

ORIGINAL ARTICLE

Risk assessment for nickel contact allergy

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ABSTRACT

Nickel is one of the most common allergens causing allergic contact dermatitis worldwide. The aim of the study was to evaluate the contributing factors to nickel contact allergy (NiCA) in Asians who have a unique culture and lifestyle. We randomly selected 324 previously patch-tested patients, 162 nickel patch test (PT)-positive patients and 162 nickel PT-negative patients. The patients were telephone interviewed for their lifestyle information. Most of the nickel PT-positive patients (93.2%) were female with a mean age of 38.9 ± 13.3 years compared with the other group of nickel PT-negative patients who had a smaller proportion of females (76.5%) with an older mean age of 44.1 ± 14.9 years ($P = 0.001$). Multivariate analysis was able to establish that the significant risk factors for NiCA were female sex (odds ratio [OR], 6.38; 95% confidence interval [CI], 2.15–18.94), young age (OR, 0.98; 95% CI, 0.96–1.00), occupation with long periods of exposure to metal (OR, 3.08; 95% CI, 1.18–8.02), seafood (OR, 1.96; 95% CI, 1.17–3.27) and canned food consumption (OR, 3.12; 95% CI, 1.17–8.33) ($P < 0.05$). The adjusted factors found to associate with NiCA were female sex, young age, occupation with long periods of exposure to metal, seafood and canned food consumption.

Key words: contact allergy, nickel sulfate, risk factors.

INTRODUCTION

Nickel is the most common cause of contact allergy worldwide¹ as well as in Thailand.² Our previous study revealed that the prevalence of nickel contact allergy (NiCA) was 26.6% with a high clinical relevance rate of 81.2%.² The prevalence and risk factors of NiCA are affected by lifestyle, geographical and sociocultural factors.

Nickel sensitization occurred from daily exposure to nickel-releasing consumer items such as jewelry, jean buttons, zippers, belt buckles, metal watches, eyeglass frames, coins and metal fasteners on clothing.^{1,3} Possible risk factors for NiCA were documented in previous studies including female sex, young age, black tattoo, body piercing, smoking, atopic diathesis, hand eczema and some occupations, especially mechanical workers and cleaners.^{1,4–7} Also, intake of a high nickel content diet may provoke eczema in nickel-sensitive individuals.^{8,9} The single protective factor of NiCA found from preceding studies was wearing nickel-containing dental braces or orthodontic appliances before piercing.^{5,7}

There were prior studies regarding risk factors of NiCA; however, our study was different in its settings because: (i) in this region, we never have had a directive to restrict nickel release in consumer items; (ii) there are always new sources of nickel allergy being discovered; and (iii) our population had a different culture, lifestyle and environmental exposure compared with those of preceding reports.^{6,7,10} This study aimed to evaluate the contributing factors for NiCA in Asian people, particularly Thais.

METHODS

Population and study design

The Siriraj Hospital institutional review board approved this study. The study design was a retrospective case-control study. According to a two-sided type I error of 0.05, 90% power, our calculated sample size was 324, with 162 in each group. Patch-tested patients attending the Contact Dermatitis Clinic, Department of Dermatology, Siriraj Hospital between May 2008 and April 2012 were randomly selected to contain 162 nickel patch test-positive patients and 162 nickel patch test-negative patients. NiCA or nickel patch test-positive patients were interpreted according to the guidelines of the International Contact Dermatitis Research Group to 5% Nickel(II)sulfate hexahydrate in petrolatum (Chemotechnique Diagnostics, Vellinge, Sweden). The demographic and clinical data were retrospectively studied in addition to telephone interviews concerning their lifestyle behavior. Lifestyle behavior including smoking habits, alcohol drinking, tattooing, piercing history, wearing dental braces and nickel-rich dietary ingestion (vegetarian, seafood, canned food and coffee/tea/cocoa) were phone-interviewed.

Statistical analysis

Descriptive statistics were used to describe the demographic data and patch test result. The Pearson χ^2 -test was performed to analyze the association between the contributing factors and NiCA. Multiple logistic regressions were used to test the association among NiCA and multiple factors simultaneously.

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Received 13 August 2014; accepted 11 September 2014.

All statistical analyses were done using PASW statistics 18.0 (IBM, Armonk, NY, USA). $P < 0.05$ was considered statistically significant.

RESULTS

Most of the patients (84.9%) in our population were female, with a female : male ratio of 5.6:1. The female : male ratio of the nickel patch test-positive group was 13.7:1, which was significantly higher than that of the nickel patch test-negative group of 3.3:1 ($P < 0.001$). The mean age ($\pm$ standard deviation) of all patients was 41.5 ± 14.4 years. However, the mean age of the nickel patch test-positive group (38.9 ± 13.3 years) was significantly less than that of the nickel patch test-negative group (44.1 ± 15.0 years, $P = 0.001$) (Table 1).

From univariate analysis (Table 1), the factors found to associate with NiCA were female sex, young age, body piercing, wearing dental braces, working with metal, and consumption of seafood and canned food ($P < 0.05$). However, there was no significant association among the factors of personal and familial history of atopy, the presence of hand eczema or tattoos, alcohol drinking, smoking, site of lesions, and intake of vegetarian food and coffee/tea/cocoa ($P > 0.05$).

Body piercing and dental brace wearing were the two factors that showed significant risk factors for NiCA only by univariate analysis. In the study, 256 of 324 (79%) had admitted having body piercing: 91.6% (256/324) of the women and 8.2% (4/49) of the men. The amount/site of piercing did not influence the outcome of nickel allergy, for either men or women. However, every male in the nickel patch test-negative group had zero body piercing; therefore, the analysis could not be performed. There was a small number of patients wearing dental braces: 56 of the 324 (17.3%) had worn dental braces and 46 of 56 (82.1%) had worn orthodontic appliances after the piercing.

Multiple logistic regression or multivariate analyses were analyzed to discover only the factors found to have significant association with NiCA from univariate analysis. In this study, women were 6.38-times more likely to have NiCA than men ($P = 0.001$). NiCA patients presented with younger age ($P = 0.03$).

Among the participants' various occupations, those in which more than half of the workers were exposed to metal for longer than 6 h per day were cloth-maker (71.4%), jeweler (67%), industrial worker (60%), constructor (50%) and hair dresser (50%). Multivariate analysis showed that time of metal exposure of longer than 6 h/day increased the risk of NiCA by 3.1 times ($P = 0.01$). Concerning nickel-rich diets, seafood and canned food were more likely to cause NiCA with an adjusted odds ratio (OR) of 1.96 ($P = 0.01$) and 3.12 ($P = 0.023$), respectively.

DISCUSSION

This study showed the risk factors of NiCA in the setting of a tertiary university hospital in Bangkok. Female sex was the strongest risk factor of NiCA (OR, 6.38; 95% confidence inter-

val, 2.15–18.94) as in previous reports worldwide.^{6,11,12} It was probably due to the use of imitation jewelry and earrings by most of the women. Women also pierce their bodies more frequently than men.⁵ Risk increased significantly with decreasing age. Young age was another significant risk factor of NiCA, which corresponded with the results from previous studies in Europe.^{6,7,13,14} Adolescent girls trend to wear imitation fashion jewelry which usually has a higher quantity of nickel. The Nickel Directive, regulating the use of nickel in jewelry and other products that come into contact with the skin, is not present in this region as in European countries.¹⁵ Hamann *et al.*¹⁶ study found that a large proportion of earrings in Thailand release excessive amounts of nickel.

Our findings of occupations that are associated with NiCA are those including exposure to metal for longer than 6 h/day such as metalworkers, mechanics and jewelry-makers, additional to previous reports of hairdressers, retail clerks, caterers and domestic cleaners.^{4,13,17} It was explained that this was because repeated or prolonged skin exposure to nickel-releasing items raised the risk of NiCA.

The high intake of a nickel-rich diet was proved to aggravate eczema in nickel-sensitive persons.^{9,18} Canned food and seafood, which are rich in nickel, were associated with NiCA. Vegetarian food and beverages, coffee, tea and cocoa, were not a risk factor in the studied population. The quantity of nickel was varied due to geographic sources and cooking procedures.^{8,19} Thai foods contain different ingredients in comparison with Western foods. More acidic Thai foods cooked in nickel-plated utensils may cause NiCA. These may be the reason for different results from assorted countries.

From multivariate analysis, body piercing was not one of our risk factors, which was in contrast to many previous studies.^{5,7,14} In Thailand, body piercing is not favored, especially in men, due to culture differences between Asian and Western countries. Further studies with larger sample sizes may be beneficial. There were reports from Scandinavia that dental braces are a protective factor against NiCA when wearing them before piercing.^{5,7} This was not a significant factor contributing to NiCA in our study which had small numbers of patients wearing dental braces and most of our cases were middle-aged who had not worn orthodontic appliances because they have only become well distributed in Thailand in the last few decades.

There was no evidence of association between NiCA and atopic diathesis, hand dermatitis, body piercing, drinking alcohol, smoking, tattooing or sites of eczema the same as previous studies.^{5-7,14,20} In addition, our data showed that smoking behavior did not play any role in NiCA, which was different from prior reports.^{10,20} It is possible that there were only seven smokers in our study due to a strong campaign of banned smoking in public places beginning in Thailand in 1985.

In conclusion, the prominent risk factors for NiCA from multivariate analysis were female sex, young age, occupation with long hours of exposure to metal, and consumption of seafood and canned food. Nevertheless, the protective factors against NiCA were not found in this study.

Table 1. Patient factors categorized by nickel case and control groups

Characteristics	Ni PT + (n, %)	Ni PT – (n, %)	Univariate analysis		Multivariate analysis	
			Crude OR (95% CI)	P	Adjusted OR (95% CI)	P
Sex						
Male	11 (6.8)	38 (23.5)	1		1	
Female	151 (93.2)	124 (76.5)	4.21 (2.06–8.57)	<0.001	6.38 (2.15–18.94)	0.001
†Mean age, years (SD)	38.9 (13.3)	44.1 (14.9)	0.98 (0.96–0.99)	0.001	0.98 (0.96–1.00)	0.030
Body piercing						
No	23 (14.2)	45 (27.8)	1		1	
Yes	139 (85.8)	117 (72.2)	2.32 (1.33–4.07)	0.003	0.61 (0.25–1.51)	0.286
Dental braces						
No	127 (78.4)	141 (87.0)	1		1	
Yes	35 (21.6)	21 (13.0)	1.85 (1.02–3.34)	0.042	1.12 (0.54–2.30)	0.764
Metal exposure						
No	18 (11.1)	27 (16.7)	1		1	
<2 h/day	36 (22.2)	48 (29.6)	1.13 (0.54–2.35)	0.754	1.11 (0.52–2.40)	0.781
2–6 h/day	77 (47.5)	72 (44.4)	1.60 (0.82–3.16)	0.172	1.38 (0.65–2.94)	0.398
>6 h/day	31 (19.1)	15 (9.3)	3.10 (1.32–7.31)	0.010	3.08 (1.18–8.02)	0.021
Personal history of atopy						
No	100 (61.7)	112 (69.1)	1			
Yes	62 (38.3)	50 (30.9)	1.39 (0.88–2.20)	0.162		
Family history of atopy						
No	108 (66.7)	115 (71.0)	1			
Yes	54 (33.3)	47 (29.0)	1.22 (0.76–1.96)	0.401		
History of hand eczema						
No	115 (71.0)	111 (68.5)	1			
Yes	47 (29.0)	51 (31.5)	0.89 (0.55–1.43)	0.629		
Alcohol drinking						
No	128 (79.0)	131 (80.9)	1			
Yes	34 (21.0)	31 (19.1)	1.12 (0.65–1.93)	0.677		
Smoking						
No	158 (97.5)	159 (98.1)	1			
Yes	4 (2.5)	3 (1.9)	1.34 (0.30–6.09)	0.703		
Tattoo						
No	145 (89.5)	148 (91.4)	1			
Yes	17 (10.5)	14 (8.6)	1.24 (0.59–2.61)	0.572		
Nickel-rich diet						
Vegetarian						
No	153 (94.4)	158 (97.5)	1			
Yes	9 (5.6)	4 (2.5)	2.32 (0.70–7.70)	0.168		
Seafood						
No	95 (58.6)	117 (72.2)	1			
Yes	67 (41.4)	45 (27.8)	1.83 (1.15–2.92)	0.011	1.96 (1.17–3.27)	0.010
Canned food						
No	143 (88.3)	154 (95.1)	1			
Yes	19 (11.7)	8 (4.9)	2.56 (1.09–6.03)	0.032	3.12 (1.17–8.33)	0.023
Coffee/tea/cocoa						
No	49 (30.2)	61 (37.7)	1			
Yes	113 (69.8)	101 (62.3)	1.39 (0.88–2.21)	0.160		

†The crude OR was continuous and calculated for 1 year. Bolding indicates statistical significance. CI, confidence interval; Ni PT, nickel patch test; OR, odds ratio; SD, standard deviation.

ACKNOWLEDGMENT: We thank Assistant Professor Chulaluk Komoltri, Ph.D., Division of Clinical Research, Faculty of Medicine, Siriraj Hospital, for statistical consultation and Ms Pacharee Iamtharac-hai, B.Ed.Sc. for technical assistance. Author contribution is as follows: O. C. and P. K. had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data

analysis. Study concept and design: W. B. Acquisition of data: O. C. and P. K. Analysis and interpretation of data: O. C., P. K. and W. B. Drafting of the manuscript: O. C., P. K. and W. B. Critical revision of the manuscript for important intellectual content: P. K. and W. B. Administrative, technical or material support: O. C. Study supervision: W. B.

CONFLICT OF INTEREST: The authors have no conflict of interest.

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