ลักษณะการใช้ถุงมือยางทางการแพทย์ชนิดลาเท็กซ์ของบุคลากรสุขภาพและความสัมพันธ์กับภาวะภูมิแพ้ลาเท็กซ์

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บทคัดย่อ

ถุงมือยางทางการแพทย์ชนิดลาเท็กซ์ (ถุงมือยางฯ) ก่อให้เกิดภูมิแพ้ลาเท็กซ์ชนิดภูมิไวเกินประเภทที่หนึ่ง (อาการภูมิแพ้ฯ) และพบปัจจัยที่สำคัญ ได้แก่ ปัจจัยส่วนบุคคลและลักษณะการใช้ถุงมือยางฯ อย่างไรก็ตาม พบจำนวนการศึกษาในประเทศไทยและแถบเอเชียตะวันออกเฉียงใต้ค่อนข้างจำกัด การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาลักษณะการใช้ถุงมือยางฯ ของบุคลากรทางการแพทย์ที่มีความสัมพันธ์กับการเกิดอาการภูมิแพ้ฯ การศึกษานี้เป็นการวิจัยวิทยาการระบาดเชิงวิเคราะห์ภาคตัดขวางโดยใช้ข้อมูลทุติยภูมิจากกลุ่มตัวอย่าง ได้แก่ บุคลากรที่มีอาการน่าจะเป็นภูมิแพ้ฯ จำนวน 45 ราย และไม่มีอาการน่าจะเป็นภูมิแพ้ฯ จำนวน 343 ราย เครื่องมือวิจัย คือ ฐานข้อมูลของแบบสอบถามชนิดตอบเอง โดยนำลักษณะการใช้ถุงมือและอาการภูมิแพ้ฯ มาวิเคราะห์ด้วยสถิติเชิงพรรณนาและการถดถอยโลจิสติก ผลการศึกษาพบว่ากลุ่มบุคลากรที่มีอาการน่าจะเป็นภูมิแพ้ฯ มีสัดส่วนประวัติผิวหนังอักเสบที่มือ (p<0.001) โรคภูมิแพ้ชนิดอโธปิก (p=0.004) และใช้ถุงมือยางที่สกัดโปรตีนได้มาก (p=0.002) สูงกว่ากลุ่มที่ไม่มีอาการฯ อย่างมีนัยสำคัญทางสถิติ ปัจจัยส่วนบุคคลและลักษณะการใช้ถุงมือยางฯ ที่สัมพันธ์กับการเกิดอาการน่าจะเป็นภูมิแพ้ฯ ได้แก่ โรคภูมิแพ้ชนิดอโธปิก (Adjusted OR = 2.34, 95%CI: 1.03, 5.35) ประวัติผิวหนังอักเสบ (Adjusted OR = 2.66, 95%CI: 1.27, 5.57) สวมถุงมือยางชนิดมีแป้ง (Adjusted OR = 2.31, 95%CI: 1.61, 8.71) และสวมถุงมือยางที่สกัดโปรตีนได้มาก (Adjusted OR = 2.21, 95%CI: 1.08, 4.58) เมื่อวิเคราะห์ปัจจัยลักษณะการใช้ถุงมือยางฯ ที่มีความสัมพันธ์กับอาการแพ้ลาเท็กซ์จริง พบว่าการสวมถุงมือยางฯ ที่สกัดโปรตีนได้มากสัมพันธ์กับอาการแพ้ลาเท็กซ์จริงอย่างมีนัยสำคัญทางสถิติ (Adjusted OR = 2.36, 95%CI: 1.98, 6.20) และเมื่อวิเคราะห์เฉพาะกลุ่มที่ไม่มีประวัติผื่นอักเสบนำพบว่าการสวมถุงมือยางฯ ที่สกัดโปรตีนได้มากสัมพันธ์กับอาการแพ้ลาเท็กซ์จริงอย่างมีนัยสำคัญทางสถิติ (Adjusted OR = 5.67, 95%CI: 1.59, 37.0) สรุปผลการวิจัย ปัจจัยหลักของการเกิดอาการภูมิแพ้ลาเท็กซ์ชนิดภาวะภูมิไวเกินของบุคลากรทางการแพทย์ของโรงพยาบาลแห่งหนึ่ง ได้แก่ การสวมถุงมือยางทางการแพทย์ที่สกัดโปรตีนได้มาก

คำสำคัญ: โปรตีนที่ละลายน้ำได้; ถุงมือลาเท็กซ์; ภาวะแพ้ลาเท็กซ์; บริการสุขภาพ; บุคลากรสุขภาพ

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Characteristics of latex medical glove usage among health personnel and association with latex allergy

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Abstract

Latex medical gloves have been shown to induce Type I hypersensitivity latex allergy (latex allergy symptoms), with significant contributing factors including personal factors and glove usage characteristics. However, studies from Thailand and Southeast Asia are relatively limited. This study aimed to investigate the characteristics of glove usage among health personnel associated with the development of latex allergy symptoms. This study was a cross-sectional analytical epidemiological study utilizing secondary data, including 45 health personnel with and 343 without probable symptoms of latex allergy. Data were collected from databases of self-administered questionnaires, which included variables on glove usage characteristics and latex allergy symptoms. The analysis was conducted using descriptive statistics and multiple logistic regression. The results indicated that the group with probable symptoms of latex allergy had a significantly higher proportion of health personnel with a history of hand dermatitis ($p < 0.001$), atopic diseases ($p = 0.004$), and usage of gloves with high extractable protein weight ($p = 0.002$) compared to those without probable symptoms of latex allergy. Personal factors and glove usage characteristics associated with probable symptoms of latex allergy included: atopic diseases (Adjusted OR = 2.34, 95% CI: 1.03, 5.35), history of hand dermatitis (Adjusted OR = 2.66, 95% CI: 1.27, 5.57), use of powdered latex gloves (Adjusted OR = 2.31, 95% CI: 1.61, 8.71), and use of gloves with high extractable protein weight (Adjusted OR = 2.21, 95% CI: 1.08, 4.58). The analysis of factors contributing to definite symptoms of latex allergy revealed that gloves with high extractable protein weight were statistically significantly associated with definite symptoms of latex allergy (Adjusted OR = 2.36, 95% CI: 1.98, 6.20). When the analysis was conducted only on the subgroup without a history of dermatitis, gloves with high extractable protein weight remained statistically significantly associated with definite symptoms of latex allergy (Adjusted OR = 5.67, 95% CI: 1.59, 37.0). In conclusion, the main factor contributing to the development of latex hypersensitivity symptoms among tertiary-level health personnel in hospitals was the utilization of high extractable protein weight medical latex gloves.

Keywords: extractable protein; latex gloves; latex allergy; healthcare; health personnel

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Introduction

Widespread use of latex gloves has been linked to a rising incidence of latex allergy, particularly Type I hypersensitivity reactions, triggered by 15 identified latex protein allergens-posing a major issue in occupational medicine. Latex allergy affects an estimated 9.7% of individuals working in healthcare settings[1,2]. A study in Thailand reported that 24% of nurses experienced symptoms associated with latex glove use[3]. To address this issue, replacing powdered latex gloves with latex-free gloves has significantly reduced the prevalence of latex allergy, as demonstrated in a U.S. study, where the rates declined from 42% to 29%[4]. However, this intervention is cost prohibitive in developing countries. Therefore, investigating the usage characteristics of latex gloves that influence the development of latex allergy while continuing the use of latex gloves may be a more practical approach to prevent latex allergy in these settings[5].

The primary risk factor for developing latex allergy is exposure to latex protein allergens, indicating that usage characteristics (i.e., frequency and duration) may play a significant role. A Thailand study identified that wearing latex gloves for more than 18 hours per week and more than three pairs per day were risk factors for latex allergy (OR, 3.69; 95% CI, 1.73, 7.87)[6]. Personal history among health personnel may also contribute to latex allergy, including a history of atopic diseases (OR 6.46; 95% CI, 1.87, 47.98) and a history of hand dermatitis (OR 2.70; 95% CI, 1.14, 6.24)[5-7]. Furthermore, a study conducted in Khon Kaen, Thailand, suggested that extractable protein weight might be the most significant risk factor, among frequency, duration, and personal history (crude OR 0.24; 95% CI 0.06, 0.74; and adjusted OR 0.18; 95% CI 0.04, 0.86). However, there is a limitation in studying the extractable protein weight in latex gloves, as previous studies did not use high-protein-weight latex gloves to evaluate latex allergy[8]. This study investigated the factors related to glove usage characteristics and latex hypersensitivity symptoms among health personnel. The personal factors and glove usage characteristics are presented in Figure 1.

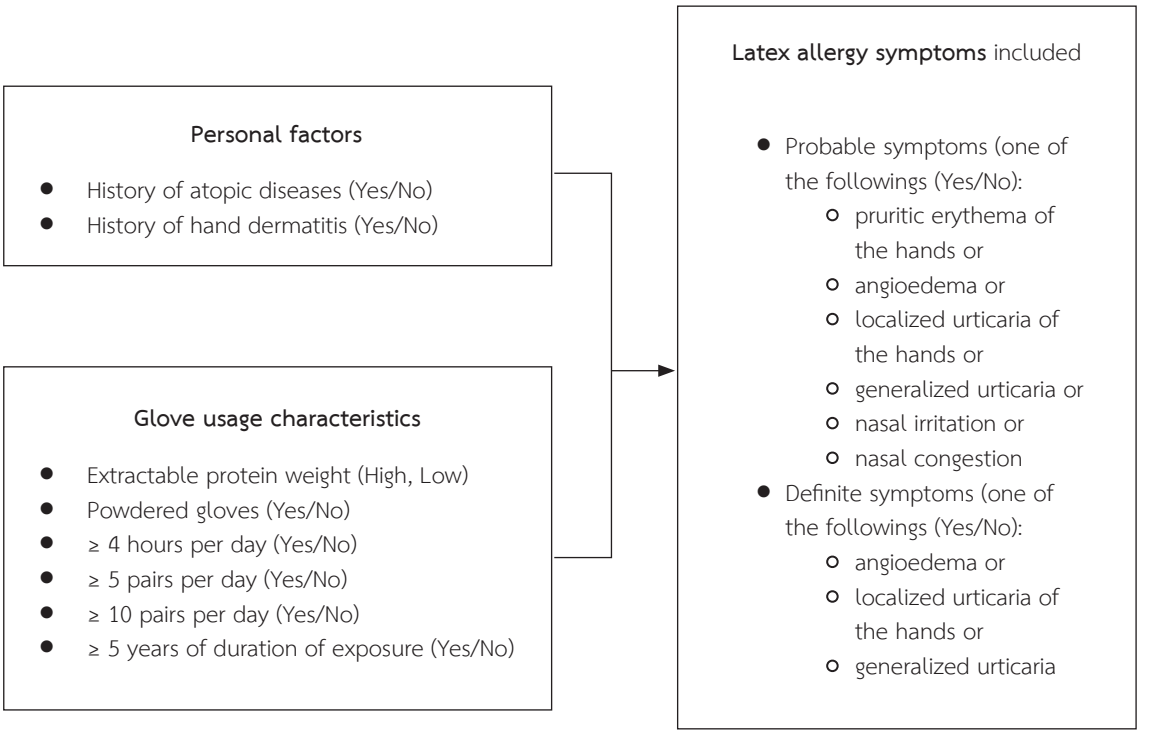

Figure 1 Conceptual framework of latex glove usage characteristics contributing to probable and definite symptoms of latex allergy

Research design

This study was a cross-sectional analytical epidemiological study utilizing secondary data from two previous databases by Ngamchokwathana et al[8]. and Luengtongkam et al[9].

Study population and sample

This study included two groups of participants: (1) health personnel with probable symptoms of latex allergy and (2) health personnel without probable symptoms of latex allergy. The classification of probable symptoms of latex allergy was adapted from a previous study by Ngamchokwathana et al[8]. Symptoms indicative of a probable latex allergy included pruritic erythema of the hands, angioedema, localized urticaria of the hands, generalized urticaria, nasal irritation, and/or nasal congestion occurring within 30 minutes to 24 hours after exposure to latex gloves. Symptoms suggestive of a definite latex allergy included angioedema, localized urticaria of the hands, and/or generalized urticaria within the same timeframe after latex glove exposure[8]. Health personnel classified as not having probable symptoms of latex allergy were those exposed to latex gloves but who did not exhibit any of the aforementioned symptoms.

The sample size calculation was based on the extractable protein weight (high) as the primary factor of interest to determine its proportion in individuals with probable and no probable symptoms of latex allergy. Using WinPepi version 11.65, with a 1:10 ratio, 5% significance level, and 80% power, the proportion of high extractable protein weight was detected in 6.9% of symptomatic and 2.4% of asymptomatic individuals in the previous study[10], the required sample size was determined to be 343 participants per group. However, with the limited number of the existing number of health personnel acquired the probable symptoms of latex allergy 45 health personnel with probable symptoms of latex allergy and 343 without probable symptoms of latex allergy were recruited. The samples were randomly recruited from two previous databases by Ngamchokwathana et al[8]. and Luengtongkam et al[9]. using the Random function in SPSS for Windows version 28.0.

Research tools and data collection

The research tools utilized in this study were databases obtained with the approved permission of Ngamchokwathana et al[8]. and Luengtongkam et al[10]. These databases provided the variables used for analysis, including personal factors (age, sex, and job title), medical history (history of hand dermatitis and history of atopic diseases, including allergic rhinitis, asthma, and/or atopic eczema), and characteristics of latex medical glove usage (high or low extractable protein weight latex gloves, powdered or non-powdered latex gloves, number of glove pairs used per day, hours of glove use per day, and years of exposure). Additionally, self-reported cutaneous (pruritic erythema of the hands, angioedema, localized urticaria of the hands, generalized urticaria) and respiratory symptoms (nasal irritation and nasal congestion) associated with the use of medical latex gloves, as well as probable and definite symptoms of latex allergy, were included. These variables were derived from responses to a self-administered questionnaire incorporated into both databases. All of these variables were utilized to analyze the association between glove usage characteristics and latex allergy symptoms among health personnel. Data from these databases were initially entered into Microsoft Excel and subsequently imported into SPSS for Windows version 28.0 for analysis. Any errors identified during the data screening process were addressed as missing data before proceeding with the statistical analysis.

Data and statistical analyses

Data was managed by SPSS for Windows version 28.0. Descriptive statistics were used to analyze the demographics, personal factors, and glove usage characteristics of the probable and no probable symptoms of latex allergy groups. Frequency and percentage distributions were reported for categorical variables, while medians with interquartile ranges (IQR) were calculated for continuous variables, including the number of

gloves used per day, hours of glove use per day, years of exposure, and age. To assess the associations between personal factors, glove usage characteristics, and probable symptoms of latex allergy, the Chi-square test and Fisher's exact test were utilized to compute *p*-values, crude odds ratios (OR), and 95% confidence intervals (CI). However, as probable symptoms of latex allergy may be misinterpreted as either Type I hypersensitivity or contact dermatitis, further analysis was conducted using definite symptoms of latex allergy-defined as angioedema, localized urticaria of the hands, or generalized urticaria occurring within 30 minutes to 24 hours after glove exposure. This additional analysis aimed to establish a more definitive association between personal factors and glove usage characteristics. Crude OR, 95% CI, and *p*-values were calculated using OpenEpi software.

Multiple logistic regression analysis was performed to evaluate the associations between personal factors, glove usage characteristics (based on the conceptual framework in Figure 1), and the development of probable and definite symptoms of latex allergy while adjusting for potential confounders. Additionally, to account for the potential misclassification of hand dermatitis symptoms as Type I hypersensitivity symptoms, a subgroup analysis was conducted on health personnel without a history of hand dermatitis who exhibited definite symptoms of latex allergy. Adjusted odds ratios (AOR), 95% confidence intervals (CI), and *p*-values were reported using SPSS for Windows version 28.0.

Ethical consideration

The study results were presented in an aggregated format that did not disclose specific study populations, organizations, brands, or trademarks. This study was reviewed and approved by the Khon Kaen University Ethics Committee for Human Research (HE661408), and Khon Kaen Hospital (KEMOU66019).

Results

The demographic results indicated that the group with latex allergy symptoms had a significantly higher proportion of individuals with a history of dermatitis ($p < 0.001$), atopic diseases ($p = 0.004$), and usage of gloves with high extractable protein weight ($p = 0.002$) than those without latex allergic symptoms.

Table 1 Comparison of demographic data, personal factors, glove characteristics, and glove use factors between the probable and no probable symptoms of latex allergy among health personnel

Demographic data, personal factors, and glove use factors	Probable symptoms of latex allergy n = 45 % (n)	No probable symptoms of latex allergy n = 343 % (n)	*p*-value
Age (years) median (IQR)	28 (25, 34)	30 (26, 36)	0.130
Sex			
Male (n = 30)	2.2 (1)	8.5 (29)	0.231
Female (n = 358)	97.8 (44)	91.5 (314)	
Job title			
Registered nurse (n = 264)	77.8 (35)	66.8 (229)	
Nurse assistant (n = 48)	13.3 (6)	12.2 (42)	
Medical technologist (n = 41)	8.9 (4)	10.8 (37)	0.140
Nursing aids (n = 35)	0 (0)	10.2 (35)	
Personal factors			
History of hand dermatitis (n = 68)	40.0 (18)	14.6 (50)	<0.001
History of atopic diseases (n = 233)	80.0 (36)	57.4 (197)	0.004
Gloves characteristics			
High extractable protein-weight latex gloves (n = 207)	71.1 (32)	51.0 (175)	0.002
Powdered latex gloves (n = 251)	88.8 (40)	61.5 (211)	0.752
Gloves usage factors			
Hours of gloves exposure per day (hours) median (IQR)	7 (3,9)	8 (5,10)	0.510
Number of gloves used per day (pairs) median (IQR)	10 (5,14)	10 (6,15)	0.729
Duration of glove exposure (years) median (IQR)	6 (4,10)	8 (5,13)	0.144

Among those with cutaneous symptoms on the hands, pruritic erythema was the most prevalent (77.8%), followed by localized (57.8%) and generalized urticaria (26.7%). Angioedema was the least common cutaneous symptom (4.4% of patients) observed. Among non-cutaneous symptoms, nasal irritation was more frequently reported (6.7%) than nasal congestion (4.4%) (Figure 2). Furthermore, none of the health personnel who reported non-cutaneous symptoms exhibited any cutaneous symptoms.

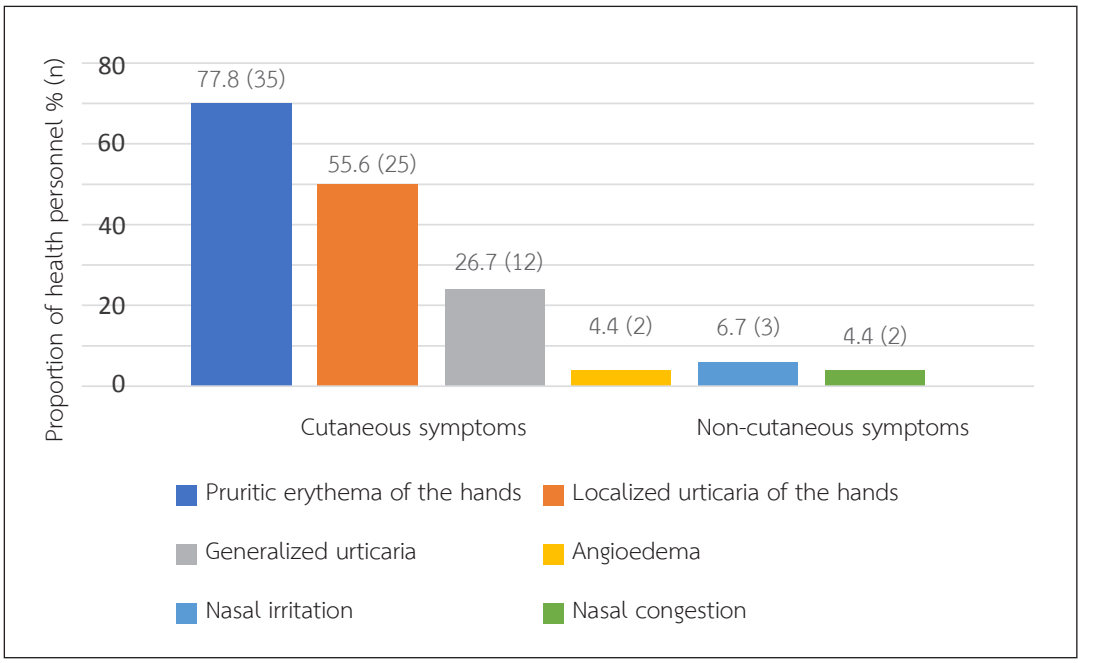

Figure 2 Proportion of health personnel exhibiting probable symptoms of latex allergy (n = 45)

The use of high-extractable protein-weight latex gloves (crude OR 2.35, 95% CI: 1.21, 4.79) and powdered latex gloves (crude OR 4.98, 95% CI: 2.33, 14.59) was significantly associated with probable symptoms of latex allergy. Personal factors, including a history of hand dermatitis (crude OR 3.89, 95% CI: 1.97, 7.59) and atopic diseases (crude OR 2.96, 95% CI: 1.42, 6.68), were also associated with probable symptoms of latex allergy. However, glove use duration (≥4 hours/day), number of pairs used per day (≥5 or ≥10 pairs/day), and cumulative exposure over five years were not significant. Multiple logistic regression confirmed these findings, with high-extractable protein latex gloves (adjusted OR 2.21, 95% CI: 1.08, 4.58, p = 0.003), powdered latex gloves (adjusted OR 2.31, 95% CI: 1.61, 8.71, p = 0.002), history of hand dermatitis (adjusted OR 2.66, 95% CI: 1.27, 5.57, p = 0.009), and atopic diseases (adjusted OR 2.34, 95% CI: 1.03, 5.35, p = 0.043) remained significant. Other glove usage factors were not significantly associated (p > 0.05) (Table 2).

Table 2 The association between personal and glove usage characteristics and probable symptoms of latex allergy

Personal and glove usage characteristics		Probable symptoms of latex allergy n = 45 % (n)	Crude OR (95%CI)	Adjusted OR (95%CI)	*p*-value
Extractable protein latex gloves	High protein (n = 207)	15.5 (32)	2.35 (1.21, 4.79)	2.21 (1.08, 4.58)	0.003
	Low protein (n = 181)	7.2 (13)			
Powdered latex gloves	Yes (n = 251)	15.9 (40)	4.98 (2.33, 14.59)	2.31 (1.61, 8.71)	0.002
	No (n = 137)	3.6 (5)			
History of hand dermatitis	Yes (n = 68)	26.5 (18)	3.89 (1.97, 7.59)	2.66 (1.27, 5.57)	0.009
	No (n = 320)	8.4 (27)			
History of atopic diseases	Yes (n = 233)	15.5 (36)	2.96 (1.42, 6.68)	2.34 (1.03, 5.35)	0.043
	No (n = 155)	5.8 (9)			
Gloves usage ≥ 4 hours per day	Yes (n = 303)	9.2 (28)	0.41 (0.21, 1.80)	0.31 (0.15, 1.65)	0.102
	No (n = 85)	20.0 (17)			
Gloves usage ≥ 5 pairs per day	Yes (n = 338)	11.8 (40)	1.21 (0.48, 3.62)	1.46 (0.45, 4.81)	0.531
	No (n = 50)	10.0 (5)			
Gloves usage ≥ 10 pairs per day	Yes (n = 249)	11.2 (28)	0.91 (0.48, 1.76)	0.66 (0.30, 1.43)	0.291
	No (n = 139)	12.2 (17)			
Gloves usage ≥ 5 years of duration of exposure	Yes (n = 290)	10.7 (31)	0.72 (0.37, 1.45)	0.68 (0.32, 1.41)	0.294
	No (n = 98)	14.3 (14)			

Definite symptoms of latex allergy were significantly associated with high-extractable protein latex gloves (crude OR 2.36, 95% CI: 1.98, 6.20) and powdered latex gloves (crude OR 3.03, 95% CI: 1.08, 10.50). Personal risk factors included a history of hand dermatitis (crude OR 4.20, 95% CI: 1.77, 9.80) and atopic diseases (crude OR 2.20, 95% CI: 1.88, 6.15). However, glove use duration (≥4 hours/day), the number of pairs used per day (≥5 or ≥10 pairs/day), and cumulative exposure over five years were not significant. Multiple logistic regression confirmed these associations with high-extractable protein latex gloves (adjusted OR 2.68, 95% CI: 2.17, 7.19, $p = 0.005$) and powdered latex gloves (adjusted OR 2.87, 95% CI: 1.04, 9.96, $p = 0.008$). A history of hand dermatitis (adjusted OR 3.50, 95% CI: 1.39, 8.85, $p = 0.008$) and atopic diseases (adjusted OR 2.73, 95% CI: 2.62, 6.84, $p = 0.029$) also remained risk factors, whereas other glove usage factors showed no significant associations ($p > 0.05$) (Table 3).

Table 3 Personal and glove usage characteristics associated with definite symptoms of latex allergy

Personal and glove usage characteristics		Definite symptoms of latex allergy n = 25 % (n)	Crude OR (95%CI)	Adjusted OR (95%CI)	*p*-value
Extractable protein latex gloves	High protein (n = 207)	8.7 (18)	2.36 (1.98, 6.20)	2.68 (2.17, 7.19)	0.005
	Low protein (n = 181)	3.9 (7)			
Powdered latex gloves	Yes (n = 251)	8.4 (21)	3.03 (1.08, 10.50)	2.87 (1.04, 9.96)	0.008
	No (n = 137)	2.9 (4)			
History of hand dermatitis	Yes (n = 68)	16.1 (11)	4.20 (1.77, 9.80)	3.50 (1.39, 8.85)	0.008
	No (n = 320)	4.4 (14)			
History of atopic diseases	Yes (n = 233)	8.2 (19)	2.20 (1.88, 6.15)	2.73 (2.62, 6.84)	0.029
	No (n = 155)	3.9 (6)			

Table 3 Continued

Personal and glove usage characteristics		Definite symptoms of latex allergy n = 25 % (n)	Crude OR (95%CI)	Adjusted OR (95%CI)	*p*-value
Gloves usage ≥ 4 hours per day	Yes (n = 303)	6.3 (19)	0.88 (0.35, 2.48)	0.87 (0.31, 2.41)	0.781
	No (n = 85)	7.1 (6)			
Gloves usage ≥ 5 pairs per day	Yes (n = 338)	6.5 (22)	1.09 (0.34, 4.74)	0.59 (0.11, 3.25)	0.546
	No (n = 50)	6.0 (3)			
Gloves usage ≥ 10 pairs per day	Yes (n = 249)	7.6 (19)	1.83 (0.73, 5.12)	1.95 (0.54, 7.01)	0.306
	No (n = 139)	4.3 (6)			
Gloves usage ≥ 5 years of duration of exposure	Yes (n = 290)	6.9 (20)	1.38 (0.52, 4.22)	1.35 (0.47, 3.83)	0.579
	No (n = 98)	5.1 (5)			

Among health personnel without a history of hand dermatitis in the definite symptoms of latex allergy groups, the use of high-extractable protein latex gloves was significantly associated with definite symptoms of latex allergy (crude OR 5.49, 95% CI: 1.36, 36.58), whereas other personal factors and glove usage characteristics showed no significant associations. Multiple logistic regression analysis confirmed this finding, with high-extractable protein latex gloves remaining significantly associated (adjusted OR 5.67, 95% CI: 1.59, 36.99), while other factors continued to show no significant association (Table 4).

Table 4 Association between personal and glove usage characteristics and definite symptoms of latex allergy (only health personnel who had no history of hand dermatitis)

Personal and glove usage characteristics		Definite symptoms of latex allergy n = 14 % (n)	Crude OR (95%CI)	Adjusted OR (95%CI)	*p*-value
Extractable protein latex gloves	High protein (n = 207)	5.8 (12)	5.49 (1.36, 36.58)	5.67 (1.59, 36.99)	0.009
	Low protein (n = 181)	1.1 (2)			
Powdered latex gloves	Yes (n = 251)	4.8 (12)	3.38 (0.84, 22.56)	3.10 (0.51, 22.14)	0.089
	No (n = 137)	1.5 (2)			
History of atopic diseases	Yes (n = 233)	4.3 (10)	1.69 (0.53, 6.32)	2.63 (0.77, 9.02)	0.125
	No (n = 155)	2.6 (4)			
Gloves usage ≥ 4 hours per day	Yes (n = 303)	4.0 (12)	1.71 (0.42, 11.45)	1.63 (0.34, 7.73)	0.539
	No (n = 85)	2.4 (2)			
Gloves usage ≥ 5 pairs per day	Yes (n = 338)	3.6 (12)	0.88 (0.21, 5.97)	0.56 (0.08, 3.72)	0.548
	No (n = 50)	4.0 (2)			
Gloves usage ≥ 10 pairs per day	Yes (n = 249)	3.6 (9)	1.01 (0.33, 3.37)	1.37 (0.35, 5.34)	0.652
	No (n = 139)	3.5 (5)			
Gloves usage ≥ 5 years of duration of exposure	Yes (n = 290)	4.1 (12)	2.07 (0.51, 13.84)	2.06 (0.44, 9.64)	0.361
	No (n = 98)	2.0 (2)			

Discussion

The objective of this cross-sectional analytical study was examining the association between current symptoms of latex allergy among health personnel and their exposure characteristics, including personal factors and latex glove usage characteristics. Although the samples of the asymptomatic group were more extensive, the analyses of the studied factors revealed sufficient evidence to determine a significant association with the sample size. The current study found no significant differences in demographic data, daily hours of glove exposure, daily number of gloves used (pairs), or duration of glove exposure (years) between the symptomatic and asymptomatic groups. These findings likely reflect the similar work characteristics of the two groups studied. Consequently, the key covariate factors related to allergy risk were comparable, minimizing the likelihood of significant confounding effects on the primary results regarding the latex allergy symptoms. Among the five health personnel who reported non-cutaneous symptoms (nasal irritation and nasal congestion) shown in Figure 2, none reported a history of atopic diseases. This suggests that misinterpretation between allergic rhinitis and non-cutaneous symptoms was unlikely in these cases.

Among the personal factors, a history of hand dermatitis (crude OR 3.89, 95% CI: 1.97, 7.59) and a history of atopic diseases (crude OR 2.96, 95% CI: 1.42, 6.68) were significantly associated with the development of probable symptoms of latex allergy. A compromised skin barrier among those who reported hand dermatitis, causing higher chances of latex allergen exposure, might explain the higher latex allergy symptoms among hand dermatitis cases[7]. In addition, a history of atopic dermatitis also showed a significant association due to genetic predisposing factors[7,11-13]. Both factors also demonstrated a significant association when controlling for other variables, with adjusted ORs of 2.66 (95% CI: 1.27, 5.57) and 2.34 (95% CI: 1.03, 5.35), respectively. These findings are consistent with those of a Thai study that identified a history of hand dermatitis (adjusted OR 2.77, 95% CI: 1.11, 6.96) and atopic diseases (adjusted OR 0.91, 95% CI: 1.11, 6.96) as risk factors for latex allergy symptoms[8].

Regarding glove usage characteristics, our study demonstrated that the use of powdered latex gloves (crude OR 4.98, 95% CI: 2.33, 14.59) and high-extractable protein weight latex gloves (crude OR 2.35, 95% CI: 1.21, 4.79) were significant factors that contributed to the development of probable symptoms of latex allergy. Glove powder may impair skin integrity by inducing dryness and disturbing the skin's protective barrier, which can enhance exposure to latex allergens and raise the potential for allergic responses[14]. In addition, powdered latex gloves can release latex aeroallergens into the workplace environment, further increasing exposure and contributing to a higher prevalence of latex allergy symptoms[15]. Baur et al. specifically observed a strong link between airborne latex allergen levels and the type of gloves used,

highlighting a notable difference between powdered and non-powdered latex gloves[16]. A study in the United States observed a reduction in the prevalence of latex-related symptoms from 42% to 29% following the substitution of powdered latex gloves with non-powdered latex and synthetic rubber gloves[4]. Our findings are consistent with those of these studies.

However, the association between a history of hand dermatitis and latex allergy symptoms should be interpreted with caution, as health personnel in our study might have faced challenges in differentiating between other types of contact dermatitis and symptoms of latex allergy. The additives in latex gloves, combined with irritant properties of powdered gloves, could lead to both allergic and irritant contact dermatitis, producing symptoms like pruritic erythema that closely resemble those of a latex allergy[8]. This overlap might explain the higher proportion of pruritic erythema among health personnel with a history of hand dermatitis. Studies indicated that a majority of individuals experiencing glove-related skin problems (93.2%) were diagnosed with contact dermatitis, while only a small proportion had contact dermatitis accompanied by latex-induced contact urticaria. This suggested the possibility of misinterpreting latex allergy as contact dermatitis, suggesting that both conditions may occur together. Therefore, pruritic erythema and a history of hand dermatitis should be managed[8,17]. To control the influence of pruritic erythema, therefore the current study used angioedema, localized urticaria of the hands, and generalized urticaria, for analyzing their association with personal factors and characteristics of glove usage. Therefore, the results demonstrated a more explicit association between glove usage characteristics and latex allergy symptoms. Similarly, this study compared two hospitals: one using non-powdered latex gloves and the other using powdered ones. When angioedema and urticaria were used as indicators, the decline in symptoms was more pronounced (50% in the powdered glove group vs. 13% in the non-powdered glove group) than in pruritic erythema (3% in the powdered glove group vs. 16% in the non-powdered glove group)[8].

To further control the influence of a history of hand dermatitis, health personnel who reported no history of hand dermatitis were selected for analysis to examine the association between personal factors, glove usage characteristics, and definite symptoms of latex allergy. After controlling for pruritic erythema and a history of hand dermatitis, high-extractable protein-weight latex gloves remained the only significant factor associated with definite symptoms of latex allergy (crude OR 5.49, 95% CI: 1.36, 36.58; adjusted OR 5.67, 95% CI: 1.59, 36.99). This association may result from latex protein exposure through skin contact or inhalation of latex-laden cornstarch from powdered gloves, triggering Type I hypersensitivity. Powdered gloves can also irritate the skin and enhance allergen penetration. The higher prevalence of latex allergy in the high-extractable protein group

underscored the role of inhaled latex aeroallergens in allergic reactions[14,18]. Higher extractable protein weight increased latex allergen binding to immune cells, triggering Type I hypersensitivity and latex allergy symptoms in health personnel[15,19-21]. This study aligns with a Canadian study showing a reduction in latex allergy symptoms from 44% to 27% after switching to low-extractable protein gloves[22] and a Thai study reporting higher symptoms in the high-extractable protein group (62.5% vs. 37.5%)[23]. The findings also suggest challenges in distinguishing latex allergy from contact dermatitis. Additionally, the results confirm that angioedema and urticaria are specific to Type I hypersensitivity, supporting their use in self-administered questionnaires without laboratory investigations[5,7,8,17,24].

The current study found no significant differences in glove use factors (hours per day, pairs per day, and duration since first exposure) between the probable and no probable symptoms of latex allergy groups, as well as between the definite and no definite symptoms of latex allergy groups. Our results were inconsistent with other studies, as other studies reported differences in glove use factors between the two groups[6,25,26]. These findings suggest a non-dose-response relationship for Type I hypersensitivity, indicating that increased exposure intensity alone is not a significant risk factor for the development of latex allergy symptoms. This supports the idea that increased exposure to latex does not reliably predict sensitization, highlighting that allergic reactions can occur even at minimal exposure levels[24]. These findings are inconsistent with those of a study conducted in Thailand, which identified using more than 8 pairs of gloves per day and wearing gloves for more than 6 hours per day as risk factors for latex allergy symptoms. This discrepancy might be due to differences in work characteristics between the groups in that study, whereas the groups in our study had similar work characteristics[8,27,28].

Although the current study offers valuable insights, it has a few limitations. Being a cross-sectional analytical study, this research might have been affected by selection bias-especially the healthy worker effect-where individuals who experienced latex allergy symptoms might have already left their jobs prior to data collection due to reactions associated with latex glove use. Additionally, reporting bias might have been present due to the self-administered questionnaire, with the potential for selective underreporting in the low-and selective overreporting in the high-extractable protein groups[28]. The association between personal factors and glove usage characteristics and definite symptoms of latex allergy among health personnel without a history of hand dermatitis (Table 4) showed wider 95% confidence intervals (CIs) for both crude and adjusted odds ratios compared to those in Table 2 and Table 3. This may be attributed to the smaller sample size in Table 4 relative to the other analyses.

Conclusion and recommendations

The main factor contributing to the development of latex hypersensitivity symptoms among tertiary-level health personnel in a hospital was the use of high extractable protein weights medical latex gloves. Health personnel with a history of hand dermatitis or atopic diseases should be aware of these personal factors and use low-extractable protein gloves to help prevent the development of latex allergy symptoms. Therefore, extractable protein weight could be a key parameter in selecting personal protective equipment for health personnel to prevent the development of hypersensitivity latex allergy symptoms. Future research should consider a randomized controlled trial or a prospective cohort study to build upon the findings of this study. Specifically, comparing health personnel using high versus low extractable protein weight latex gloves and monitoring the incidence of latex allergy across all types of hypersensitivity reactions would provide valuable and clinically relevant insights.

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