# Glove Allergy and Sensitization to Natural Rubber Latex among Nursing Staff at Srinagarind Hospital, Khon Kaen, Thailand

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***Background:*** *According to studies from different countries, the prevalence of natural rubber latex (NRL) sensitization in healthcare workers ranges from 2.9 to 17%. The incidence and prevalence of sensitization and allergy to NRL in Thailand is limited to two studies. There is no study among the high risk healthcare workers.*
***Objectives:*** *1) To estimate the prevalence of natural rubber latex (NRL) glove allergy and NRL sensitization among nurses; 2) To describe its clinical symptoms.*
***Material and Method:*** *Included in the present study were 412 nursing and medical record staff. A self-administered questionnaire was used to collect personal biodata and individual allergy histories to NRL products. Skin prick tests (SPTs) with the commercial NRL allergens; Stallerg nes, S.A, Fresnes, France, and common environmental allergens, were performed.*
***Results:*** *The questionnaire response rate was 88% (412/470), 93% females. The response rate of SPT was 72% (295/412) (95%CI 67.2, 76.0). The prevalence of NRL glove allergic symptoms and NRL sensitization was 24% (95%CI 19.9, 28.1) and 2% (95%CI 0.4, 3.6), respectively. The most frequently reported symptoms among the positive SPT to NRL was angioedema. Five of the six NRL sensitised subjects had had high exposure to NRL.*
***Conclusion:*** *NRL sensitization among Thai nursing staff is less prevalent than in healthcare workers in Europe.*

***Keywords:*** *Natural rubber latex, Latex, Allergy, Nurses, Sensitization, Healthcare worker*

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Natural rubber latex (NRL) gloves were introduced as a protective barrier in the 1900s[1]. In 1979, Nutter reported the first case of rubber causing urticaria, a type I, IgE-mediated, immediate-hypersensitivity[2]. Since then, sensitization to natural rubber latex and rubber additives (*e.g* accelerators, antioxidants, and lubricants) have been reported continuously[3-7]. Clinical symptoms reported include contact urticaria, rhinoconjunctivitis, asthma and anaphylaxis[2,4,6,8-11]. During the last two decades, awareness of the risk of transmission of HIV, hepatitis B and C viruses from blood and body fluid has been a major influence in the increased use of NRL gloves among healthcar workers, thus increasing the potential for sensitization to NRL.

A number of studies concerning NRL sensitization and allergy among healthcare workers have been conducted[12-33]; mostly in Europe and the USA, where the prevalence of NRL allergy ranges between 2.5 and 22 percent[6,13-26,28-41].The wide variation is likely due

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to differences in definition, methodology, glove allergen concentration and exposure duration. However, several studies published between 1999 and 2003 indicate a low prevalence of NRL sensitization and NRL allergy[11,12,14,17,20,22,23,27,31,42], while another study reported the prevalence of NRL glove allergy among hairdressers at 18%[43].

The incidence and prevalence of sensitization and allergy to NRL in Thailand is limited to two studies. One was conducted among rubber-tree tappers and NRL glove factory workers. In that group, the prevalence of sensitization was between 1.3 and 1.7 percent, respectively[44]. The other study was conducted among healthcare personnel, where prevalence of NRL sensitization was 3.13[45].The exact prevalence of NRL allergy among healthcare workers is not known.

NRL is a measurable aeroallergen[46,47] and the asthmatic response to NRL in sensitized individuals is a function of duration of exposure and varies widely between individuals[48]. The authors explored the effect of allergen concentration in the air based on prevalence of NRL sensitization. The authors did not measure NRL particles in the air; the air concentration level is dependant on many other factors including the gloves content of NRL protein, the ambient temperature, the way the gloves are worn or snapped into place, ventilation of the environment. The aim of the present study was to estimate the prevalence of nature rubber latex (NRL) glove allergy, NRL sensitization and describe its clinical symptoms among nurses at Srinagarind Hospital, Khon Kaen, Thailand. The findings of the present study will be useful for planning and implementing NRL sensitization prevention.

## Material and Method

### *Hospital description*

Srinagarind Hospital is a 770-bed, tertiary-care university hospital. There were 1,812 health care workers, of whom 1,424 were nursing staff (640 Professional nurses, 440 technical nurses and 229 nurse aids); who performed various kinds of nursing care such as injection, dressing, feeding and introduced catheterizing of work areas where the employees use powdered latex gloves and 115 medical recorders who recorded the patients' information and did not wear gloves at all (control group) in Srinagarind Hospital. The 1083 nursing staff and medical recorders who worked 8 hours per day met the inclusion criteria and were willing to participate in the present study.

Srinagarind Hospital is one of the university and tertiary-care hospitals in Thailand, where all NRL gloves used are powdered with cornstarch. Sterile gloves are used for sterile purposes and examination gloves for non-sterile ones.

### *Study population*

This was a cross-sectional study. Subjects included nurses, technical nurses, nurse aids and medical recorders working in Srinagarind Hospital, Thailand. Subjects were recruited from all 14 departments except those persons exposed to glutaraldehyde, formaldehyde or antibiotics. The average pair of NRL gloves used per person per day in each unit during the past twelve months was used as a criterion to classify the staff into three groups: high ($\geq 6$), moderate (1-5) and low ($< 1$) pairs/person/day. The minimum number of samples required in the present study was 470. Proportionate random sampling was employed to select samples from each exposure group. The high, moderate and low exposure groups included 869, 179 and 35 staff, respectively.

### *Questionnaire*

The questionnaire used was written in Thai and was a modified version of one translated by Chaiear et al[44], which was a compilation of the questionnaire developed by Dr. Shutman (California University of San Francisco) for determining the prevalence of NRL allergy and, the European Standard Questionnaire for Occupational Respiratory Diseases and Occupational Asthma (European Community Respiratory Health Survey-Screening Questionnaire, 1986). The first version was used to collect data on sensitization to NRL among rubber-tree tappers and workers in glove factories. The modified version included questions on personal information, NRL use, history of symptoms related to NRL products, work related allergic symptoms and atopic history.

### *Skin prick testing*

The skin prick test (SPT) has a greater sensitivity than the specific IgE test[49]. The SPT was performed by a trained nurse using (a) an NRL reagent (Stallerg nes, SA, Fresnes, France 1:200 w/v), (b) common inhalable allergens including cockroach, Bermuda grass, cat allergen, dog allergen, house dust and *Dermatophagoides pteronyssinus* (Center Laboratory, Inc. Port, Washington, NY), and, (c) a buffer saline (control). A reading on the maximal wheal diameter was made after 15 minutes. A wheal 3 mm larger than that of the saline buffer was considered positive. There was a minimal risk of anaphylaxis while doing the test[50].

***Definitions***

- *Sensitization to natural rubber latex*: Positive response to Stallerg nes SPT.

- *Natural rubber latex Allergy*: Nasal eye or sinus symptoms, rhinorrhea, nausea or vomiting, skin rash, urticaria, flushing, itching, asthma, in severe cases anaphalaxis.

- *Atopy*: Positive response to at least one of the common inhalable allergens used for SPT.

- *Allergic history*: Report of having asthma or allergic symptoms when exposed to pollen, household dust, cat, dog, metal, milk or fruit.

- *Work related allergic symptoms*: During the past 12 months, a report at work of having wheezing, breathlessness, coughing, eye irritation, runny nose, angioedema, urticaria or skin irritation.

***Data handling and statistical analysis***

Data were analysed using SPSS-PC software. Point prevalence of NRL sensitization/allergy with a 95% confidence interval was calculated using a descriptive statistics form. P-value of less than 0.05 and Pearson Chi square test,unpaired t test, Mann-Whitney U test as appropriate were used to compare the characteristics of subjects who had SPT and those with out SPT. Clinical symptoms of NRL allergy were presented in terms of number and percent.

The Ethics Committee of Khon Kaen University, Khon Kaen, Thailand, approved the present protocols. All participants gave consent before entering the study.

## Results

***Participants***

The response rate to the questionnaire was 87.6% (412/470). Most of the respondents were female (93.4%). Respondents averaged 33.4 years of age (SD 6.6). All participants of the duration time of employment were between 1 and 5 years. The high, moderate and low staff exposures presented as proportions from these groups accounted for 39.4% (342/869), 21.1% (38/179) and 28.6% (10/35) of the population, respectively. The respondents included nurses (48.8%), technical nurses (31.1%), nursing aids (15%), medical recorders (2.4%) and others (2.1%). All of the participants were invited to undergo the skin prick tests (SPTs). The response rate to the SPTs was 71.6% (295/412) 95%CI (67.2, 76.0) (Fig. 1).

Most of the participants were non-smokers (94%) and had underlying of house dust mites allergy (46.6%), eczema (31.8%), hay fever (18.4%), food (17.5%), animal dandruff allergy (17.2%) or asthma (9.2%).

***Characteristics of SPT and non-SPT participants***

The characteristics of SPT and non-SPT in terms of mean age, gender and atopic diseases were not significantly different between these two groups. Only duration of employment varied significantly; those who were tested for SPT had worked longer on average than those who were not. (Table 1).

***Work-related symptoms***

Subjects (326) reported at least one allergic symptom during the past 12 months, of whom 233 (56.6%) perceived that their symptoms were caused by workplace exposures. The most frequent symptoms were work-related cough (27.9%), eye irritation (26.7%) and runny nose (23.5%). Other symptoms included breathlessness (19.2%), urticaria (14.1%), wheezing (11.7%) and contact dermatitis (5.1%).

**Table 1.** Characteristics of SPT and Non-SPT participants who nursing staff at the different stages (n = 412)

| Characteristics | SPT (n = 295) | Non-SPT (n = 117) | p-value |
|---|---|---|---|
| Mean age (years, SD) | 33.9 (6.42) | 32.2(6.92) | t-test<br>0.056 |
| Gender | | | |
| Male | 20 (6.8%) | 8 (6.8%) | Pearson $^2$ |
| Female | 275 (93.2%) | 109 (93.2%) | 1.00 |
| Duration of employment (months) | 123 .7 (76.6) | 98.9 (71.3) | Man-Whitney U Test<br>0.02 |
| Atopic diseases | | | |
| Yes | 126 (45.0%) | 41 (36.6%) | Pearson $^2$ |
| No | 154 (55.0%) | 71 (63.4%) | 0.142 |

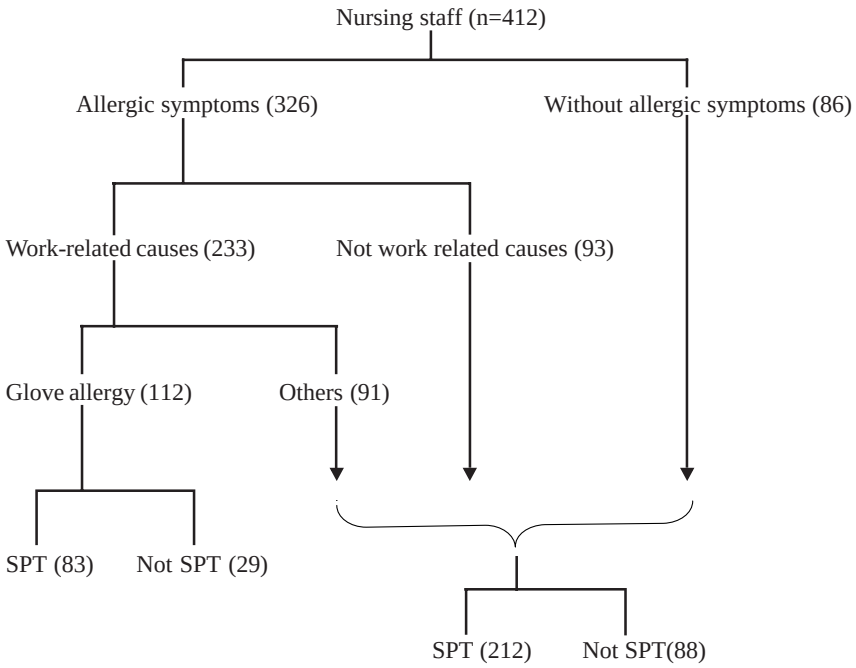


**Fig. 1** Numbers of participants at the different stages

***Prevalence of glove allergic symptoms***

Among the 412 nursing staff who responded to the questionnaire, the most common allergic symptoms, when wearing NRL gloves, were of the skin itch (32%), dry or chapped skin (19.2%), eye irritation (17.7%), redness of skin (15.5%) and runny nose (15.3%). Lip swelling, tightness in the chest and wheezing occurred in less than 5%. Details are shown in Table 2.

***Prevalence of NRL sensitization and NRL allergy***

Among the 295 nurses who underwent SPT to NRL reagent, six (2.03%, 95%CI 0.42, 3.64) had a positive reaction. All six individuals reported NRL allergic symptoms which resulted in NRL allergy prevalence of 2.03% (95%CI 0.42, 3.64). Due to the small number of workers with a positive reaction, the authors were not able to test the relationship between NRL sensitization/allergy and the exposure group, age, gender and atopic history.

***Clinical symptoms of NRL Allergy***

Among those with a positive reaction to the NRL reagent, the most frequently reported symptom was a runny nose. Among those having a negative reaction to NRL reagent, and those who did not undergo the SPT, the most frequently reported symptoms were runny nose and eye irritation (Table 2).

***Characteristics of NRL sensitization or allergy***

Four of the 6 positives used gloves < 2 hours/day. All subjects experiencing NRL sensitization or allergy persisted in using NRL gloves. They used new most frequently but also reused gloves. Five of the six NRL sensitized subjects belonged to the high exposure group (Table 3).

**Discussion**

The prevalence of NRL allergy in the present study is lower than a study conducted among health personnel at Siriraj Hospital, Bangkok[45], significantly lower than reported in most studies[14-16,19,21,28], comparable to studies published between 1999 and 2003[12,14,17,20,22,23,27,31,42]. The present results are near the prevalence of NRL sensitization for the general population[51] perhaps because of: 1) the low prevalence may be due to false negative prick test reactions. This may be due to workers taking antihistamines. In addition, it could be due to the improved manufacturing process, the NRL protein level in these gloves is very low compared to those gloves produced in the early days and have a higher concentration of NRL protein, 2) a difference in the definition. In the present study, NRL allergy refers to symptoms suggestive of NRL allergy not to non-specific symptoms such as itching of the hands or rashes, 3) a difference in the

**Table 2.** Allergic symptoms after exposure to latex gloves

| Symptoms | Positive to NRL SPT n = 6 | Negative to NRL SPT n =289 | Without SPT n = 117 | Total n = 412 |
|---|---|---|---|---|
| Skin itch | 3 (50.0%) | 95 (32.9%) | 34 (29.1%) | 132 (32.0%) |
| Red rash | 2 (33.3%) | 43 (14.9%) | 19 (16.2%) | 64 (15.5%) |
| Skin swelling | 6 (100%) | 7 (2.4%) | 13 (11.1%) | 26 (6.3%) |
| Dry and chapped skin | 3 (50.0%) | 60 (20.8%) | 16 (13.7%) | 79 (19.2%) |
| Runny nose | 3 (50.0%) | 47 (16.3%) | 13 (11.1%) | 63 (15.3%) |
| Eye irritation | 2 (33.0%) | 57 (19.7%) | 14 (12.0%) | 73 (17.7%) |
| Lip swelling | 6 (100%) | 3 (1.0%) | 5 (4.3%) | 14 (3.4%) |
| Breathlessness | 2 (33.3%) | 16 (5.5%) | 6 (5.1%) | 24 (5.8%) |
| Wheezing | 1 (16.7%) | 11 (3.8%) | 3 (2.6%) | 15 (3.6%) |

**Table 3.** Characteristics of NRL sensitization and allergy amongst nursing staff at Srinagarind hospital, Khon Kaen, Thailand

| No. | Sex* | Age (yrs) | Exposure | Useness Pairs/day | Contact/day (hour) | Atopy | Symptoms | Exposure to NRL gloves (months) |
|---|---|---|---|---|---|---|---|---|
| 1 | F | 37 | High | 1-5 | 1-2 | Yes | Angioedema | 144 |
| 2 | F | 38 | High | 21-40 | 5-6 | No | Angioedema<br>Runny nose<br>Eye irritation<br>Breathlessness | 127 |
| 3 | F | 33 | High | 6-10 | > 6 | No | Angioedema<br>Breathlessness<br>Wheezing | 166 |
| 4 | M | 24 | High | 6-10 | < 1 | Yes | Angioedema<br>Runny nose<br>Eye irritation | 81 |
| 5 | F | 38 | Moderate | 6-10 | < 1 | No | Runny nose | 216 |
| 6 | F | 34 | High | 1-5 | < 1 | yes | Angioedema | 166 |

*F: Female , M: Male

method of diagnosis and/or reagents used in the diagnostic test. The NRL allergy prevalence obtained by a self-administered questionnaire tended to overestimate. The authors used a combination of the questionnaire and SPT to diagnose an NRL allergy and invited both symptomatic and asymptomatic subjects to undergo a SPT. The participation rate was very high so there should not be many NRL allergic subjects among those who did not undergo the SPT. The reagent used to test for NRL sensitization was Stallerg nes (SA, Fresnes, France 1:200 w/v), which has 93% sensitivity, 100% specificity, 100% positive and 96% negative predictive values[9]. Turjanmaa et al stated that it contains most of the important allergens including proteins of about 14, 20, 27, 30 and 45 kDa[9]. It should, therefore, be able to detect NRL sensitization if present. However, Poole and Nagendran stated that more than 20 allergenic proteins have been identified in NRL. Not all of these allergens were contained within the commercial preparations used for diagnosis, resulting in false-negatives[27], and 4) in the present study, 112 subjects reported a glove allergy, although only 6 of 83 underwent SPT, which showed a positive reaction to Stallerg nes SPT. Possibly rubber additives caused most of the glove allergy rather than the NRL protein itself. In addition, nursing staff in the hospital re-used sterilized NRL gloves, especially those working in operating theaters, suggesting the cleaning process washes away allergens.

If the proceeding three possibilities do not

explain away this low prevalence, then one must conclude the prevalence of NRL allergy is truly low. In the UK[27], the prevalence of NRL allergy among healthcare workers at two NHS trusts in 1999 was 0.5%, which is lower than other published studies[6,15-26,28-41]. The authors explained: (1) the trusts had stopped buying gloves with NRL protein concentrations > 100 g/g; and, (2) the staff had reduced the contact time by using NRL gloves only when handling blood or body fluids.

The latter might also explain the low prevalence of NRL allergy in the present study as our healthcare workers only use gloves while handling blood or body fluids (between 1 and 2 hours/day). A study from Wales also reported an overall low prevalence rate of NRL allergy (0.56%)[42] perhaps due to the exclusion of asymptomatic individuals from the investigation and including only those with symptoms suggestive of NRL allergy.

The authors failed to identify potential risk factors associated with NRL allergy; however, those reported having work related allergic symptoms but not any NRL allergy should be investigated further to ascertain the cause of the symptoms e.g. prick test to their own rubber gloves, cornstarch, exclude false negative prick test and followed up as an NRL allergy may develop.

The popular interventions to minimize NRL sensitivity are: 1) the substitution of NRL gloves with non-NRL ones or non-powdered ones because the cornstarch powder on NRL products is an allergen carrier[52]; and, 2) the relocation of the allergic person to an environment where NRL gloves are not or less used.

At present, non-NRL gloves are still expensive and not widely available in Thailand. To relocate an allergic person to an environment where NRL gloves are not used is not practicable. As NRL is an aeroallergen, any action to reduce concentration of NRL allergen in the air should be considered. For example, in any workplace, which does not need fitted gloves, plastic gloves should be substituted. At the industry level, development should aim for reducing NRL protein concentration, substitute cornstarch with other safe material or coating NRL with polymer.

While polymer coated gloves are not available here, nursing staff should understand that the cornstarch powder on NRL products is an allergen carrier[52] and be encouraged to gently don and remove gloves in order to minimize dispersing allergens into the air. Immunological study should be conducted to investigate and identify NRL proteins responsible for evoking allergic reactions in the Thai population.

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## ภาวะภูมิแพ้และภาวะภูมิไวต่อการใช้ถุงมือยางธรรมชาติในพยาบาลโรงพยาบาลศรีนครินทร์ จังหวัดขอนแก่น ประเทศไทย

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*การศึกษาความชุกของภาวะภูมิแพ้และภาวะภูมิไวต่อการใช้ถุงมือยางของบุคลากรทางการแพทย์ใน ประเทศต่าง ๆ ทั่วโลกอยู่ในช่วงร้อยละ 2.9-17 แต่อย่างไรก็ตาม อุบัติการณ์และความชุกของการเกิดภาวะภูมิแพ้ และภาวะภูมิไวในประเทศไทยยังมีการศึกษาน้อยมาก โดยเฉพาะอย่างยิ่งในกลุ่มที่มีความเสี่ยงสูง ดังนั้นผู้วิจัยจึงต้องการศึกษาความชุกของภาวะภูมิแพ้และภาวะภูมิไวรวมถึงอาการทางคลินิกต่อการใช้ถุงมือยางในกลุ่มอาชีพพยาบาล*

***วัตถุประสงค์**: 1) เพื่อประมาณค่าความชุกของภาวะภูมิแพ้และภาวะภูมิไวต่อการใช้ถุงมือยางในกลุ่มอาชีพพยาบาล; 2) อธิบายอาการทางคลินิก*

***รูปแบบการวิจัย**: การศึกษาแบบพรรณนา ภาคตัดขวาง*

***วัสดุและวิธีการ**: กลุ่มตัวอย่างเป็นพยาบาลรวมทั้งทีมงานที่ทำรายงานทางการแพทย์จำนวน 412 คนที่สมัครใจเข้าร่วมการศึกษา ได้รับแบบสอบถามแบบตอบกลับด้วยตนเอง ซึ่งแบบสอบถามประกอบด้วยข้อมูลการทำงานและประวัติการแพ้ผลิตภัณฑ์ยาง อาการทางผิวหนังและทางเดินหายใจ ร่วมกับการทดสอบทางผิวหนังโดยวิธีสะกิด วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนาและ 95%CI และได้ผ่านความเห็นชอบจากคณะกรรมการจริยธรรมการวิจัยในมนุษย์ มหาวิทยาลัยขอนแก่น*

***ผลการศึกษา**: อัตราการตอบกลับของแบบสอบถามเป็นร้อยละ 88 (412/470), ส่วนใหญ่เป็นผู้หญิงถึงร้อยละ 93 มีอัตราการทดสอบของผิวหนังโดยวิธีสะกิดร้อยละ 72 (295/412) (95%CI 67.2, 76.0) ค่าความชุกของอาการภูมิแพ้และความชุกของภาวะภูมิไวต่อการใช้ถุงมือยาง ร้อยละ 24 (95%CI 19.9, 28.1) และร้อยละ 2 (95%CI 0.4, 3.6) ตามลำดับ ในส่วนของอาการทางคลินิกของผู้ที่มีผลการทดสอบผิวหนังด้วยวิธีสะกิดได้แก่ อาการผิวหนังและเยื่อบุเมือกบวม และพยาบาลที่มีภาวะภูมิไวต่อยางธรรมชาติพบว่า จำนวน 5 ใน 6 คน สัมผัสกับถุงมือยางเป็นจำนวนมาก*

***สรุป**: ค่าความชุกของภาวะภูมิแพ้และภาวะภูมิไวต่อการใช้ถุงมือยางในกลุ่มพยาบาลไทยมีค่าความชุกน้อยกว่าบุคลากรทางการแพทย์และสาธารณสุขในแถบประเทศทางยุโรปและสหรัฐอเมริกา*