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Original Article

A Study on Prevalence and Risk Factors for Varicose Veins in Nurses at a University Hospital

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ABSTRACT

Background: Lower-limb varicose veins (VVs) are common and known to have a higher prevalence among people who work in occupations requiring prolonged standing. In the Republic of Korea, however, VV-related occupational factors have seldom been examined. This study was conducted to assess the prevalence of VVs among nurses, an occupational group considered to be at high risk of VVs, and determine the occupational risk factors of prolonged standing.

Methods: Between March and August 2014, a questionnaire survey coupled with Doppler ultrasonography was conducted on the nurses working at a university hospital.

Results: A total of 414 nurses participated in the survey and diagnostic testing. From the survey analysis and test results, the prevalence of VVs in nurses was estimated to be 16.18%. Significant factors for venous reflux were age [odds ratio (OR) = 1.06, 95% confidence interval (CI) = 1.03–1.10], pregnancy (OR = 2.15, 95% CI = 1.17–3.94), and delivery (OR = 2.02, 95% CI = 1.08–3.78). The statistical significance of these factors was verified after risk adjustment for sociodemographic factors (OR = 3.40, 95% CI = 1.27–9.09).

Conclusion: Factors significantly associated with venous reflux were increasing age and prolonged working hours (≥ 4 hours) in a standing position (OR = 2.80, 95% CI = 1.08–7.25), even after risk adjustment for sociodemographic factors. This study is significant in that an objective diagnosis of VVs preceded the analysis of the risk factors for VV incidence, thus verifying objectively that VVs are associated with occupations requiring prolonged hours of working in a standing position.

1. Introduction

Lower-limb varicose veins (VVs) are relatively common, with reported prevalence ranging between 10% and 30% worldwide [1,2]. While the etiology of VVs is not clearly known at present, exacerbating factors have been identified. General risk factors are increasing age [3], belonging to the female sex [4,5], family history of venous diseases [6], pregnancy [7], smoking [8], and overweight [9]. Prolonged working in a standing position increases the prevalence of VVs and is an important occupational risk factor [10,11].

Most studies on VVs concern treatment and therapeutic effects. Studies investigating risk factors have mostly explored general risk factors in patients diagnosed with VVs. There are few studies on occupational risk factors in the general population. Most studies on VV-related occupational risk factors deal with working in a standing position. An inpatient cohort study conducted by Tüchsen et al. [12] reported the risk ratio of the prevalence of VVs for prolonged standing position, after adjustment for age and smoking status, to be 1.85 [95% confidence interval (CI) = 1.33–2.36] for men and 2.63 (95% CI = 2.25–3.02) for women. Likewise, a Danish retrospective

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study [13] estimated the relative risk of workers with longer hours of standing or walking to be 1.75-fold (95% CI = 0.92–3.34) for men and 1.82-fold (95% CI = 1.12–2.95) for women, compared with other workers. Among the studies on occupational factors in the general population, Kohno et al. [14] investigated adults aged 45 years or over and reported that prolonged standing at work increased the risk of VVs [odds ratio (OR) = 3.42, 95% CI = 1.07–10.89]; this suggested that a prolonged standing position is a risk factor for VV incidence among the general population, independent of occupational group. A Danish longitudinal study conducted by Tabatabaeifar et al. [15] assessed the occupational risk factors in patients who underwent first VV surgery and reported that working long hours (≥ 6 h/d) in a standing position and lifting heavy objects (≥ 1,000 kg/d), were associated with significantly higher risks [hazard ratio (HR) = 3.17, 95% CI = 2.06–4.89 for men, and HR = 2.34, 95% CI = 1.72–3.19 for women; and HR = 3.95, 95% CI = 2.32–6.73 for men, and HR = 2.54, 95% CI = 1.95–3.31 for women, respectively]. Other studies investigating the risk of VVs in workers of specific occupational groups, e.g., Chen and Gou [16] in hairdressers and Sharif et al. [17] in nurses, reported that the VV risk increased with the increase in the hours of work in a standing position, thus confirming the association of VV incidence with occupations involving long hours of standing.

In Republic of Korea, VV-related research results mostly revolve around treatment methods, and only a few studies have dealt with occupational risk factors. Moreover, except for a study with VV inpatients, those [18,19] that reported on the occupational risks of working in a standing position on a regular basis relied on surveys of symptoms for VV estimation, without performing Doppler ultrasonography, thus lacking clear evidence of VV incidence.

In Republic of Korea, musculoskeletal disorders were not recognized as occupational diseases until the early 1990s. In the wake of massive incidence of occupation-associated cervicobrachial disorders in certain occupational groups in the early 1990s, recognition criteria for the musculoskeletal system were established in 1994. However, only a limited number of musculoskeletal diseases met these criteria [20]. In the 2000s, workers in certain occupational groups expressed their dissatisfaction in the form of collective application for compensation medical care. Between 2002 and 2004, for example, workers in the production sector, such as the automotive and shipbuilding industries, collectively applied for compensation medical care for musculoskeletal diseases across the county and obtained recognition for occupational diseases. Currently, musculoskeletal diseases occurring in the production sector account for 70% of all officially recognized occupational diseases [21]. Given that such musculoskeletal diseases can be prevented through timely ergonomic interventions [22], it is essential to accurately identify related occupational risk factors. According to the criteria currently applied in Republic of Korea, not only new instances of musculoskeletal disease but also the exacerbation of already existing disease through exposure to occupational risk factors are recognized as occupational diseases [23]. Therefore, if working in a standing position on a regular basis is proven as a factor increasing the risk of VVs, VVs will likely be recognized as an occupational disease. At present, however, the general awareness of VVs as a potential occupational disease is very low, and related research is still lacking.

Nurses are reported to have a higher rate of musculoskeletal symptoms than other occupational groups [24], especially with regard to lower-limb swelling and pain, which are typical VV symptoms [25]. They are also reported to be at a higher risk of VVs than other occupational groups [26,27]. Therefore, this study was intended to objectively diagnose VVs in nurses and determine the association between prevalence and occupational risk factors as well as to identify these factors.

2. Materials and methods

2.1. Study population

This study was approved by the Institute Review Board (IRB) of Pusan National University, Yangsan Hospital where the author belongs (IRB No. 05-2014-007). As a study population representative of the larger target population, nurses at a university hospital in Busan were chosen. A questionnaire survey and Doppler ultrasonography were conducted by visit survey between March and August 2014. Of the entire nursing staff, 95% (715 out of 750) participated in the questionnaire survey. High participation in the questionnaire survey resulted from the help of the Department of Nursing. Of these, apart from those treated with VVs, 414 nurses (55% of the entire staff) who received ultrasound examinations were appointed as the final participants of the study.

2.2. Study methods

This study was conducted by the questionnaire and the ultrasound scan examination.

2.2.1. Questionnaire

The questionnaire was composed of items pertaining to sociodemographic, VV-related, and occupation-related factors. The sociodemographic items included questions regarding sex, age, height, body weight, smoking, drinking, exercise, past medical history, and family history. Items pertaining to VV-related factors concerned pregnancy, delivery, history of trauma or injury to the lower limbs, and use of compression stockings. Items concerning occupational characteristics included the number of daily working hours in a static standing, walking, and sitting position, as well as at rest, past occupations, number of consecutive service years, and department (classified into ward, emergency room, outpatient clinic, intensive care unit, and operating room).

2.2.2. Diagnosis

VV diagnosis was made using a portable ultrasound machine (LOGIQ e Ultrasound; GE Healthcare, USA). Venous reflux in lower limbs was induced by using the method of manual compression distal to the segment being tested by Doppler sonography, followed by release [28]. Observations were made at the superficial femoral vein (proximal, middle, and distal parts) and the popliteal vein (proximal and distal parts) of the test segments in both the lower limbs. The international standard of 0.5 seconds was used as a cutoff threshold between normal physiological or pathological reflux. With reflux occurring after 0.5 seconds defined as pathological [29], evidence for pathological reflux was the diagnostic criterion for VVs. An ultrasound scan was conducted by a specialist of occupational and environmental medicine to increase the consistency of the examination. The data on the worker's occupation approved for VVs mentioned in the Discussion section were obtained from the Korea Workers' Compensation & Welfare Service by applying for information disclosure.

2.3. Statistical analysis

The relationships between VVs and risk factors were verified by determining significant correlations using the chi-square test. Logistic regression was performed to compare the impacts of individual risk factors on the incidence of VVs. Significant variables in univariate logistic analysis and variables suspected confounding factors were used as adjusted variables in multiple logistic regression. A p value < 0.05 was set as the threshold for statistical

Table 1
General characteristics and varicose vein

Variables		*n* (Total = 414)	*p**	Crude† OR (95% CI)
Varicose vein diagnosis	No Yes	347 67		
Sex	Male Female	7 407	0.68	1 1.16 (0.14–9.81)
Age (y)	Mean age: 30		0.006	1.06 (1.03–1.10)
BMI	< 25 ≥ 25	390 24	0.44	1 0.73 (0.21–2.51)
Contraceptive	No Yes	410 4	0.49	1 0.001 (0.001–<10)
Pregnancy	No Yes	341 73	0.01	1 2.15 (1.17–3.94)
Delivery	No Yes	347 67	0.03	1 2.02 (1.08–3.78)
Smoke	No Yes	410 4	0.51	1 1.74 (0.17–16.96)
Drink	No Yes	198 216	0.18	1 0.75 (0.45–1.27)
Exercise	No Yes	281 133	0.48	1 0.82 (0.47–1.42)
Trauma history	No Yes	413 1	0.84	1 0.001 (0.001–<10)
Family history	No Yes	247 167	0.41	1 1.26 (0.73–2.16)
Stocking period			0.002	1.17 (1.08–1.28)

* Normal group and varicose vein (diagnosed by duplex ultrasound scan), Chi-square test.
† Univariate logistic regression.
BMI, body mass index; CI, confidence interval; OR, odds ratio.

significance. The software SAS version 9.1 (SAS institute, Cary, NC, USA) was used.

3. Results

In total, 414 nurses (407 women and 7 men) with a mean age of 30 years participated in the study (Table 1). Of these, 67 (66 women and 1 man) were diagnosed with VVs by duplex ultrasonography, accounting for 16.2% (16.2% of women and 14.3% of men) as the overall prevalence.

Among the sociodemographic factors, those confirmed to have a statistically significant association were age (OR = 1.06, 95% CI = 1.03–1.10), pregnancy (OR = 2.15, 95% CI = 1.17–3.94), delivery (OR = 2.02, 95% CI = 1.08–3.78), and the length of time using compression stockings (OR = 1.06, 95% CI = 1.03–1.10).

The observation of venous reflux for each department category was statistically significant ($p = 0.003$), with the highest prevalence demonstrated by working in the operating room (36.4%), followed by the outpatient clinic (26.9%), intensive care unit (19.4%), emergency room (18.2%), and ward (10.2%).

A logistic regression of department-dependent venous reflux was performed using the ward that showed the least amount of work requiring standing as the reference. As a result, OR = 3.24 (95% CI = 1.55–6.80) and OR = 5.03 (95% CI = 2.21–11.43) were derived for the outpatient clinic and operating room, respectively. The values after risk adjustment for sociodemographic factors were also statistically significant, with OR = 2.55 (95%CI = 1.11–5.82) for the outpatient clinic and OR = 4.86 (95% CI = 1.98–11.97) for the operating room (Table 2).

The daily working hours by position were broken down into standing (average 6.5 hours), either static (1.8 hours) or ambulatory (4.9 hours), and sitting (average 2.2 hours), with average breaks of 0.23 hours. Comparing those with less or more than 4 hours of standing, the ≥ 4-hour-group showed significantly more pathological reflux compared with the < 4-hour-group (OR = 2.80, 95% CI = 1.08–7.25); the statistical significance was retained after adjustment for sociodemographic factors (OR = 3.40, 95% CI = 1.27–9.09). The average number of years of consecutive service was 4.36 years (Table 3).

4. Discussion

Lower-limb VVs refers to a condition characterized by visible, tortuous VVs in the lower limbs resulting from intravenous blood reflux, in turn due to vein wall dilation and valvular incompetence of superficial veins. It is common, and present in 10–30% of the general population. Once developed, there is no spontaneous recovery, and symptoms are exacerbated in proportion to disease duration [30]. Therefore, VVs should be treated actively in their early phases. More importantly, however, their risk factors should be counteracted before the symptoms appear.

The prevalence of VVs of 16.2% in the nurses surveyed and examined in this study falls under the generally known range of prevalence, but it is lower than the expected value, given that nurses are among the occupational groups known to be at higher risk of developing VVs. However, the results cannot be compared simply, because the diagnosis of VVs was based on symptoms by questionnaires rather than ultrasound. Consequently, the results of other studies may be exaggerated compared with the results of this study. This is assumed to be ascribable to the relatively short duration of exposure to risk factors for developing VVs, given the participants' young average age (30 years) and short average service period (4.36 years); which was because the turnover rates of nurses were high. We did not expect these situations at the stage of study design. Among the sociodemographic risk factors for developing VVs, statistically significant factors were found to be age (OR = 1.06, 95% CI = 1.03–1.10), pregnancy (OR = 2.15, 95% CI = 1.17–3.94), and delivery (OR = 2.02, 95% CI = 1.08–3.78), which were in good agreement with the results of previous studies. While these studies identified sex as a risk factor of VVs, no sex-dependent difference was verified in this study, presumably due to the group-specific nature, in which women were predominant. Although the duration of using compression stockings for prevention and treatment purposes [25,26] was proved to be related to VV incidence in this study (OR = 1.17, 95% CI = 1.08–1.28), this simply demonstrates an association between disease and a single factor, which is insufficient for proving a causal relationship.

With regard to the association between departments and VV prevalence, using the ward that had the least amount of work in a standing position as the reference group, statistically significant differences after risk adjustment for sociodemographic factors were shown for the outpatient clinic (OR 2.55, 95% CI = 1.11–5.82) and operating room (OR 4.86, 95%CI = 1.98–11.97). However, the emergency room and intensive care unit, two departments that expected to show high risk values due to their increased hours of standing, did not differ significantly from the reference group. The low estimations for these two inherently high-risk groups within the hospital maybe attributable to the high job transfer rate, which was not considered in this study design and the regular provision of compression stockings by the hospital to these high-risk groups to prevent VV occurrence. Despite this preventive measure, the operating room yielded a higher OR than the other departments; however, the outpatient clinic, for which compression stockings were not provided, as it was considered a low-risk department, showed a higher OR than high-risk departments. This points toward the need for anti-VV measures for the nursing workforce, which indirectly proves it to be a high-risk group for VVs. In the analysis concerning working position, comparing the groups with

Table 2
Department and varicose veins

Department	Total n	Reflux n (%)	*p*-value*	Crude OR (95% CI)†	Adjusted OR (95% CI)‡
Ward	245	25 (10.20%)	0.003	1 (ref)	1 (ref)
Emergency room	22	4 (18.18%)		1.96 (0.61–6.27)	1.99 (0.60–6.58)
Intensive care unit	62	12 (19.35%)		2.11 (0.99–4.49)	1.66 (0.75–3.68)
Clinic	52	14 (26.92%)		3.24 (1.55–6.80)	2.55 (1.11–5.82)
Operating room	33	12 (36.36%)		5.03 (2.21–11.43)	4.86 (1.98–11.97)

* Varicose vein reflux and department, Chi-square test.
† Univariate logistic regression.
‡ Multiple logistic regression (adjusted for age, pregnancy, stocking period).
CI, confidence interval; OR, odds ratio.

less and more than 4 hours of standing, the ≥ 4-hour-group showed significantly higher VV prevalence (OR = 2.80, 95% CI = 1.08–7.25); the statistical significance was retained after adjustment for sociodemographic factors, such as age, obesity, and pregnancy (OR = 3.40, 95% CI = 1.27–9.09). Furthermore, there may be problems with the changes of department while on duty. However, most of the study participants were new nurses; therefore, there were no changes of department. Only 13% of nurses had experienced the changes of department, so we analyzed the department before occurrence of VVs for them. Therefore, we do not think that there may be a problem with department changes.

The results of our study coincided with those of previous studies showing that VV incidence is directly associated with working hours in a standing position [12–17]; however, the low average age and short average continuous service period of the participants in our study were not enough to induce the effects of exposure to prolonged standing. We compared our findings with those of previous studies on occupational risk factors for VVs and found that they were consistent with the two Danish cohort studies [12,13] reporting that prolonged standing at work increased the risk of VVs in the hospitalized patients surveyed. However, in contrast to the finding in these studies that women were at a higher risk of developing VVs than men, no sex difference could be verified in our study. This is considered to result from the woman-dominant sex structure of the nursing workforce as shown in this study, in which over 98% of the participants were women. In other words, the number of male participants was too low to yield any statistically significant result in terms of sex difference. A study [16] with hairdressers as an occupational group requiring prolonged standing at work also reported the association between VV incidence and long hours of working in a standing position; however, the results of that study lack objectivity because they solely relied on a questionnaire survey. While the study with hairdressers found that the number of consecutive working years was directly associated with the increase in VV occurrence, we could not verify an association between service years and VV occurrence. This is assumed to be ascribable to the fact that the average consecutive service period (4.36 years) of our participants was not sufficient to induce the effects of occupational exposure to risk factors, especially because musculoskeletal diseases become manifest after a relatively long period of exposure to occupational risk factors. A Danish longitudinal study [15] demonstrated that not only prolonged standing at work but also heavy lifting can be a risk factor for VV occurrence. This aspect could not be explored in our study because it did not involve heavy objects. Additionally, because that study was conducted on surgical cases of VVs, recall bias about occupational risk factors cannot be ruled out. A study with nurses [17] yielded the same results as our study, in that the VV risk increased with the increase in the working hours in a standing position; however, that study, unlike ours, provided a clinical diagnosis based on the Clinical–Etiology–Anatomy–Pathophysiology classification for chronic venous diseases, thus lacking confirmatory diagnosis with ultrasonography. Unlike our sex-related findings, the previous study demonstrated that the prevalence in women was significantly higher than that in men (77.9% vs. 56.9%). This may be explained by the higher sex balance (28.5%; 58 men out of 203 participants) than in our study (1.7%; 7/414).

In our study, analysis of occupational risk factors was preceded by objective diagnosis of VVs using ultrasound for lower-limb venous reflux quantification. Therefore, our study has an advantage over previous studies conducted in Republic of Korea that estimated occupation-related VVs solely based on symptom-related questionnaires. The present study is thus significant as it overcomes the problem of lack of objectivity in VV diagnosis. As a limitation of the present study, the sample population's low average age and short period of service were not taken into account in the study plan, although musculoskeletal diseases become manifest after relatively long exposure to occupational risk factors. With a lower prevalence than expected, it is therefore highly probable that our study yielded underestimated results regarding the association between VV prevalence and the occupational risk factor of prolonged standing at work. Despite this limitation, our study verified that working in a standing position is positively associated with VV prevalence. This finding was supported by the fact that the VV prevalence among nurses working in the operating room was higher than in those working in other departments even though they wore compression stockings provided by the hospital for high-risk departments. Likewise, the high prevalence in the outpatient clinic, which was considered a low-risk department in the study plan, highlighted the necessity for preventive measures against VV occurrence. In Republic of Korea, the exacerbation of

Table 3
Work posture and varicose vein (logistic regression)

Work posture (h)	Crude OR (95% CI)*	Adjusted OR (95% CI)†
Stand (mean: 1.81)		
Stand < 2	1 (reference)	1 (reference)
2 ≤ Stand < 4	1.14 (0.60–2.16)	1.03 (0.53–2.00)
4 ≤ Stand	1.67 (0.84–3.32)	1.53 (0.75–3.14)
Walk (mean: 4.87)		
Walk < 2	1 (reference)	1 (reference)
2 ≤ Walk < 4	0.95 (0.29–3.16)	0.92 (0.27–3.14)
4 ≤ Walk	1.40 (0.47–4.19)	1.70 (0.55–5.22)
Up (stand + walk) (mean: 6.50)		
Up ≤ 4	1 (reference)	1 (reference)
4 < Up	2.80 (1.08–7.25)	3.40 (1.27–9.09)
Sit (mean: 2.20)		
Sit < 2	1 (reference)	1 (reference)
2 ≤ Sit < 4	0.82 (0.43–1.55)	0.64 (0.33–1.25)
4 ≤ Sit	0.72 (0.36–1.45)	0.58 (0.27–1.21)
Rest (mean: 0.23)		
Stand < 0.2	1 (reference)	1 (reference)
0.2 ≤ Stand	0.93 (0.53–1.64)	0.92 (0.51–1.66)

* Univariate logistic regression.
† Multiple logistic regression (adjusted for age, pregnancy, stocking period).
CI, confidence interval; OR, odds ratio.

pre-existing musculoskeletal diseases through exposure to occupational risk factors is also recognized as an occupational disease and is covered by Worker's compensation. Therefore, the objective determination of VV-related occupational risk factors will serve as a basis for the recognition of VVs as an occupational disease. According to the Korea Workers' Compensation & Welfare Service, the worker's occupation of approved VVs were assembly workers in the automobile industry, sales workers in the wholesale and retail industry, cooks, machine workers, hairdressers, school teachers, etc. However, they were nonhealthcare workers. In that respect, the current state of research, mostly cross-sectional studies incapable of deriving cause-and-effect relationships, does not provide enough objectivity to verify VV-related occupational risk factors. A follow-up study on occupational risk factors for VVs is necessary, with a more representative and stable cohort study population.

5. Conclusion

This study was carried out to determine the occupational risk factors for VVs and their prevalence in the nursing workforce, a high-risk occupational group. To achieve this end, we performed Doppler ultrasonography on all the participants for objective diagnosis before analyzing the occupational risk factors on the basis of a questionnaire survey. The results verified that despite a low average age and short duration of successive service, prolonged work in a standing position was positively associated with the incidence of VVs. Based on the results of this study, a follow-up cohort study will be needed; the primary focus must be the clarification of the cause-and-effect relationship between work position and occurrence of VVs in order to establish an objective rationale for recognizing lower-limb VVs as an occupational disease in Republic of Korea.

Conflicts of interest

All authors have no conflicts of interest to declare.

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