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1 **Evaluation of Proteins in Natural Rubber Latex Gloves and Pulmonary Function**
2 **amongst Female Nurses in Two Tertiary Hospitals in Southern, Thailand**

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10 **Short running title**

11 Latex glove exposure and lung function

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26 **Structured abstract**

27 **Background:** Inhaled natural rubber latex (NRL) allergens in a healthcare environment can
28 cause NRL sensitization and reduce pulmonary functions.

29 **Objectives:** To determine the amount of proteins and the effects of NRL gloves on the
30 pulmonary functions of female nurses in two hospitals in the southern Thailand.

31 **Methods:** The study included 340 female nurses from two hospitals in which self-reported
32 information and a blood sample was collected. NRL sensitization was determined by using a
33 solid-phase enzyme-labeled fluoroenzyme-immunoassay for anti-NRL IgE antibodies.
34 Proteins in NRL gloves were measured by a modified Lowry method. Pulmonary function was
35 measured by a spirometer.

36 **Results:** The prevalences of respiratory effects self-attributed to NRL glove use and of NRL
37 sensitization were 6.5 and 4.7%, respectively. Four of the 16 sensitized nurses reported
38 respiratory symptoms. NRL sensitized nurses had lower forced expiratory flow (FEF_{25-75%}
39 predicted value) than those who were non-sensitized (Adj. difference = -12.56, 95% CI = -
40 24.41 to - 0.70). Furthermore, examination gloves contained protein levels in the range of 111
41 – 250 mg/dm². Difference types of NRL glove contained with different amount of proteins.
42 NRL sensitization was more prevalent in nurses with high concentrations of proteins in NRL
43 gloves (p = 0.04).

44 **Conclusion:** Sensitization to NRL was associated with a decrease in FEF_{25 - 75%} predicted
45 value, indicating narrowing of the small airways of the lung. Use of gloves with low proteins
46 can reducing NRL allergen exposure in these hospitals, which may reduce the risk of
47 developing respiratory problems and NRL sensitization.

48 **Keywords:** sensitization, pulmonary function, nurse, protein, glove

49

50 **Introduction**

51 Using powdered latex gloves (PLGs) at work can result in Healthcare workers (HCWs)
52 having a high risk of exposure to latex allergens.¹ Cornstarch powder on PLGs has been
53 reported as a natural rubber latex (NRL) allergen carrier.² NRL allergens in powdered gloves
54 can spread out as airborne particles in workplaces during the wearing and removing of PLGs.³
55 A high concentration of NRL allergenic proteins has been found in NRL gloves; particularly
56 in PLGs.^{1,4} In hospitals where a high concentration of NRL aeroallergen was detected, HCWs
57 were more likely to have symptoms, including runny nose, wheezing, shortness of breath,
58 rhinitis, rhino-conjunctivitis and asthma⁵⁻⁸ with a prevalence ranging between 2.3-4.8% of
59 HCWs.^{7,8}

60 NRL allergy remains an occupational health concern, particularly in HCWs in
61 developing countries such as Thailand due to the high cost of alternatives such as synthetic and
62 powder-free gloves.^{9,10} In 2017, a study of NRL glove used in a university hospital in Thailand
63 reported that PLG was mostly used in health care workers (95.6%), while less than 3 percent
64 of them used nitrile gloves, powder free gloves and neoprene gloves.⁸ Furthermore, numerous
65 medical instruments, such as surgical and examination gloves, catheters, blood pressure cuffs,
66 tourniquets, stethoscopes, elastic bandages and wraps, containing NRL are also used in
67 hospitals^{4,11} and high levels of NRL protein allergens have been reported in medical gloves,
68 particularly PLGs.^{12,13} HCWs who wear PLGs can be exposed to NRL protein allergens by
69 cutaneous and/or respiratory routes.¹⁴⁻¹⁶ Such exposure can induce respiratory symptoms in
70 NRL sensitized individuals.¹⁷

71 Changes in pulmonary function (e.g. a reduced FEV₁) have been described.¹⁸
72 Respiratory reactions have been reported to occur even in those workers who no longer wear
73 NRL gloves, but who stayed in the environment where PLGs were used.⁶ In a study amongst
74 HCWs in the USA, NRL sensitized HCWs were more likely to leave employment within 2

75 years when compared with HCWs who were not sensitized to NRL.¹⁹Hence there are
76 significant health implications to the continuing use of PLGs in Thailand.

77 There is little information about the prevalence of health effects and on risk factors
78 specifically related to NRL allergy in Thai HCWs, and so the aim of this study was to evaluate
79 the amount of crude water soluble proteins in NRL gloves used in hospitals and to determine
80 the effects of occupational use of NRL gloves on the pulmonary function and NRL sensitization
81 of nurses in two tertiary hospitals in Thailand.

82

83 **Methods**

84 *Study design and population.*

85 An analytical observational study was conducted among 664 female nurses working in
86 two tertiary hospitals in the south of Thailand. All nurses wore NRL gloves at work. The study
87 was approved by the hospital human right committees from two hospitals (Ref.
88 YL0027.102/17050 and Ref. SK0027.103/93) and the ethics committee of The University of
89 Manchester (ref. 08117).This study was approved by Thai Clinical Trial Registry (TCTR:
90 20190605004). The information sheet and consent form were distributed to nurses before the
91 study began. Three hundred forty participating nurses had signed in the consent form to confirm
92 that they all agreed to take part of this study.

93

94 *Questionnaire*

95 Information on personal demographics (*i.e.* personal lifestyle), health status (*i.e.* history
96 of ill-health, symptoms related to NRL gloves use) and occupational factors (*i.e.* working
97 conditions and use of NRL gloves) was collected using a self-completed questionnaire. This
98 questionnaire was translated to Thai language and back-translated into English by a second bi-

99 lingual researcher to ensure consistency and the clarity of translation. The content validity was
100 considered by three experts. The index of item objective congruence (IOC) was 0.92.

101 *Spirometry*

102 Spirometry was measured using an electronic spirometer (Micro Medical MicroLab
103 3500, Cardinal Health, UK) using standard procedures and calibrated using normal values for
104 the population of Thailand.²⁰ Before the test, personal information such as age, weight and
105 height were recorded. Nurses were asked to sit in a convenient position, take a deep breath and
106 blow into a spirometer. This was repeated 3 times, and the best of three acceptable blows
107 (largest value) was recorded. The forced expiratory volume at one second (FEV₁) and forced
108 vital capacity (FVC) were based on the maximal inspiration and expiration of the subjects. The
109 forced expiratory flow (FEF)₂₅₋₇₅ was also recorded. The expected values were based on the
110 age, sex and height of the subjects.

111

112 *Detection of Anti-NRL Immunoglobulin E (IgE) Antibodies*

113 Nurses provided 5 ml of blood. These samples were centrifuged (4,000g) at room
114 temperature for 15 minutes, the serum separated and transferred into microcentrifuge tubes.
115 Serum levels of anti-NRL IgE antibody was measured using a solid-phase enzyme-labelled
116 fluoroenzyme immunoassay (NRL UniCAP Specific IgE Assay) in which allergens are
117 covalently linked to high-binding-capacity sponge matrices. Specific IgE antibodies present in
118 serum react with the NRL allergens and non-specific IgE antibodies are removed by washing
119 the matrices. Enzyme labeled antibodies against IgE antibodies are then added, followed by
120 developing reagents. Fluorescence was measured and antibody levels determined using a
121 calibration curve. A positive IgE antibody on NRL was a result $> 35 \text{ kU}_A/\text{I}$.²¹

122

123 *Determination of protein levels in NRL Glove Extracts*

124 Two types of NRL gloves most used in medical procedures were selected for testing,
125 namely powdered examination gloves (PEGs) and powdered surgical gloves (PSGs). Each type
126 of NRL glove used in hospital 1 and 2 was produced by different glove companies. Crude water
127 soluble proteins of these gloves were extracted and quantified by using a Modified Lowry
128 method (the standard of The American Society for Testing Materials (ASTM) test D5712-2005
129 protocol).²² Briefly, proteins from PLGs were extracted into aqueous buffer solution for pH 7.4
130 ± 0.2 and then precipitated with sodium deoxycholate to concentrate them and to separate them
131 from water soluble substances. The proteins were then redissolved in alkali and quantified
132 colorimetrically by a Modified Lowry method. Spectrophotometric measurement was
133 performed at a wavelength of 750 nm. The concentrations of protein in NRL gloves were
134 reported in microgram per gram ($\mu\text{g/g}$) of NRL glove. The sensitivity of this method is 50
135 $\mu\text{g/g}$.²³

136

137 *Statistical Analysis*

138 Exploratory data analyses were conducted using frequency tables. Continuous data
139 were described using mean, median, standard deviation, minimum and maximum values. Chi-
140 square tests were used to analyse the difference in categorical variables. Fisher's exact test was
141 used to analyse for small cell counts ($n < 5$). Mann Whitney U tests were used to analyse data
142 when the assumption of the t-test was not met. Analysis of covariance (ANCOVA) was used
143 to analyse effects of sensitization to latex on pulmonary functions. Statistical significance was
144 considered when p-values were lower than 0.05.

145

146 **Results**

147 Of 664 nurses, 340 (51.2% response rate) completed the questionnaires, underwent a
148 blood test and also spirometry. Detectable levels of IgE antibodies to NRL were found in 4.7%

149 of participating (16 of 340 nurses). The demographics of this population were described in
150 Table 1. There were border significant differences on age and work period between NRL
151 sensitised and non-sensitised nurses ($p = 0.07$).

152

153 ***Respiratory symptoms and pulmonary function***

154 Of 340 nurses, 22 nurses (6.5%) reported respiratory symptoms related to NRL gloves
155 used. Of 16 nurses with NRL sensitization, 4 sensitised nurses (25%) had reported respiratory
156 symptoms related to NRL gloves used. The respiratory symptoms included sneezing, rhinitis,
157 shortness of breath, wheezing and asthma. NRL-sensitized nurses had lower $FEF_{25-75\%}$
158 predicted values than non-sensitized nurses (Adjusted difference = -12.56 (95% CI -24.41 to -
159 0.70); Table 2).

160

161 ***Use of NRL glove and level of proteins in NRL gloves***

162 The results showed that PEGs had higher proteins than PSGs and there were different
163 amount of protein levels in PEGs and PSGs between hospital 1 and 2. The protein levels were
164 found in PEGs in the range of 111.1 – 250.8 $\mu\text{g}/\text{dm}^2$, while the NRL sterile gloves were found
165 proteins in the range of 115.1 – 203.9 $\mu\text{g}/\text{dm}^2$. Moreover, there were significant differences in
166 the levels of proteins of PEGs and PSGs between hospital 1 and 2 (Mean difference (95% CI)
167 = 139.76 (112.53 to 166.99) and 88.82 (64.19 to 113.44), respectively). According to the
168 consequence above, high latex sensitisation was found in the hospital where NRL gloves with
169 high protein levels were used (6.9% vs 2.4%, $p = 0.04$). Furthermore, the latex sensitised nurses
170 working in hospital 1 where used NRL gloves with high proteins had reported respiratory
171 symptoms, while the NRL sensitised nurses in hospital 2 where used NRL gloves with low
172 protein levels had not found, as shown in Table 3.

173

174 **Discussion**

175 High levels of water soluble proteins were found PLGs, particularly PEGs. However,
176 it has been showed that the low water soluble protein level was found in powder free
177 examination glove, as a study in Germany had evaluated the amount of proteins from powdered
178 free gloves using a modified Lowry method. The results showed that 13 of 18 powder free
179 gloves contained protein between 7.1 and 92.3 µg protein/g, while another 5 gloves were found
180 under detection limit.²⁵ The German technical standards for hazardous material (TRGS 540)
181 has been recommended that protein levels of NRL glove should be less than 30 µg
182 proteins/g.^{24,25} According to the results in this current study, level of proteins in PLGs was
183 eight times higher than the recommend value.

184 The prevalence of NRL sensitisation was higher where PLGs of high protein content
185 were used to suggest an association between the two. This result supported the findings of a
186 previous study which reported a decrease of NRL sensitisation and allergic symptoms related
187 to NRL glove use when low protein NRL gloves were used in hospital workplaces.²⁶ For the
188 respiratory symptoms which had found in 4 sensitised nurses, all of them worked in the hospital
189 1 where NRL gloves with high water soluble protein levels were used, while sensitized nurses
190 in Hospital 2 where NRL gloves with low water soluble protein level were used. This may
191 assume that NRL glove with a high protein level had also had a high level of NRL allergens.
192 As, a previous study found that PEGs has highly released an amount of NRL aeroallergens
193 which 68% of released particles sized was in the range of particle meter between 2.5 and 10
194 micron, and also 56% NRL aeroallergens were carried on them.²⁷

195 Exposure to NRL allergens among sensitized nurses in this study was associated with a
196 decline in pulmonary function, particularly the FEF_{25-75%} predicted value, while there was no
197 evidence of effect on the other pulmonary functions. The FEF_{25-75%} is a parameter which is
198 more reflective of small airways and sensitive indicator of symptomatic asthma.²⁸ Another

199 study on FEF₂₅₋₇₅ in Italy reported that the abnormal FEF₂₅₋₇₅ was an early marker of airflow
200 limitation and it had also suggested that the FEF₂₅₋₇₅ can be a predictive marker of newly
201 diagnosed asthma.²⁹ It also has been reported that the reduced FEF₂₅₋₇₅ (<65% of predicted
202 value) was associated with bronchial hyperreactivity.³⁰ FEF₂₅₋₇₅ could be used to predict
203 airway hyper responsiveness in adult patient with asthma. Low FEF_{25-75%} predicted value can
204 show that there was decreased function in the small airways of the lung. However, FEF_{25-75%}
205 predicted values are not specific for small airway diseases,³¹ but is a sensitive indicator for
206 airway obstruction.³² FEF_{25-75%} predicted value is more sensitive than FEV₁ in detecting
207 peripheral or small airway narrowing in adults³³ as well as identifying individuals with
208 asymptomatic asthma.³⁴ A previous study on the clinical diagnosis of asthma and FEF_{25-75%}
209 predicted value has been compared the baseline FEF_{25-75%} predicted value using the subsequent
210 methacholine bronchial provocation test and the results on FEF_{25-75%} predicted value in patients
211 with positive bronchial provocation test had significantly lower than patient with normal
212 responsive airway ($t = 4.616, p < 0.001$).³⁵ The change of small airways may be one of initially
213 presenting parameters of a respiratory reaction in NRL sensitized nurses who worked in the
214 environment with PLG use.

215 In the past years, there had numerous articles about NRL allergy in health care workers
216 and also the study of NRL allergens in NRL gloves and other NRL products. Various types of
217 glove used had different levels of proteins. These proteins were contained with NRL allergens
218 inducing NRL sensitization in the health care workers. In developing countries as Thailand,
219 the PLGs were widely used in hospitals for a long time until now. There were few studies about
220 NRL allergy from NRL gloves exposed in Thai health care workers and no report for the
221 proteins extracted from NRL glove and NRL sensitization (anti-NRL IgE antibodies) in Thai
222 nurses. This current study revealed more information on the NRL sensitization, amount of

223 glove proteins, respiratory symptoms and pulmonary functions in nurses working in
224 governmental hospitals.

225 The limitations of this study were that the voluntary participation may have resulted in
226 volunteer bias in that nurses who reported health problems may have been overrepresented
227 compared to nurses who were healthy. Furthermore, the healthy worker effects may be found
228 in this study due to some evidences showed that non-sensitized nurse are older and have worked
229 longer than sensitized nurses. The sensitized nurses might change their job positions due to
230 health problems related to gloves used before the study was done. This study collected the self-
231 reported data of respiratory symptoms related to gloves used, but fixed choice questions may
232 lack flexibility and forces to answer and also social desirability bias may occur. The self-
233 reported symptoms may occur not only expose to NRL allergens, but also chemical and powder
234 cornstarch from PLGs. The design of this study cannot derive causal relationship between
235 pulmonary function and proteins of NRL glove exposure and NRL sensitization. Furthermore,
236 the confounding factors such as secondary smoking, underlying lung disease or allergic
237 diseases may affect the result of pulmonary function test.

238 In conclusion, there was moderate evidence that exposure to NRL airborne allergens in
239 the healthcare sector can affect pulmonary function of sensitized workers as measured by FEF₂₅
240 – 75% predicted value. The evidences in this study revealed exposure to high level protein in
241 NRL glove has affected the respiratory and the low FEF_{25-75 %} predicted value where found in
242 sensitized nurses. This suggests that it is important to minimize the level of NRL aeroallergens
243 in the workplace environment by using powder free gloves or synthetic latex free gloves, which
244 can reduce the risk of respiratory ill-health in NRL sensitized HCWs.

245

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249

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- 344
- 345

346 **Table 1. Characteristics of nurses**

| Variable | All nurses (n = 340) | Latex sensitized cases (n = 16) | Non-latex sensitized cases (n = 324) | P-value |
|--|-------------------------|---------------------------------------|--|--------------------|
| Age (years) | | | | 0.07 ^a |
| Mean ± SD | 36.9 ± 8.3 | 33.1 ± 8.2 | 37.1 ± 8.3 | |
| Median | 35.0 | 33.0 | 35.0 | |
| Min-Max | 23.0 – 60.0 | 23 - 48 | 23 - 60 | |
| BMI classification, n (%) | | | | 0.49 ^a |
| Mean ± SD | 22.1 ± 3.4 | 22.3 ± 2.9 | 22.1 ± 3.4 | |
| Median | 21.4 | 22.4 | 21.36 | |
| Min-Max | 116.0-34.5 | 17.9-30.3 | 16.0 – 34.5 | |
| Education, n (%) | | | | 1.00 |
| Diploma | 16 (4.7) | 1 (6.3) | 15 (4.6) | |
| Bachelor and over | 292 (85.9) | 14 (87.5) | 278 (85.5) | |
| Ethnicity, n (%) | | | | |
| Thai | 269 (79.1) | 14 (87.5) | 255 (78.7) | 0.54 ^c |
| Thai-Chinese/Malaysian | 71 (20.9) | 2 (12.5) | 69 (21.3) | |
| Non-Smoker, n (%) | 340 (100.0) | 16 (100.0) | 324 (100.0) | - |
| Personal history of allergic disease (Y/N, % yes) | 134/206 (39.4) | 5/11 (31.3) | 129/195 (39.8) | 0.494 ^b |
| Type of personal allergic disease | | | | |
| Hay fever (Y/N, % yes) | 36/304 (10.6) | 2/14 (12.5) | 34/290 (10.5) | 0.682 ^c |
| Grass allergy (Y/N, % yes) | 31/309 (9.1) | 2/14 (12.5) | 29/295 (9.0) | 0.648 ^c |
| Eczema (Y/N, % yes) | 56/284 (16.5) | 1/15 (6.3) | 55/269 (17.0) | 0.487 ^c |

| | | | | |
|---|----------------|-------------|----------------|--------------------|
| Hives (Y/N, % yes) | 91/249 (26.8) | 3/13 (18.8) | 88/236 (27.2) | 0.573 ^c |
| Asthma (Y/N, % yes) | 16/324 (4.7) | 2/14 (12.5) | 14/310 (4.3) | 0.170 ^c |
| Autoimmune (Y/N, % yes) | 5/335 (1.5) | 0/16 (0.0) | 5/319 (1.5) | 1.000 ^c |
| Atopy (Y/N, % yes) | 87/253 (25.6) | 3/13 (18.8) | 84/240 (25.9) | 0.770 ^c |
| Family history of allergic diseases (Y/N, % yes) | 153/187 (45.0) | 8/8 (50.0) | 145/179 (44.8) | 0.680 ^b |
| Type of family allergic disease | | | | |
| Hay fever (Y/N, % yes) | 37/303 (10.9) | 3/13(18.8) | 34/290 (10.5) | 0.398 ^c |
| Grass allergy (Y/N, % yes) | 29/311 (8.5) | 2/14 (12.5) | 27/297 (8.3) | 0.636 ^c |
| Eczema (Y/N, % yes) | 65/275 (19.1) | 2/14 (12.5) | 63/261 (19.4) | 0.746 ^c |
| Hives (Y/N, % yes) | 84/256 (24.7) | 3/13 (18.8) | 81/243 (25.0) | 0.769 ^c |
| Asthma (Y/N, % yes) | 67/273 (19.7) | 2/14 (12.5) | 65/259 (20.1) | 0.747 ^c |
| Autoimmune (Y/N, % yes) | 9/331 (2.6) | 1/15 (6.3) | 8/316 (2.5) | 0.355 ^c |
| Atopy (Y/N, % yes) | 122/218 (35.9) | 6/10 (37.5) | 116/208 (35.8) | 1.000 ^c |
| Position, n (%) | | | | |
| Registered nurses | 323 (95.0) | 15 (93.8) | 308 (95.1) | 0.57 ^b |
| Practical or Technical nurses | 17 (5.0) | 1 (6.3) | 16 (4.9) | |
| Workplace, n (%) | | | | |
| OPD | 31 (9.1) | 0 (0.0) | 31 (9.6) | - |
| ER | 19 (5.6) | 0 (0.0) | 19 (5.9) | |
| ICU | 60 (17.6) | 1 (6.3) | 59 (18.2) | |
| OR | 50 (14.7) | 2 (12.5) | 48 (14.8) | |
| LR | 23 (6.8) | 3 (18.8) | 20 (6.2) | |
| Sur | 74 (21.8) | 4 (25.0) | 70 (21.6) | |
| Obs | 33 (9.7) | 4 (25.0) | 29 (9.0) | |

| | | | | |
|----------------------|----------------|----------------|----------------|-------------------|
| Med | 50 (14.7) | 2 (12.5) | 48 (14.8) | |
| Work period | | | | |
| Mean \pm SD | 14.7 \pm 8.5 | 11.0 \pm 8.1 | 14.9 \pm 8.5 | |
| Median | 13.0 | 10.9 | 13.0 | 0.07 ^b |
| Min-Max | 0.7 – 36.0 | 0.8 – 24.1 | 0.7 - 36 | |
| Work shift, n (%) | | | | |
| \leq 35 hours/week | 133 (39.2) | 5 (31.3) | 128 (39.6) | 0.61 ^b |
| > 35 hours/week | 206 (60.8) | 11 (68.8) | 195 (60.4) | |

347 ^aP-value by Mann-Whitney U Test; ^bP-value by using Chi-Square Test; ^cP-value by using

348 Fisher's Exact Test.

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363 **Table 2. Comparison of pulmonary function in sensitized and non-sensitized female**
 364 **nurses**

| Variable | Sensitized | Non-sensitized | <i>P</i> -value | Adj.difference (95% CI) |
|-----------------------------------|-------------|----------------|-------------------|----------------------------|
| | (n = 16) | (n = 324) | | |
| | Mean ± SD | Mean ± SD | | |
| FEV ₁ (L) | 2.21 ± 0.20 | 2.24 ± 0.35 | 0.62 ^a | - 0.04 (-0.19 to 0.11) |
| FVC (L) | 2.51 ± 0.30 | 2.51 ± 0.40 | 0.95 ^a | 0.01 (-0.17 to 0.18) |
| FEV ₁ /FVC ratio | 88.3 ± 4.7 | 89.7 ± 5.5 | 0.28 ^a | - 1.51 (- 4.23 to 1.21) |
| FEV ₁ (% predicted) | 90.7 ± 10.2 | 91.8 ± 12.1 | 0.74 ^b | - 1.01 (-7.03 to 5.01) |
| FVC (% predicted) | 90.3 ± 11.5 | 89.0 ± 12.3 | 0.69 ^b | 1.26 (-4.86 to 7.37) |
| FEF _{25% -75%} predicted | 83.3 ± 17.0 | 95.8 ± 23.8 | 0.04 ^b | - 12.56 (- 24.41 to -0.70) |

365 ^aAdjusted for age, height, and weight using ANCOVA; ^bAdjusted for weight using
 366 ANCOVA; FEV₁: Force expiration volume in one second; FVC: Force volume capacity;
 367 FEF: Force expiratory flow

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378 **Table 3. Comparison of number of NRL glove used, total proteins in NRL gloves, latex**
 379 **sensitisation and respiratory symptoms in latex sensitised nurses between hospital 1 and**
 380 **2**

| Variable | Hospital 1 | Hospital 2 | Mean Difference | P-value |
|---|---------------------------------|---------------------------------|------------------------------|----------------|
| | Mean \pm SD | Mean \pm SD | (95%CI) | |
| -Average number of NRL examination glove used per day | 9.97 \pm 9.54 | 9.17 \pm 9.34 | 0.80 (-1.36 to 2.96) | 0.467 |
| -Average number of NRL surgical glove used per day | 6.77 \pm 9.41 | 6.36 \pm 7.29 | 0.41 (-1.71 to 2.54) | 0.698 |
| -Average total protein of powdered examination gloves (ug/dm ²) \pm SD | 250.8 \pm 16.00 | 111.1 \pm 5.60 | 139.76 (112.53 to 166.99) | <0.001 |
| -Average total protein of powdered surgical gloves (ug/dm ²) \pm SD | 203.9 \pm 13.00 | 115.1 \pm 8.20 | 88.82 (64.19 to 113.44) | 0.001 |
| -Latex sensitization(%) | 6.9 | 2.4 | | 0.048 |
| -Respiratory symptoms in latex sensitized nurses (n=4) | 4 | 0 | | - |

381 P-value by Independent t test

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