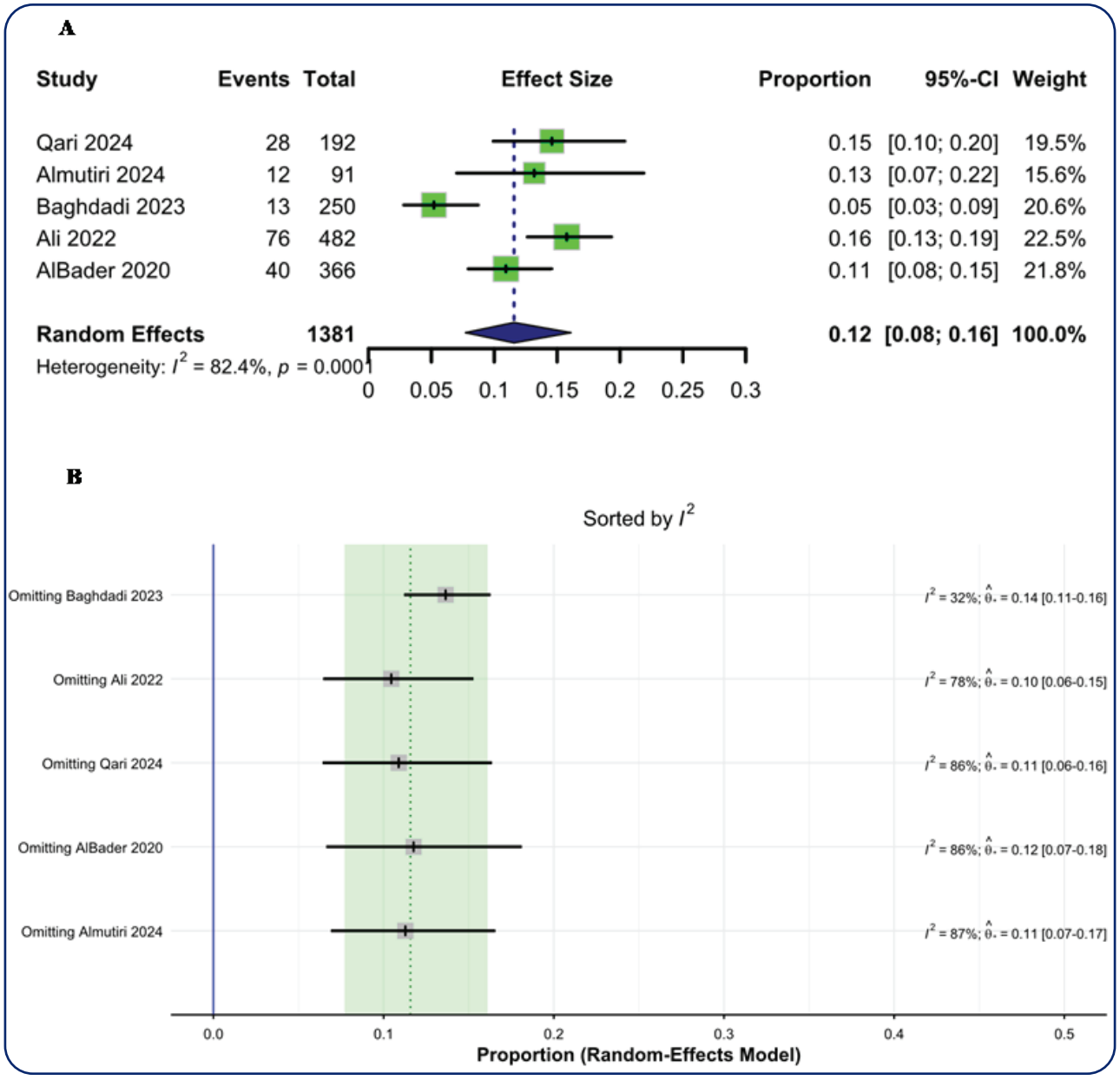

Figure 2. A) *Prevalence of varicose veins among HCW in Saudi Arabia,* ***B)*** *Leave-one-out analysis.*

For Saudi HCWs, primary studies vary widely. For instance, AlBader et al. 2020 found 11% in 366 nurses[15]. Another Riyadh survey (Baghdadi et al. 2023[12]) found 5.2% had high risk for VV. Such discrepancies likely reflect differences in populations: older, female-heavy cohorts showed higher rates, while mixed-gender or younger samples had lower rates. In other Middle Eastern studies, rates also vary: an Egyptian hospital study found 18.4% among nurses[17], whereas an Iranian series reported 72.4% (mostly women)[18]. In contrast, general-population surveys in Saudi Arabia (e.g., teachers) report a prevalence of 42%, underscoring occupational influences[19]. Globally, a recent meta-analysis of HCWs reported a pooled prevalence of 25% (95% CI 18%–31%)[16]. In that review, the Middle East/North Africa subgroup showed the highest prevalence rate at 28%. These figures exceed our 12%, perhaps because non-Saudi samples included higher-risk groups or used more sensitive detection (Doppler). Importantly, reported risk factors are consistent across studies: female sex, long-standing hours, parity, obesity, and family history. Another review emphasized female gender, prolonged standing, nursing roles, and ICU work as significant[20]. Our findings align with these patterns (our narrative results note the same predictors).

VV in medical personnel have important occupational health implications. Clinicians and occupational health

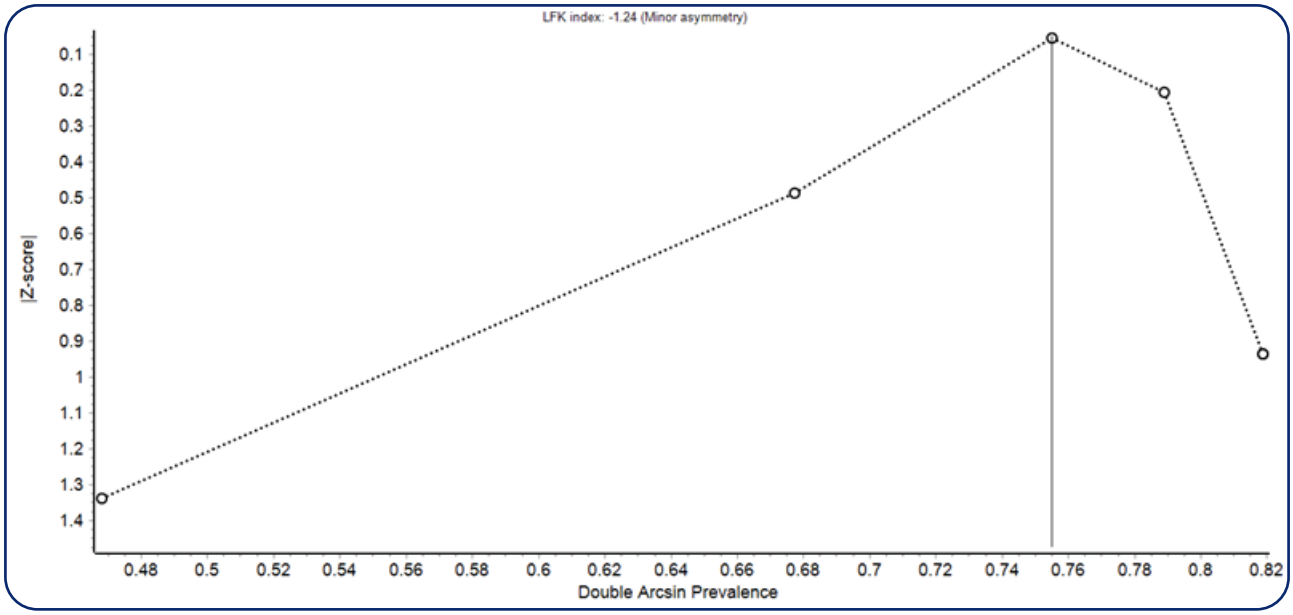

Figure 3. *Doi plot and LFK index for prevalence of varicose veins among HCW in Saudi Arabia.*

services should recognize VV as a prevalent work-related condition. Early identification (e.g., screening symptomatic staff) and management (compression therapy, leg exercises, weight control) can prevent progression to pain, ulceration, or disability. Notably, VV can impair quality of life and productivity, so prevention has both human and economic benefits. Hospitals should implement preventive measures: educate staff on VV risk (especially women and those standing long hours), provide ergonomic supports (anti-fatigue mats, seated breaks), and encourage use of compression stockings for high-risk roles. We also suggest adding simple VV screening (leg exam or Doppler) to annual employee health check-ups for high-risk groups, facilitating early treatment. Future research should evaluate interventions: for instance, randomized trials of compression stocking use or scheduled sit-down breaks could test efficacy in nurses. Longitudinal cohort studies of Saudi HCWs (tracking VV development over time) would clarify causality and incidence.

Our review's strength lies in a comprehensive search and quantitative synthesis of all available Saudi data, providing, to the best of the authors' knowledge, the first pooled estimate of VV prevalence in this population. We adhered to PRISMA methodology and used robust meta-analytic techniques. By comparing to regional and global literature, we contextualized our findings thoroughly. Limitations include the small number of included studies and their cross-sectional design. Many had convenience samples and relied on self-reported VV or non-standardized assessments, risking under- or over-estimation. High heterogeneity limits the precision of our pooled estimate. We lacked detailed individual data, so subgroup analyses were not feasible.

Another limitation is the variation in methods used to ascertain VV across studies. Although VV were assessed and reported in all included studies, the diagnostic approaches were not fully standardized, which may have contributed to the observed heterogeneity. Future Saudi research should use standardized diagnostic methods (e.g., CEAP-based assessment or ultrasound) and provide comprehensive demographic and occupational data. Larger, multicenter studies with representative samples are needed to improve the precision of prevalence estimates and clarify potential occupational risk factors.

Conclusion

The findings suggest that VV represent a notable health concern among healthcare personnel in Saudi Arabia. However, the pooled prevalence estimate of 12% should be interpreted cautiously given the substantial heterogeneity, limited number of studies, and fair quality of the available evidence. Further large, multicenter studies using standardized diagnostic methods are needed to provide more precise estimates and better characterize potential occupational risk factors.

List of Abbreviations

CEAP	Clinical, Etiological, Anatomical, and Pathophysiological classification
CI	Confidence Interval
HCW	Healthcare worker
LFK	Luis Furuya-Kanamori (index)
NHLBI	National Heart, Lung, and Blood Institute

PRISMA Preferred Reporting Items for Systematic Reviews and Meta-Analyses

VV Varicose veins

Declarations

Conflict of interest

The authors declare that they have no conflict of interest regarding the publication of this article.

Authors' contributions:

The authors meet the criteria for authorship as recommended by the International Committee of Medical Journal Editors (ICMJE).

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Consent for publication

Not applicable.

Human ethics and consent to participate statement

Our manuscript was not applied to human beings and thus requires no ethical approval.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Ethics approval and consent to participate

Not applicable.

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