Review Article

Green Tobacco Sickness among Tobacco Harvesters: A Review of the Literature

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Abstract

Green tobacco sickness (GTS) is an occupational illness that affects tobacco harvesters. It is a type of acute nicotine intoxication caused by nicotine absorption through the epidermis of a moist green tobacco plant. The purpose of this study was to systematically review the existing literature on the green tobacco sickness and its health impacts on tobacco harvesters. A standard literature search was performed using multiple electronic databases like PubMed, PubMed Central, Cochrane Library, Campbell systematic review Embase, Google Scholar and Scopus for studies published on green tobacco sickness from 2000 to 2020. A total of 11 studies with a total population of 6,253 were reviewed. The prevalence of green tobacco sickness among tobacco harvesters ranged from 6.6% to 56.9%. Exposure to Sunlight, use of pesticides, Stalk removal of tobacco leaves, gender of the farmer, smoking, skin rash, wearing a wet suit, process of curing tobacco leaves, and watering tobacco plants, task, topping, barning and working in wet clothing were some of the risk factors reported by authors. Green tobacco sickness was shown to be common in the study population, indicating that a significant regulatory effort is needed to address the potential dangers of GTS.

Keywords: Green tobacco sickness, health risk, nicotine, tobacco harvesters, tobacco

Introduction

For years, the tobacco sector has allowed countries and farmers to grow more tobacco to increase their profits. Tobacco companies have promoted the expansion of tobacco as a panacea, thinking that it would provide unprecedented riches to farmers, their families, and their countries.[1]

Tobacco (Nicotiana tabacum) is grown in over 100 countries, with around 5.73 million metric tonnes of dry tobacco produced in 2004. The top five tobacco producers predicted for 2004 are China (2.01 million metric tonnes; 35.1%), Brazil (757 thousand metric tonnes; 13.2%), India (598 thousand metric tonnes; 10.4%), the United States (358 thousand metric tonnes; 6.2%), and Malawi (138 thousand metric tons; 2.4%). Together, these five countries produce two-thirds of all tobacco produced worldwide.[2]

Bernardino Ramazzini, known as the "Father of Occupational Medicine," first detailed the health risks associated with tobacco growing in 1713. He saw a variety of symptoms among Italian tobacco workers, including headaches and gastrointestinal problems, which he attributed to tobacco dust exposure.[3] Weizenecker and Deal initially observed green tobacco illness in 1970 among 68 farmers in Florida, and Stephen and Gehlbach later recognized it.[3]

Green tobacco sickness (GTS) is an occupational illness that affects tobacco harvesters. It is a type of acute nicotine intoxication caused by nicotine absorption through the epidermis of a moist green tobacco plant.[4] When rain, dew, or perspiration moistens the clothing or tobacco plants, GTS happens.[5] However, this illness was well-known among tobacco producers even before this report was published in the medical literature.[6]

Tobacco workers are at an elevated risk of injury and sickness due to the hazards of tobacco manufacturing. Despite the fact that GTS is not linked to death or long-term morbidity, it

Access this article online

Quick Response Code:

Website: www.ijcommdent.com

DOI: 10.4103/ijcd.ijcd_23_21

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How to cite this article: Raja BK, Prashanth V, Devi K. Green tobacco sickness among tobacco harvesters: A review of the literature. Int J Community Dent 2021;9:36-40.

Received: 02-11-21; **Accepted:** 03-12-21; **Web Published:** 26-03-22

causes significant pain and productivity loss among tobacco workers.[7]

GTS is characterized by symptoms such as nausea, vomiting, pallor, dizziness, headaches, increased transpiration, chills, stomach discomfort, diarrhea, and increased salivation, prostration, and weariness, depending on the level of exposure. These signs and symptoms are referred to as neurological problems. Other signs and symptoms include a cough with or without expectoration, dyspnea, and a decrease in blood pressure or heart rate on occasion.[8-10]

Above all, illness is self-limiting and short-lived. It usually goes away on its own without any treatment. Extreme instances, on the other hand, necessitate institutionalization for treatment. Nicotine toxicity is proportional to the amount of nicotine eaten. Its size, on the other hand, is determined by factors such as tobacco variety, smoking habit, humidity, ambient temperature, work kind, and dew deposition on the plant.[11]

The symptoms of GTS are frequently similar to those of chemical poisoning or heat exhaustion, as well as nicotine overdose in novice smokers. Clinicians who are inexperienced with GTS may potentially misdiagnose the condition.[7]

Tobacco cultivation also has a negative impact on the environment.[1] Wood is used as a fuel to heal tobacco leaves and to construct healing barns in many poor nations. Tobacco cultivation destroys an estimated 200 000 hectares of forest and woods each year throughout the world.[12] The tobacco plant degrades the environment by leaching nutrients from the soil and polluting it with pesticides and fertilizers used on tobacco farms.[13] As a result, this review summarizes the existing research on green tobacco illness and its health effects on tobacco harvesters in a methodical manner.

Materials and Methods

A conventional literature search was conducted using PubMed, PubMed Central, Cochrane review, Campbell systematic review, Scopus, Embase, and Google scholar, among other electronic databases. This review covered all English-language publications published between the years 2000 and 2020.

Inclusion criteria

- Cross-sectional studies, longitudinal studies
- Studies carried out till January 2021
- Studies reported in English language
- Studies have examined GTS among tobacco harvesters.

Exclusion criteria

- Letter to editor, case report, personnel proceedings, personal communications, and any types of reviews were excluded
- Systematic reviews and meta-analysis
- Studies in language other than English were also excluded.

Outcomes

The following outcomes were assessed from each included study:

1. Prevalence of GTS
2. Risk factor for GTS
3. Preventive measures suggested from each study.

Search strategy

A comprehensive electronic search was performed in the following databases, such as PubMed, PubMed Central, EMBASE, Google Scholar, Scopus, Campbell systematic review, and Cochrane. Search was carried out using keywords such as tobacco, tobacco farm, health, GTS to find the relevant studies. Studies published till January 2021 were included in this review. Hand searching of the reference lists of the eligible article as well as of review articles was performed.

Search for relevant studies was performed until January 30, 2021. In case of any relevant articles found without full text during the search process, the corresponding authors were contacted through E-mail to retrieve the article. In the beginning duplicate articles were excluded. Then the titles and abstracts of the study were independently assessed by two authors based on the eligibility criteria.

Finally, the full text of the articles that were initially included was evaluated according to the inclusion and exclusion criteria. Along the process, the two authors reached a consensus through discussion if their options were different. Cohen's kappa was adopted to assess the interexaminer reliability. The Kappa coefficient value for inter-examiner reliability for the investigator was 0.87–0.89. The overall interexaminer reliability was good and showed a high degree of conformity. When the study results were published more than once or were detailed in multiple publications, the most complete data set was identified and included.

Extraction of data

Data from included studies were extracted by the first author using a data extraction form which was validated through consensus with the second author. The following data were collected from each article: Surname of the first author, year of article publication, place of study, sample size, prevalence of GTS, gender, methodology, significant findings of the study, risk factors, and preventive strategies [Tables 1-3]. These data were derived by three authors independently. Any disagreement was resolved between them and consensus was reached in the end.

Results

One hundred and five records were found by preliminary screening through database search and one record was discovered by additional sources. Out of these 106 articles 35 articles were assessed for eligibility of which 24 articles failed to meet the inclusion criteria and finally 11 articles were included for the review. Figure 1 shows the flow diagram for the selection of articles included in this review.

Table 1: Risk factors reported for green tobacco sickness by author of included studies

Author (Publication year)	Risk factors reported from their study
Campos *et al*., 2020[14]	Sunlight exposure, use of pesticides
Rokhmah *et al*., 2019[15]	NR
da Mota E Silva *et al*., 2018[16]	Stalk removal of tobacco leaves
Park *et al*., 2017[5]	Cotinine concentration at dawn was significantly higher than that at other times; it was significantly lower during the non-harvesting period than during the harvesting period
Saleeon *et al*., 2015[17]	Gender of the farmer, smoking, skin rash, wearing a wet suit, process of curing tobacco leaves, and watering tobacco plants
Fassa *et al*., 2014[18]	Among men: Age, being a nonsmoker, hanging tobacco sticks in the barn, harvesting wet leaves, and exposure to physical exertion were risk factors for GTS Among women: Tying hands of tobacco, transporting bales, harvesting wet leaves, having had contact with pesticides, and exposure to physical exertion
Van Minh *et al*., 2009[1]	Men and increasing age
Arcury *et al*., 2008[19]	Task, topping, barning, and working in wet clothing, fewer than 25% of workdays had the largest effect
Parikh *et al*., 2005[11]	NR
Arcury *et al*., 2001[20]	Task, working in wet clothing, fewer than 25% of workdays
Ghosh *et al*., 1986[21]	NR

NR: Not reported, GTS: Green tobacco sickness

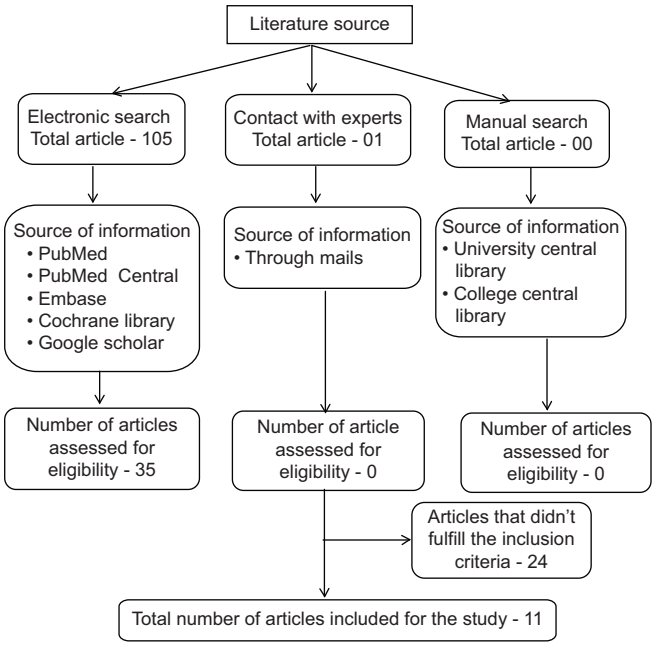

Figure 1: Search strategy

Discussion

There has been very little regulatory action to address the possible dangers of GTS. There is currently no legal obligation that employees be educated about the dangers of nicotine exposure. As a result, it is important to raise public knowledge of GTS.

Different GTS incidence frequencies have been recorded in studies done in many nations, ranging from higher to lower prevalence. In this comprehensive study, a wide range of GTS prevalence was observed, ranging from 6.6%[18] to 56.9%.[16] These discrepancies, as well as the distinct variances across the groups studied, may be explained by the variety in sample size of each research considered.

The varied techniques employed by each study, as well as the varying features of the tobacco-producing processes in different places, according to the kind of growing tobacco, might explain the reported range of GTS frequencies. Da Mota E Silva *et al*.[16] reported age was not directly associated with GTS but Minh HV[1] reported that increasing age was associated with a higher occurrence of GTS.

Interestingly prevalence of GTS was observed to be more among women in study reported by Da Mota E Silva *et al*.[16] where he explained the difference in the prevalence of GTS between gender was due to distinct tasks performed by women. Authors also explained that "women performed the stalk removal of tobacco leaves, which demands a continuous contact of the worker's palms (an area of intense sweating) with the leaf surface, providing considerable absorption of nicotine, solubilized by sweat." Similarly Saleeon *et al*.[17] and Minh HV[1] reported the highest prevalence of GTS among women. Arcury *et al*.[20] documented where almost all of the farmers affected by GTS were male. A higher prevalence of GTS among women could also be related to biological gender differences. Females have a relatively larger dermal area of absorption in relation to their body volume when compared to males.[18] These findings indicate immediate actions toward women's livelihoods and health are urgently needed.

Da Mota e silva *et al*.[16] reported smoking was not found to be directly related to the onset of GTS and Saleeon *et al*.[17] reported smoking found to be protective against GTS. The relationship between smoking and GTS has been reported to have a weak protective effect,[9] but another report suggested no protective effect.[21]

As the consequences of acute nicotine toxicity may be mistaken for those of pesticide poisoning or heat exhaustion, physicians and public health authorities and organizations need to become more aware of the causes of GTS and its signs and symptoms.

Table 2: General characteristics of included studies in this review

Author (publication year)	Study period	Study location	Sample size	Prevalence	Gender	Methodology	Significant findings of the study
Campos *et al*., 2020[14]	August-October 2011 and January-February 2012	Brazil	354	34.5%	Both	Cross sectional study	The urinary cotinine level was assessed
Rokhmah *et al*., 2019[15]	April-November 2017	Indonesia	322	NR	Both	Cross-sectional study	Knowledge was significantly related to GTS symptoms
da Mota E Silva *et al*., 2018[16]	August to September 2011	Northeastern Brazil	167	56.9%	Both	Cross-sectional study	No association was identified between the investigated polymorphisms and GTS
Park *et al*., 2017[5]	July 20, 2008 to July 30, 2008	Korea	40	37.5%	Both	Cross-sectional survey	GTS incidence according to number of workdays was 3.4 occurrences/100 person-days
Saleeon *et al*., 2015[17]	December 2012	Thailand	473	22.6% Male - 17.9% Female - 26.6%	Both	Systematic random sampling	Body soaking during watering further increased adverse health effects related to GTS
Fassa *et al*., 2014[18]	NR	Brazil	2469	Male - 6.6%, Female - 11.9%	Both	Cross-sectional survey	Among men, age, being a nonsmoker, hanging tobacco sticks in the barn, harvesting wet leaves, and exposure to physical exertion were risk factors for GTS
Van Minh *et al*., 2009[1]	2007	Vietam	968	NR	Both	Cross-sectional study with Two-stage cluster sampling technique	9 out of the 16 health problems were statistically significant higher among tobacco growing farmers compared to that among non-tobacco farmers
Arcury TA *et al*., 2008[21]	May-October 2005	Eastern North Carolina	304	18.4%	Both	Longitudinal surveillance study	Self-reported rash increased the odds of having GTS in the bivariate and multivariate analyses
Parikh *et al*., 2005[11]	NR	Three villages of Central Gujarat	685	47% Men - 42.66% Women - 55.7%	Both	Case-control study	Severity can be considered as mild acute nicotine toxicity, which is relieved without medication
Arcury *et al*., 2001[20]	1999	North Carolina	182	24.2%	Both	Longitudinal surveillance study	Working in wet clothing had the largest effect on GTS
Ghosh *et al*., 1986[21]	NR	Rajahmundry Andhra Pradesh, India	289	NR	Both	Cross-sectional survey	The frequency symptoms of green tobacco sickness was high (53 29%)

NR: Not reported, GTS: Green tobacco sickness

Table 3: Preventive measure suggested for green tobacco sickness by author of included studies

Author (Publication year)	Preventive measure suggested by authors of included studies
Campos *et al*., 2020[14]	Preventive steps should be undertaken to implement measures as set in articles 17 and 18 of WHO-FCTC
Rokhmah *et al*., 2019[15]	Media campaign for GTS prevention
da Mota E Silva *et al*., 2018[16]	Preventive steps should be undertaken to implement measures as set in Articles 17 and 18 of WHO-FCTC
Park *et al*., 2017[5]	An accurate diagnosis, treatment, and prevention plan need for farmers, as many cases were misdiagnosed and no prevention method has been developed
Saleeon *et al*., 2015[17]	Health education programs were recommended for risk reduction
Fassa *et al*., 2014[18]	Health care providers should be trained to diagnose and treat the problem
Van Minh *et al*., 2009[1]	Increasing public awareness to reduce harmful effects of tobacco growing
Arcury TA *et al*.[20] 2008	Arousing the attention of public health authorities
Parikh *et al*., 2005[11]	NR
Arcury *et al*., 2001[20]	Action should be taken to address farmworker's risk for GTS
Ghosh *et al*., 1986[21]	NR

NR: Not reported, GTS: Green tobacco sickness, WHO-FCTC: WHO Framework convention on tobacco control

Exposure to Sunlight,[14] use of pesticides,[15] Stalk removal of tobacco leaves,[16] gender of the farmer,[17] smoking,[17] skin rash,[17] wearing a wet suit,[17] process of curing tobacco leaves,[17] and watering tobacco plants,[17] task,[19] topping,[19]

barning and working in wet clothing[19] were some of the risk factors reported by authors.

Campos *et al*.[14] and da Mota E Silva MS *et al*.[16] suggested necessary steps should be undertaken to implement measures as set in Articles 17 and 18 of WHO-FCTC.

Media campaigning[15] accurate diagnosis of symptoms,[5] health education programs, training of health care providers,[18] increasing the public awareness[1] and arousing the attention of public health authorities,[19] were some the preventive measures suggested by some authors. Training on the use of various personnel protective equipment and providing provision for handwashing with soap and water after working hours can be also advocated for reducing nicotine exposure. Wearing a rain suit has been suggested as a procedure to reduce the occurrence of GTS.[19]

There are no recognized diagnostic criteria for GTS. Nonsmokers should have blood, saliva (cotinine alone), or urine tests for nicotine and cotinine to confirm their exposure to nicotine from tobacco leaves, which is required for the diagnosis of GTS.[22]

There are few limitations in this review which might temper the conclusions (1) Articles published in English language were only included in this review, which might have omitted potentially useful evidence published in other languages. (2) Due to variability in included studies meta-analysis was not performed. In future, more systematic reviews should be undertaken to overcome these shortcomings.

Conclusion

The study population had a significant frequency of green tobacco illness. As a result, tobacco farm employees must be appropriately educated about GTS and other occupational health concerns prior to and during the tobacco harvesting season. To address the possible dangers of GTS, a significant regulatory effort is required.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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