GREEN TOBACCO SICKNESS AND PROTECTIVE BEHAVIORSAMONG THAI TRADITIONAL TOBACCO FARMERS IN NORTHERN THAILAND

Thanusin Saleeon[1], Wattasit Siriwong[1, 2, *], Héctor Luis Maldonado-Pérez[3], Mark Gregory Robson[2, 3]

[1] College of Public Health Sciences, Chulalongkorn University, Bangkok, 10330, Thailand
[2] Thai Fogarty ITREOH Center, Chulalongkorn University, Bangkok, 10330, Thailand
[3] School of Environmental and Biological Sciences, Rutgers University, New Jersey, USA

ABSTRACT:

Background: Thai traditional tobacco is mainly produced in Nan Province in the northern region of Thailand. Thai traditional tobacco (*Nicotiana Tabacum* L.) is a non-Virginia type. Health consequences of traditional tobacco exposure include vomiting, nausea, headache, and dizziness that result from acute nicotine poisoning caused by dermal absorption of nicotine from mature tobacco plants, which is defined as Green Tobacco Sickness (GTS). Farmers' use of protective equipment may be important to protect them from such negative health effects.

Methods: This study aimed to characterize the association between GTS and use of personal protective equipment (PPE) among Thai traditional tobacco farmers in Nan province. A cross-sectional study was conducted with 473 Thai traditional tobacco farmers in Praputthabath sub-district and Phatow sub-district in Nan province. The farmers were randomly selected and subsequently interviewed using standardized questionnaires. Chi-square and Fisher's exact tests were employed to examine relationships between the dependent and independent variables.

Results: GTS was statistically significantly associated with farmers' uses of personal protective equipment (PPE) such as plastic aprons and masks and farmers' good practice of changing wet clothes after work that the direction of association mean the farmers who wore a plastic apron or mask had risk of GTS lower than who did not use it and changing wet clothes was risk of GTS lower than in who did not change. However, GTS risk was not related to use of gloves. It is worth noting that almost all of the farmers used rubber latex gloves. This might paradoxically increase nicotine absorption due to the hot climate promoting sweating on the farmers' hands. A number of famers always tried to use some form of self-protection to protect themselves from nicotine exposure while working, even though some of the PPE they chose may not be effective enough to protect them from GTS. For example, some farmers believed that wearing rubber latex gloves or plastic gloves would be helpful when in fact these gloves could not offer them protection from exposure to nicotine.

Conclusions: Based on the study finding of strong difference association between good practices of wearing mask, plastic apron, changing wet clothes after work and GTS, it is recommended that such practice should be promoted among Thai traditional tobacco farmers.

Keywords: Green tobacco sickness, Personal protective equipment, Thai traditional tobacco farmers, Thailand

DOI: *Received: November 2015; Accepted: January 2016*

INTRODUCTION

Tobacco farming is associated with the hazard of green tobacco sickness (GTS). This is caused by nicotine which penetrates through the skin of the hands of workers who cultivate and harvest tobacco [1-3]. Green tobacco sickness (GTS) is an occupational illness reported by tobacco workers worldwide [4-7]. Earlier studies have pointed out that dermal absorption of nicotine from plant

* *Correspondence to: Wattasit Siriwong*
E-mail: wattasit.s@chula.ac.th

Cite this article as: Saleeon T, Siriwong W, Maldonado-Pérez HL, Robson MG. Green tobacco sickness and protective behaviors among Thai traditional tobacco farmers in northern Thailand. J Health Res. 2016; 30(5): 289-95. DOI:

surfaces results in the characteristic symptoms of GTS [8].GTS is acute nicotine poisoning caused by dermal absorption of nicotine from mature tobacco plants. Its health consequences include vomiting, nausea, headache, and dizziness [9, 10]. In the northern region of Thailand, Nan province is one of the provinces that are well known for Thai traditional tobacco cultivation. Thai traditional tobacco (*Nicotiana Tabacum*) is a non-Virginia type, and its distinguishing characteristics include thicker leaves that contain three to four times more nicotine than the Virginia type [7]. Thai traditional tobacco farming in this province accounts for 10% of total tobacco farming in the country. Furthermore, during 2012-2013, the land used to cultivate Thai traditional tobacco increased by as much as 50% due to higher prices of tobacco leaves, meaning more profits that have encouraged farmers to cultivate it more. In fact, the total production of Thai traditional tobacco was approximately 3.7 million kilograms from the total land of 7,190 *Rais*, (1 Acre =2.539 *Rais*).

Thai traditional tobacco cultivation and the production process of dry tobacco in Thailand are different from those in western countries. In traditional tobacco farming, farmers have to water the plants in the morning or evening, during which they may come into contact with wet tobacco leaves. The process of Thai traditional tobacco farming starts with cultivating and transplanting seedlings in the tobacco field, maintaining tobacco plants with application of fertilizers and insecticides, removing axillary buds, cutting the top of tobacco plants, and getting rid of weeds with a knife. Timing for picking mature tobacco leaves is around 100 to 120 days after planting, after which tobacco leaves will be transferred to the farmers' home or specific places nearby. After that, tobacco leaves are cured between five and seven days until they become ripened. A stem of ripened tobacco leaves will be removed, and tobacco leaves are rolled into a bundle in preparation for slicing with the cutting machine, before tobacco slices are put on a square bamboo rack. In the following step, the rack will be dried in the sunlight for one to three days. During this time, the farmers have to flip the bamboo rack once in the morning and once at nighttime every day to ensure even coloring of tobacco lines, and dry tobacco extract is sprayed onto the dried tobacco leaves to adjust their color. At night, dew will make tobacco slices soft and easy to fold. In the end, the tobacco slices will be packed in a plastic bag, weighing 10 kilograms per bag, ready to be sold to merchants. During these processes, the farmers will be exposed to nicotine in tobacco leaves which may have adverse effects on their health, or GTS. Farmers' exposure to nicotine during their handing of tobacco leaves as well as their inhalation of nicotine dust particles from dried tobacco, put them at risk of nicotine poisoning.

The purpose of this study was to investigate the association between green tobacco sickness (GTS) and use of personal protective equipment (PPE) among Thai traditional tobacco farmers in Praputthabath sub-district, Chiangklang district and Phatow sub-district, Thawangpha district in Nan province, Thailand. It was anticipated that the present study could advance understanding of GTS in Thailand, so that appropriate preventive measures could be devised.

METHODOLOGY

Sample and sampling method

This study was conducted in December 2012. The target population was the farmers who cultivated Thai traditional tobacco plants in Nan province, a province in the northern region of Thailand. Seven villages and 1,116 households in Phatow sub-district in Thawangpha district and ten villages and 1,755 households in Praputthabath sub-district in Chiangklang district were chosen as the study population. The representatives of households in the chosen sub-districts were randomly selected with a drawing technique and were asked to respond to the questionnaire. There were both male and female subjects who ranged in age from 20 to 65 years of age, totaling 473 tobacco farmers. They were local tobacco farmers who were in generally good health, and they grew tobacco for tobacco leaves or produced dry tobacco leaves during the tobacco season. In addition, they had no fever or other symptoms of a common cold and no diarrhea. The subjects did not have recent tobacco farming-related pesticide exposure, because pesticides are used only early in the cultivation cycle, whereas interviews were conducted when the tobacco was full grown, about 3 months after planting.

Data collection instruments

Data collection instruments comprised a standardized questionnaire and an environmental survey. The questionnaire was modified from that used in a previous study [9]. Questionnaire data included individual characteristics of the farmers (gender, age, family status, level of education, current smoking status, and alcohol consumption), work related conditions (process of tobacco plantation and cultivation: seedling, growing, watering, fertilizing; previous use of pesticides or chemicals in the early stage of tobacco cultivation; process of maintaining tobacco plants (watering,

cutting the top and axillaries buds, dropping herbicide on the top and buds, fertilizing, getting rid of grass, spraying insecticide); and picking and curing tobacco leaves (picking tobacco leaves, transferring them from farm to home, and curing tobacco leaves).Other data collected included the process of drying tobacco (removing the stem of tobacco leaves, rolling a bundle of tobacco leaves, cutting tobacco leaves with the cutting machine, putting slices of tobacco on a bamboo rack, bringing the bamboo rack of tobacco out to dry in the sunlight, flipping the bamboo rack, spraying tobacco extract to adjust the tobacco coloring, packing dry tobacco in a plastic bag, and picking the bamboo rack). In this study, definition of GTS refers to health consequences of traditional tobacco exposure that are caused by acute nicotine poisoning due to absorption of nicotine from mature tobacco plants within two to three days of working with the plants, with subjective health symptoms from self-reported by farmers including vomiting, nausea, headache, and dizziness that a person had to have one or more of these symptoms after working with tobacco plants. Information including farming description, handling of tobacco leaves, and use of personal protective equipment (PPE) was also elicited from the subjects and observed by the researchers and well-trained interviewees. The acute symptoms consistent with the definition of GTS (typical symptoms occurred relating to tobacco harvesting and dried tobacco producing including vomiting, nausea, headache, and dizziness, which followed the definition of a previous study by Arcury et al. [10]) were asked in the form of dichotomous (YES/NO) outcomes. This study was approved by the Institutional Review Board on Research Ethics of College of Public Health Sciences, Chulalongkorn University, with the approval code COA No.170/2012.

Data analysis

All data were coded and entered into the Statistical Package for Social Sciences (SPSS) version 22 (licensed for Chulalongkorn University). Describe statistical analyses were conducted using frequency and percentage, mean and standard deviation. The prevalence of GTS was stratified based on farmers' characteristics, work-related characteristics, and health consequences of traditional tobacco exposure following the definition. Finally, the association between GTS and use of PPE was analyzed by means of the Chi-square test.

RESULTS

There were 473 Thai traditional tobacco farmers who participated in the questionnaire interview. As regards demographic characteristics of these farmers, half of them, or 50.7%, were male, while 49.3% were female. They ranged in age from 35 to 65 years old, with the average age of 51.82 years old (SD = 7.39). Moreover, a little more than half of the subjects, or 56.7%, were head of the family. As for educational background, the majority of the subjects, or 83.1%, completed primary education, and 15.8% completed secondary education. In addition, most of them, or 89%, had experiences with Thai traditional tobacco plantation for more than 20 years, and 57.9% worked with tobacco around six to ten hours per day. With regard to history of smoking, 88.8% of the farmers did not smoke cigarettes, but nearly two-thirds, or 61.5%, had history of alcohol consumption. The findings regarding demographic characteristics of the study subjects are summarized in Table 1. It is worth noting that the demographic characteristics of the study subjects were consistent with those of the people living in a rural area in the northern region of Thailand. Almost all of them graduated from a primary school, and tobacco farming was their traditional occupation. On average, the farmers were

Table 1 Demographic characteristics of the study sample (n=473)

Characteristics (n=473)	N	%
Gender		
Male	240	50.7
Female	233	49.3
Age group (years)		
35 - 51	248	52.4
52 - 65	225	47.6
Mean = 51.82; SD= 7.39; Min= 35; Max = 65		
Status in the family		
Head of family	268	56.7
Housewife	195	41.2
Member	10	2.1
Education level		
Primary school	393	83.1
Secondary school	75	15.8
Higher than secondary school	5	1.1
History of cigarette smoking		
No	420	88.8
Yes	53	11.2
History of alcohol consumption		
No	182	38.5
Yes	291	61.5
Experience with tobacco planting (years)		
<20	52	11.0
≥20	421	89.0
Number of hours working with tobacco per day		
0-5	199	42.1
6-10	274	57.9
Mean = 5.26; SD= 4.19; Min= 0; Max = 10		

Table 2 Use of personal protective equipment among Thai traditional tobacco farmers (n=473)

Use of PPE	Thai traditional tobacco farmers: n (%)		
	Never	Sometimes	Always
Long-sleeved shirts	88(18.6)	7(1.5)	378(79.9)
Pants	52(11.0)	1(0.2)	420(88.8)
Raincoat	320(67.7)	80(16.9)	73(15.4)
Plastic apron	311(65.8)	94(19.9)	68(14.4)
Gloves	274(57.9)	41(8.7)	158(33.4)
Boots	271(57.3)	118(24.9)	84(17.8)
Face mask	135(28.5)	43(9.1)	295(62.4)
Changing wet clothes after work	310(65.5)	94(19.9)	69(14.6)

Table 3 The prevalence of green tobacco sickness among Thai traditional tobacco farmers (n=473)

Gender	Total (GTS cases)	Prevalence of GTS (95% CI)
Male	240 (43)	17.92 (13.58-23.26)
Female	233 (64)	27.47 (22.14-33.53)
Overall	473 (107)	22.62 (19.08-26.60)

Table 4 Associations between the use of PPE and green tobacco sickness (n=473)

Green Tobacco Sickness (GTS)	Type of PPE use n (%)			χ^2	*p*-value*
	Never	Sometimes	Always		
Wearing long-sleeved shirts					
No	69(18.9)	7(1.9)	290(79.2)		
Yes	19(17.8)	0(0)	88(82.2)	2.194	0.334
Total	88(18.6)	7(1.5)	378(79.9)		
Wearing long leg pants					
No	43(11.7)	1(0.3)	322(88.0)		
Yes	9(8.4)	0(0.0)	98(91.6)	1.253	0.535
Total	52(11.0)	1(0.2)	420(88.8)		
Wearing plastic apron					
No	227(62.0)	76(20.8)	63(17.2)		
Yes	84(78.5)	18(16.8)	5(4.7)	13.125	0.001*
Total	311(65.8)	94(19.9)	68(14.4)		
Wearing rain coat					
No	244(66.7)	61(16.7)	61(16.7)		
Yes	76(71.0)	19(17.8)	12(11.2)	1.885	0.390
Total	320(67.7)	80(16.9)	73(15.4)		
Changing wet clothes after work					
No	225(61.5)	77(21.0)	64(17.5)		
Yes	85(79.4)	17(15.9)	5(4.7)	14.500	0.001
Total	310(65.5)	94(19.9)	69(14.6)		
Wearing gloves					
No	214(58.5)	30(8.2)	122(33.3)		
Yes	60(56.1)	11(10.3)	36(33.6)	0.499	0.779
Total	274(57.9)	41(8.7)	158(33.4)		
Wearing boots					
No	208(56.8)	95(26.0)	63(17.2)		
Yes	63(58.9)	23(21.5)	21(19.6)	0.993	0.609
Total	271(57.3)	118(24.9)	84(17.8)		
Wearing mask					
No	95(26.0)	32(8.7)	239(65.3)		
Yes	40(37.4)	11(10.3)	56(52.3)	6.234	0.044*
Total	135(28.5)	43(9.1)	295(62.4)		

*The *p-values* were based on the Chi-square test or Fisher's Exact test < 0.05.

in their middle to late adulthood (35-51 years old), and such a finding was in congruence with the current age of farmers in the rural areas of Thailand, who are mostly in their middle or late adulthood.

Table 2 presents the frequency of farmers' use of personal protective equipment (PPE) while working with tobacco processing. Most of the subjects reported that they always used PPE (a long-sleeved shirt, pants, and a mask). However, 67.7% and 65.8% of the subjects had never worn a raincoat or a plastic apron, respectively. In addition, even though a mask was always used by almost two-thirds of the subjects (62.4%), it could be seen that more than one-fourth of the subjects, or 28.5%, had never used it. Finally, nearly two-thirds of the subjects, or 65.5%, never changed their wet clothes after finishing their work with tobacco plants.

According to Table 3, the total prevalence of GTS was 22.62% (95% CI= 19.08-26.60). When the prevalence was stratified by means of personal and work-related characteristics, it was equal to 17.92% (95% CI= 13.58-23.26) and 27.47% (95% CI= 22.14-33.53) among male and female subjects, respectively.

The results of this study showed that the total prevalence of GTS was 22.62% among Thai traditional tobacco farmers in Nan province, Thailand, where only the Thai traditional tobacco type (non-Virginia type) was cultivated. This finding defined GTS as health consequences of traditional tobacco after exposure to tobacco leaves [11] that resulted in such symptoms as headache, nausea, dizziness, and vomiting, and it was the same definition as specifically defined by a previous study [9] previously mentioned and in this study, definition of GTS refers to health consequences of traditional tobacco exposure that are caused by acute nicotine poisoning due to absorption of nicotine from mature tobacco plants though work with tobacco plants within two to three days, with subjective health symptoms from self-reported by farmers including vomiting, nausea, headache, and dizziness that a person had to have one or more of these symptoms after working with tobacco plants. There is a wide range of prevalence of GTS reported in the literature, from 8% to 89% per season [12].

As shown in Table 4, the association between green tobacco sickness (GTS) and use of personal protective equipment was found as the farmers who wore a plastic apron or mask had a strongly difference statistically significant association with GTS ($p = 0.001$ and $p = 0.044$, respectively that farmers who wore a plastic apron or mask was risk of GTS lower than who did not use it. However, wearing a long-sleeved shirt, pants, raincoat, gloves, and boots were not statistically significantly associated with GTS ($p>0.05$). Also, a good practice of changing wet clothes after work was strongly difference statistically significantly associated with GTS ($p =0.001$) that means farmers who changing wet clothes was risk of GTS lower than in who did not change.

DISCUSSION

Based on the findings of this study, it could be seen that almost all of the farmers worked in wet clothes when watering tobacco plants and never changed clothes until they finished their work. Such a practice was found to have a statistically significant association with GTS. In fact, watering tobacco plants needs to be conducted every seven days. In this study, the farmer who watered tobacco plants with a hose, sprinkler, or pipe line may have been associated with GTS. Such findings were consistent with findings of a previous study [13]that a wet condition promotes dermal absorption of nicotine. Furthermore, GTS was associated with changing out of wet clothing. In this study, the farmers never changed from their wet clothes (65.5%) until they finished their work of the day or in the evening. Thus, continuously wearing wet clothes may increase exposure to nicotine from mature plants which have more soluble nicotine that can be more easily absorbed via the skin. This may have helped explain why a wet condition was found to be related to GTS. Even in a dry working condition, the farmers who wear a long-sleeved shirt or pants maybe susceptible to exposure to nicotine on tobacco leaves. However, if they work in a wet condition, their wet clothes may increase area absorption of nicotine as nicotine is water soluble. Likewise, a previous study has reported similar findings that Thai traditional tobacco farmers are engaged in several work processes associated with GTS, as similarly reported by Quandt et al.[13]. In this study, it was found that types of work were associated with the exposure to wet plants and to matured tobacco plants that have high nicotine content. In the process to maintain tobacco plants, cutting axillaries buds is related to exposure to nicotine in the mature plants, and the farmers must engage in this process every seven days until the plants are matured. The leaves or all parts of the plants contain nicotine, and when the farmers break the axillaries buds, they have to use their hands to bring out the buds or twist the buds from the plants. In so doing, their hands will be exposed to the plants' juice or sap. Moreover, in this process, the farmers have to walk through and move up and down rows of plants, which can increase their

exposure to nicotine as well. Accordingly, in this study, it was found that there was statistically significant different between the famers who always wore a plastic apron and those who did not use a plastic apron when it came to association with GTS. In addition, during the processes of picking tobacco leaves, curing tobacco leaves, and putting tobacco slices on the bamboo rack, the farmers use their hands and arms to contact with the juice and sap of the plants. Similarly, their hands contact the juice and sap of the plants when they transfer the leaves from the pickup truck or the pushcart to the place of curing (air curing) in their home or nearby places. In particular, in the process of putting tobacco slices on the bamboo rack or picking dried tobacco, even though the farmers use rubber latex gloves, the gloves cannot protect them from exposure to nicotine on their hands. This is because a hot climate may promote sweating of the hands, so the moisture from the sweat may still lead to GTS in the farmers. Such findings have yielded support to findings of a previous study[14]. However, such findings were inconsistent with the findings of earlier studies in which a variety of seamless knitted hand gloves were tested to determine prevention of dermal nicotine absorption and nylon gloves were found to be most durable and suitable in all the processes of tobacco cultivation [15] and the use of any type of gloves significantly reduced the levels of nicotine ($p<0.01$) and cotinine ($p<0.0005$) in the urine [16]. In contrast, in the present study, almost all of the subjects wore rubber latex gloves and reused their gloves until they leaked; thus, nicotine may have been absorbed through dermal contact. This may explain why there were no differences in association with GTS between the farmers who used and those who did not use rubber latex gloves. In addition, previous studies have also revealed that wearing boots could reduce nicotine absorption [15, 17].However, in the present study, the farmer used boots and worked with tobacco plants in a dry condition, so wearing boots may not be associated with GTS. Meanwhile, in the watering process, the farmers who did not use boots or gloves during their work in a wet condition manifested symptoms of GTS, and such a finding was congruent with the finding of a previous study [18]. Furthermore, it was discovered that the farmers who wore a mask (nose mask) had a negative relationship with GTS. Such a negative association could be explained with the inverse direction of two factors. In this study, the farmers who worked with dried tobacco processing including putting tobacco slices on the bamboo rack, flipping the bamboo rack, and picking dried tobacco had a close contact with the tobacco pieces which were only around two to three feet away in front of them. The farmers sat down and used their hands to handle the situation, and this may lead to inhalation exposure, causing these farmers to be exposed to nicotine dust through both inhalation and dermal contact, hence susceptibility to GTS [19]. The personal protective equipment used among farmers in this study was also found to be related to different magnitudes of GTS. Put another way, protective equipment could decrease the magnitude of GTS significantly. Moreover, in order to use the equipment, farmers felt that they should be comfortable as well while working in a hot climate[5, 9]. Finally, the results of this study were similar to the results of Gehlbach et al.[15]which highlighted a key element in primary prevention of GTS/nicotine absorption in tobacco harvesters. Knowledge should be provided with findings also indicated that there were a number of famers who always tried to use some form of self-protection to protect themselves from nicotine exposure while working, even though some of the PPE they chose may not give effective protection from GTS. For example, some farmers believed that wearing rubber latex gloves or plastic gloves would be helpful when in fact these gloves could not offer them protection from exposure to nicotine. Farmers who wore a plastic apron or mask were risk of GTS lower than who did not use it. Farmers who changing wet clothes was risk of GTS lower than in who did not change. To promote hand washing and allow workers time to change if their clothes are soaking wet. In short, in order to prevent health effects, running water or water supply should be provided all over the facilities so that the farmers could wash their hands as often as they would like to. Necessary knowledge about self-protection and GTS prevention should be made available to all tobacco farmers as well [9].

LIMITATIONS

Some limitations of this study should be noted. As in many studies of GTS, the definitions of GTS vary. The present study followed the definition of GTS given in previous studies by Arcury et al. in 2003 [10] as there are no established criteria for the diagnosis of GTS in Thailand.

CONCLUSION AND RECOMMENDATIONS

The findings of this study indicated that a number of famers always used proper PPE in order to protect themselves from symptoms caused by nicotine exposure during their work. However, it is noteworthy that some farmers may have misunderstood that some PPE such as rubber latex

gloves may give them full protection from GTS when, in fact, it is actually possible to promote GTS due to sweat or moisture of sweat during the time when the gloves are used. A strong association between a good practice of changing wet clothes after work and GTS is the most remarkable finding of this study. Moreover, the findings help confirm that less use of personal protective equipment may increase adverse health symptoms related to GTS. Finally, a health education program is recommended to increase farmers' awareness of health risks caused by exposure to nicotine in tobacco. Finally, long-term health effects of exposure to nicotine in tobacco should be investigated in further studies.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the Ratchadapisek Sompoch Endowment Fund (2014), Chulalongkorn University (CU-57-078-AS) and the Thai Fogarty ITREOH Center (Grant Number. 1D43 TW007849 Fogarty International Center-National Institutes of Health) for a financial support for this research. The College of Public Health Sciences, Chulalongkorn University, Bangkok, Thailand is also gratefully acknowledged.

REFERENCES

1. McKnight RH, Koetke CA, Donnelly C. Familial Clusters of Green Tobacco Sickness. Journal of Agromedicine. 1996; 3(2): 51-9. doi: 10.1300/J096v03n02_06
2. McBride JS, Altman DG, Klein M, White W. Green tobacco sickness. Tob Control. 1998 Autumn; 7(3): 294-8.
3. Curwin BD, Hein MJ, Sanderson WT, Nishioka MG, Buhler W. Nicotine exposure and decontamination on tobacco harvesters' hands. Ann Occup Hyg. 2005 Jul; 49(5): 407-13. doi: 10.1093/annhyg/meh112
4. Centers for Disease Control and Prevention [CDC]. Green tobacco sickness in tobacco harvesters--Kentucky, 1992. MMWR Morb Mortal Wkly Rep. 1993 Apr 9; 42(13): 237-40.
5. Nicotine absorption by workers harvesting green tobacco. Lancet. 1975 Mar; 1(7905): 478-80.
6. Yokoyama K. Our recent experiences with sarin poisoning cases in Japan and pesticide users with references to some selected chemicals. Neurotoxicology. 2007 Mar; 28(2): 364-73. doi: 10.1016/j.neuro.2006.04.006
7. Ghosh SK, Parikh JR, Gokani VN, Rao MN, Kashyap SK, Chatterjee SK. Studies on occupational health problems in agricultural tobacco workers. J Soc Occup Med. 1980 Jul; 30(3): 113-7.
8. Achalli S, Shetty SR, Babu SG. The Green hazards: a meta-analysis of green tobacco sickness. International Journal of Occupational Safety and Health. 2012; 2(1): 11-4.
9. Arcury TA, Quandt SA, Preisser JS, Bernert JT, Norton D, Wang J. High levels of transdermal nicotine exposure produce green tobacco sickness in Latino farmworkers. Nicotine Tob Res. 2003 Jun; 5(3): 315-21.
10. Arcury TA, Quandt SA, Simmons S. Farmer health beliefs about an occupational illness that affects farmworkers: the case of green tobacco sickness. J Agric Saf Health. 2003 Feb; 9(1): 33-45.
11. Quandt SA, Arcury TA, Preisser JS, Norton D, Austin C. Migrant farmworkers and green tobacco sickness: new issues for an understudied disease. Am J Ind Med. 2000 Mar; 37(3): 307-15.
12. Schmitt NM, Schmitt J, Kouimintzis DJ, Kirch W. Health risks in tobacco farm workers—a review of the literature. Journal of Public Health. 2007; 15(4): 255-64. doi: 10.1007/s10389-007-0122-4
13. Quandt SA, Arcury TA, Preisser JS, Bernert JT, Norton D. Environmental and behavioral predictors of salivary cotinine in Latino tobacco workers. J Occup Environ Med. 2001 Oct; 43(10): 844-52.
14. Kongtip P, Trikunakornwong A, Chantanakul S, Yoosook W, Loosereewanich P, Rojanavipart P. Assessment of nicotine dermal contact and urinary cotinine of tobacco processing workers. J Med Assoc Thai. 2009 Dec; 92(Suppl. 7): S128-33.
15. Gehlbach SH, Williams WA, Freeman JI. Protective clothing as a means of reducing nicotine absorption in tobacco harvesters. Arch Environ Health. 1979 Mar-Apr; 34(2): 111-4.
16. Doctor PB, Gokani VN, Kulkarni PK, Parikh JR, Saiyed HN. Determination of nicotine and cotinine in tobacco harvesters' urine by solid-phase extraction and liquid chromatography. J Chromatogr B Analyt Technol Biomed Life Sci. 2004 Apr; 802(2): 323-8. doi: 10.1016/j.jchromb.2003.12.013
17. McKnight RH, Levine EJ, Rodgers GC, Jr. Detection of green tobacco sickness by a regional poison center. Vet Hum Toxicol. 1994 Dec; 36(6): 505-10.
18. Onuki M, Yokoyama K, Kimura K, Sato H, Nordin RB, Naing L, et al. Assessment of urinary cotinine as a marker of nicotine absorption from tobacco leaves: a study on tobacco farmers in Malaysia. J Occup Health. 2003 May; 45(3): 140-5.
19. Trikunakornwongs A, Kongtip P, Chantanakul S, Yoosook W, Loosereewanich P, Rojanavipart P. Assessment of nicotine inhalation exposure and urinary cotinine of tobacco processing workers. J Med Assoc Thai. 2009 Dec; 92(Suppl. 7): S121-7.