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ORIGINAL RESEARCH

THE OVERVIEW OF GREEN TOBACCO SICKNESS AMONG TOBACCO FARMERS IN JEMBER DISTRICT, INDONESIA

Gambaran Kasus Green Tobacco Sickness Pada Petani Tembakau di Kabupaten Jember Indonesia

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ABSTRACT

Background: Green tobacco sickness (GTS) is a type of disease that is still not widely understood, but is often experienced by tobacco farmers. The duration and frequency of contact, the work procedures associated with wet tobacco, and individual vulnerability are risk factors for GTS. **Purpose:** This study aimed to measure the factors associated with incidences of GTS in tobacco farmers in Jember, Indonesia, to contribute to the prevention of GTS. **Method:** The research design used case-control. This research was conducted in Jember District, within a group of tobacco farmers. The case group included farmers who experienced GTS and the control group included farmers who did not experience GTS. The study measured age, sex, nutritional status, passive smoking status, alcohol consumption status, subjective complaints, individual hygiene, Occupational Health and Safety (OHS) attitudes, OHS actions, use of personal protective equipment, principal occupation, extra work, type of tobacco leaf, length of service, length of work-rest period, and workload. The study population were tobacco farmers. The sample size was determined using the Lemeshow sampling formula for case-control. The sampling technique was simple random sampling. Data analysis was conducted using chi-squared tests. **Results:** Variables related to GTS cases in tobacco farmers were sex (p = 0.01) and nutritional status (p = 0.03). There were no significant occupational factors. **Conclusion:** Factors that influence GTS are sex and nutritional status.

ABSTRAK

Latar Belakang*: Green Tobacco Sickness (GTS) merupakan jenis*

penyakit yang masih belum dikenal secara luas dan sering dialami oleh petani tembakau. Lama dan frekuensi kontak serta prosedur kerja dengan tembakau basah dan kerentanan individu merupakan risiko terjadinya GTS. ***Tujuan:*** *Penelitian ini bertujuan untuk mengukur faktor apa saja yang berhubungan dengan kejadian GTS pada petani tembakau di Jember, Indonesia, sehingga tujuan preventif GTS bisa tercapai.* ***Metode****: Desain penelitian menggunakan case control. Penelitian ini dilakukan di Kabupaten Jember pada kelompok petani tembakau. Kelompok kasus adalah etani yang mengalami positif GTS dan kelompok kontrol adalah petani yang tidak mengalami GTS. Penelitian mengukur usia, jenis kelamin, status gizi, status perokok pasif, status konsumsi alkohol, keluhan subyektif, higiene individu, sikap K3, tindakan K3, penggunaan alat pelindung diri, pekerjaan utama, pekerjaan tambahan, jenis daun tembakau, masa kerja, lama kerja, lama istirahat dan beban kerja. Populasi penelitian adalah petani tembakau. Besar sampel menggunakan rumus pengambilan sampel Lameshow untuk case control. Teknik pengmabilan sampel menggunakan simple random sampling. Analisis data menggunakan chi-square.* ***Hasil:*** *Variabel yang berhubungan terhadap kasus GTS pada petani tembakau adalah jenis kelamin (p=0,01) dan status gizi (0,03). Variabel faktor pekerjaan tidak memiliki pengaruh yang signifikan terhadap GTS,* ***Kesimpulan:*** *Faktor yang berpengaruh terhadap GTS adalah jenis kelamin dan status gizi.*

INTRODUCTION

Green tobacco sickness (GTS) is a type of disease caused by acute nicotine poisoning that occurs through skin absorption (Acharya & Lee, 2018). GTS occurs in the working population on tobacco farms, especially those engaged in planting and harvesting tobacco. GTS occurs when farmers come into direct contact with a wet pond. Previous studies have mentioned that GTS is characterized by dizziness, nausea, vomiting, headaches, and excessive salivation, and is sometimes accompanied by decreased consciousness (Paul et al., 2019). The risk of nicotine poisoning increases when the individual also experiences wet conditions due to rain, dew, or sweat. GTS weakens occupational health (McMahon, 2019).

GTS is found in several tobacco-producing countries throughout the world, such as Brazil, Korea, and Thailand (Park, Lim, Lee, & Yoo, 2018; Saleeon, Siriwong, Maldonado-Pérez, & Robson, 2015). The prevalence of GTS in Brazil in males is 6.60% and 11.90% in women; it occurs during the harvest season and usually results in workers having to take time off (Fassa et al., 2014). In Korea, 15 out of 40 tobacco farmers (37.50%) experience GTS. The incidence of GTS in women (55%) is higher than in men (20%) and this difference is significant. There is no difference in age group for incidences of GTS. The incidence of GTS is higher in the nonsmoker group (57.50%) compared to the smoker group (0%), and this difference is significant ($p < 0.01$) (Park, Lim, Lee, & Yoo, 2018).

Tobacco farmers are a population group with an occupational type that means they are vulnerable to work-related diseases. Work-related diseases are caused by interactions between workers as hosts and their work or the work environment. Exposure to complex, multi-causal hazards in tobacco farming, in the long term, will cause health problems (Kahl et al., 2018). Data on work-related diseases are not recorded correctly in Indonesia, although work-related diseases, particularly those related to the tobacco industry, are crucial for discussion, as Indonesia is one of the largest tobacco producers in the world. Tobacco farming, while contributing to the economy, also has an impact on health due to tobacco consumption (Natarajan, 2018). Few studies have discussed GTS as a work-related

disease or occupational illness. This study aims to identify the factors that influence the occurrence of GTS in tobacco farmers in Jember District, Indonesia.

METHOD

This study adopted an observational analytic research design, using case-control. It consisted of two stages – identifying cases of GTS and identifying respondents who tested positive for cotinine. This research was conducted on farmers in Jember District. There were two considerations for the selection of this population; tobacco farmers in Jember District have a history of work-related diseases and initial research has been conducted on the health risks in tobacco farming. This study was conducted over a six month period, from May to October 2018. Jember District is one of the largest producers of quality tobacco in East Java, which has the potential to cause GTS in tobacco farmers. Therefore, one of the determinants of farmers' health and safety must be guaranteed at work (Muksin, Hari, Tanti, & Titik, 2018) .

The study population were tobacco farmers who met the inclusion and exclusion criteria. The inclusion criteria required participants to be aged between 18 and 55 years, with a minimum period of five years working as a tobacco farmer, having been involved in the process of tobacco farming for at least the last three months, and willing to be involved in the research by signing an informed consent form. The exclusion criteria included pregnancy, other illness, a history of lung disease, or skin disease. Total of sample is determined through Lwanga & Lemeshow (1991) formula. The sample calculation results identified that the number of samples for Phase 1 was 145 people. In Phase 2, there were 43 positive cases of cotinine poisoning. Sampling was conducted using simple random sampling.

The independent variables included both individual and occupational variables. The individual variables were age, sex, nutritional status, alcohol consumption status, passive smoking status, subjective complaints, individual hygiene, use of Personal Protective Equipment (PPE), and Occupational Health and Safety (OHS) measures. The occupational variables included main work type, additional work, types of tobacco leaves planted, length of workday, length of rest period, and workload.

In this study, cases of GTS were defined as respondents whose urine tested positive for cotinine and who experienced several significant clinical symptoms, including dizziness, headache, nausea, vomiting, and decreased consciousness. Urine cotinine was measured using the Rapid Test COT Cotinine Rapid Sign Cassette. Urine tests can detect cotinine up to 200 ng/ml and two to three days after exposure. Individual socio-demographic data and job characteristics were collected through interviews and questionnaires. An analysis was conducted using chi-squared tests. The level of significance was determined as $p < 0.05$. Ethical approval was requested through the Health Research Ethics Commission of the Faculty of Public Health, Airlangga University, Surabaya. The study received approval on 3 August 2018 (No. 472-KEPK).

RESULTS

Description of the Work Process in Tobacco Agriculture in Jember District

The tobacco processing industry primarily consists of the tobacco industry in the upstream region and the tobacco industry in the downstream region. Tobacco processing in the upstream region involves raising seedlings, planting, maintenance, and harvesting. After the tobacco is harvested, it is brought to the processing plant, which is part of the downstream industry. This research is limited to the upstream industry. The highest GTS risk potential is at the harvest stage. The tobacco processing stage in the upstream region, and the health risks faced based on field observations, are summarized in Table 1

Bivariate Analysis of Individual Factor

Table 2 shows that the majority of respondents who were positive suffering from GTS were over 45 years old (55.81%), male (67.44%), and non-passive smoking (53.49%). The majority of respondents who were negative GTS were less than 45 years old (52.53%), female (76.77%), and passive smoking (63.64%).

Table 2 shows that the majority of both the positive and negative GTS groups were did not consume alcohol, did not experience subjective complaints, and more likely use personal protective action, but categorized into the abnormal nutritional group (underweight and overweight), had poor individual hygiene, and had poor OHS measures . In the positive GTS group, 40 respondents did not consume alcohol (93.02%), 25 respondents did not experience subjective complaints (58.14%), and 29 respondents use personal protective equipment (67.44%), but 33

respondents had an abnormal nutritional status (76.74%), 25 respondents had poor individual hygiene (58.14%), and 38 respondents had poor OHS measures (88.38%). In the negative GTS group, 97 respondents did not consume alcohol (97.98%), 64 respondents did not experience subjective complaints (64.65%), and 58 respondents use personal protective equipment (58.59%), but 55 respondents had an abnormal nutritional status (55.56%), 64 respondents had poor individual hygiene (64.65%), and 95 respondents had poor OHS measures (95.96%).

There is no significant influence between age with GTS (p=0.36), passive smoking (p=0.06), alcohol consumption (p=0.14), subjective complaint (p=0.46), individual hygiene (p=0.46), personal protective equipment (0.32), and OHS measures (p=0.08) with GTS, but there is a significant influences between sex (p=0.01) and nutritional status (p=0.03) with GTS. Table 2 shows that the majority of tobacco farmers in both the positive and negative GTS groups did not consume alcohol. In the group of farmers who were positive for GTS, as many as 40 people (29.20%) did not consume alcohol. In the negative group GTS, as many as 97 people (70.80%). This relationship was not significant (p = 0.33). It also explain that both the positive group GTS and the majority group negative GTS did not experience subjective complaints, respectively, as many as 25 people (28.10%) and 71 people (89%). This relationship was not significant (p = 0.59).

Table 2 shows that both the positive GTS group and the majority negative GTS group had poor individual hygiene status. Respectively, 25 people (28.10%) in the positive GTS group and 64 people (71.90%) in the GTS negative group. This relationship was not significant (p = 0.58).

Table 2 shows that both the positive GTS group and the negative GTS majority used personal protective equipment well. Respectively 29 people (33.30%) and 58 people (66.70%). This relationship was not significant (p = 0.82). It also reveals that both the positive GTS group and the majority negative GTS group had poor K3 measures at 38 people (88.4%) and 95 people (96%). This relationship was not significant (p = 0.183).

Table 1
Potential Health Risks at Each Stage of Tobacco Processing

Stage	Activity	Potential Hazard	Complaints
Land preparation, processing, and pre-treatment	- Fertilizing - Pest control - Irrigation	- Solar heat exposure - Contact with fertilizer - Unnatural work postures - Contact with pesticides	- Heat stress - Heat rash - Musculoskeletal disorders
Harvesting	- Picking leaves - Transporting crops to warehouse	- Solar heat exposure - Contact with wet tobacco leaves	- Dizziness - Headaches - Itchiness - Nausea, vomiting - Musculoskeletal disorders
Selection and drying	- Arranging leaves on bamboo sticks to be hung and dried with smoke (traditional Na Oogst type tobacco and Shade grown (TBN) tobacco	- Injury from bamboo sticks - Smell - Contact with liquid in rotting tobacco leaves - Poor lighting - Exposure to combustion smoke - Contact with wet tobacco leaves	- Dizziness - Being impaled - Sore eyes - Itchy hands and feet
Drying (in warehouse)	- Hanging the leaves on the ceiling	- Fall from a height - Limited lighting	- Injury - Bamboo stick injury - Smell - Itchy hands and feet - Cough
Weighing and packing	- Packing selected tobacco leaves	- Dry tobacco dust - Unnatural work position - Monotonous work - High heat	- Cough - Dizziness - Breathlessness - Joint complaints

Table 2
Bivariate Analysis of Individual Factors and GTS

Variable	GTS				p	OR (95% CI)
	Positive		Negative			
	n	%	n	%		
Age (years)						
≤45	19	44.19	52	52.53	0.36	0.72
>45	24	55.81	47	47.47		(0.35 – 1.47)
Sex						
Male	29	67.44	23	23.23	0.01*	6.84
Female	14	32.56	76	76.77		(3.11– 15.08)
Nutritional status						
Normal	10	23.26	44	44.44	0.03*	2.64
Abnormal (overweight, underweight)	33	76.74	55	55.56		(1.17 – 5.94)
Passive smoking						
Non-passive smoking	23	53.49	36	36.36	0.06	0.50
Passive smoking	20	46.51	63	63.64		(0.24 – 1.03)
Alcohol consumption						
No	40	93.02	97	97.98	0.14	3.64
Yes	3	6.98	2	2.02		(0.59 – 22.60)
Subjective complaints						
No	25	58.14	64	64.65	0.46	1.32
Yes	18	41.86	35	35.35		(0.63 – 2.74)
Individual hygiene						
Good	18	41.86	35	35.35	0.46	0.76
Poor	25	58.14	64	64.65		(0.37 – 1.58)
Personal protective equipment						
Good	29	67.44	58	58.59	0.32	0.68
Poor	14	32.56	41	41.41		(0.32 – 1.45)
OHS measures / Safety action						
Good	5	11.62	4	4.04	0.08	0.32
Poor	38	88.38	95	95.96		(0.08 – 1.26)
Total	43	100.00	99	100.00		

*signifikan (p<0,05)

Bivariate Analysis of Occupational Factor

Table 3 shows that both groups had a main job as farmers or landowners, had a additional job, had been working for ≥8 hours per day, engaged in high risk work, and had a rest period ≤1 hours per day at work. In the positive GTS group, 28 respondents had a main job as farmers or landowners and had a additional job (65.12%), 26 respondents had been working for ≥8 hours per day (60.47%), 29 respondents engaged in high risk work (67.44%), and 41 respondents had a rest period ≤1 hours per day at work (95.35%). In the negative GTS group, 68 respondents had a main job as farmers or landowners (68.69%), 70 respondents had a additional job (70.71%), 52 respondents had been working for ≥8 hours per day (52.52%), 56 respondents engaged in high risk work (56.57%), and 95 respondents had a rest period ≤1 hours per day at work (95.96%)

Table 3 shows that the majority of respondents who were positive suffering from GTS were had been working for <18 years (53.49%) with Kasturi and Rajang leaf (55.81%). The majority of respondents who were negative GTS were had been working for ≥18 years (57.58%) with Na Oogst and TBN leaf (50.51%)

There is no significant influence between occupational factors which are main job (p=0.68), additional job (p=0.51), tobacco leaf (p=0.49), length of working (p=0.22), working time/day (p=0.38), resting time (p=0.87), and work load (p=0.22) towards GTS.

DISCUSSION

Tobacco cultivation reduces soil fertility through the absorption of nutrients, involves intensive use of highly polluting pesticides, disturbs the ecosystem through deforestation, and

releases nicotine into the environment, which is toxic to humans (Masanotti, Abbafati, Petrella, Vinciguerra, & Stracci, 2019). The main toxic substances found in tobacco leaves are alkaloids, nicotine and its metabolites, and polycyclic aromatic hydrocarbons (PAHs), such as benzopyrene (Bonamonte et al., 2016; Matthes & Zatoński, 2019). Nicotine contained in tobacco leaves can cause GTS, which can be detected through urine tests for cotinine as a biomarker (Cezar-Vaz & Cargnin, 2019). The entry of nicotine into the body is not affected by age. Nicotine can be absorbed through the skin (transdermal) into the blood plasma. The period of contact time until symptoms of GTS is between one and three days. The speed of this process is determined by method of entry, contact time, and other individual vulnerabilities (Patel, Jadhav, Shah, & Gupta, 2017).

Workers can experience symptoms of GTS while working or several hours after the workday ends. GTS is an occupational health problem that has not been widely examined (Fotedar & Fotedar, 2017). The key factors that contribute to the absorption of nicotine are a failure to use protective equipment, picking tobacco leaves when there is dew on them, and collecting tobacco leaves under the armpits (Kinay, Kurt, Ekren, & Mercimek, 2018). The use of personal protective equipment can reduce nicotine contact (Reddy & Ashok, 2019).

This study showed that there is a significant influences between sex towards GTS with OR=6.84, which means male workers are more at higher risk 6.84 times than female workers towards GTS. This result is not line with research conducted by Saleeon, Siriwong, Maldonado-Pérez, & Robson (2015), Female workers are dominant in the tobacco industry. Almost all work activities involved in tobacco farming are carried out by women. Working with and exposure to environmental hazards can impact female reproductive functions if appropriate protection is not used (Fassa et al., 2014). Sex is a variable that influences the occurrence of work-related diseases. Other research in Tanzania shows that the amount of time women spend in tobacco farming is more significant and leads to tobacco-related health hazards (Kidane, Hepelwa, Mdadila, Lee, & Hu, 2018). In this study, the male is more at risk than female.

Tabel 3
Bivariate Analysis of Occupational Factors

Variable	GTS				p value	OR (95%CI)
	Positive		Negative			
	n	%	n	%		
Main job						
Worker	15	34.88	31	31.31	0.68	0.85
Farmer or landowner	28	65.12	68	68.69		(0.40 – 1.82)
Additional job						
No	15	34.88	29	29.29	0.51	0.77
Yes	28	65.12	70	70.71		(0.36 – 1.66)
Tobacco leaf						
Kasturi and Rajang	24	55.81	49	49.49	0.49	0.78
Na Oogst and TBN	19	44.19	50	50.51		(0.38 – 1.59)
Length of working (years)						
<18	23	53.49	42	42.42	0.22	0.64
≥18	20	46.51	57	57.58		(0.31 – 1.32)
Working time/day (hours)						
<8	17	39.53	47	47.47	0.38	1.38
≥8	26	60.47	52	52.52		(0.67 – 2.86)
Resting time (hours)						
≤1	41	95.35	95	95.96	0.87	0.86
>1	2	4.65	4	4.04		(0.15 – 4.90)
Work load						
Low risk	14	32.56	43	43.43	0.22	1.59
High risk	29	67.44	56	56.57		(0.75 – 3.37)
Total	43	100.00	99	100.00		

The results of this study show that the majority of respondents use personal protection equipment which female workers are more likely to use personal protection than male workers. This is similar to the results of a study by Fassa et al (2014). which showed that he majority of respondents wear long sleeve shirts, long pants, and hats. The use of long-sleeved shirts and long pants is highly recommended for preventing direct contact with tobacco. Several studies have mentioned that the use of proper personal protective equipment can prevent GTS (Reddy & Ashok, 2019). The use of PPE, in addition to preventing direct contact with nicotine, also prevents contact with pesticides. One study mentioned that pesticide exposure for tobacco farmers could trigger central auditory dysfunction, characterized by a decrease in temporal processing and binaural integration processes/abilities (França et al., 2017). Lack of adequate control measures increases the vulnerability of tobacco workers to chronic and acute poisoning (Ngajilo, Adams, & Jeebhay, 2018).

Nutritional status is correlated with the incidence of GTS. Normal or abnormal nutrition will not contribute to the incidence of GTS, but a poor nutritional status remains a determining factor in individual vulnerability. A poor nutritional status makes individuals more vulnerable to disease attacks and can contribute to obesity, which leads to work activity inhibition. Exposure to pesticides in tobacco fields can cause genomic instability, can cause the individual to be more sensitive to nutrient intake, and can lead to epigenetic changes (Kahl et al., 2018). In another study, tobacco-related DNA damage was more significant in individuals who had an inadequate intake of folic acid, vitamin B12, and vitamin B6, as assessed by the Comet test (Fernandes et al., 2017).

The status of passive smokers is not related to the incidence of GTS. However, passive smoking can lead to various diseases. Alcohol consumption is also not related to GTS. Respondents who consume alcohol or do not consume alcohol have the same risk of developing GTS. This is because GTS is not affected by alcohol intake. Not many tobacco farmers consume alcohol and research in Brazil states that alcohol consumption among tobacco farmers limits their physical abilities at work (Fávero, Meucci, Faria, Fiori, & Fassa, 2018).

Individual hygiene was not related to the incidence of GTS in tobacco farmers in this research. However, individual hygiene is an important variable that can contribute to the occurrence of GTS. The hygiene of the individuals studied included the habit of washing hands and feet after finishing work and the habit of bathing after work (Oliver, 2019).

The majority of respondents who were positive suffering had been working ≥ 18 years with Kasturi and Rajang leaf. The results of the bivariate analysis using chi-squared tests showed that both the primary and additional employment, the length of service and rest of tobacco farmers, and type of tobacco leaf were not related to the incidence of GTS. This is different with another research which showed that even though both farmer-owners and farm laborers have the same risk of developing GTS, TBN and Na Oogst tobacco types had more risk towards GTS than Kasturi and Rajang types, because Na Oogst and TBN tobacco leaves are dried in the warehouse, while the Kasturi and Rajang types tobacco types are dried using the sun's heat. The difference in results in this study can be caused by the presence of other variables that influence such as pesticides or another chemical exposure that may have been used by farmer (Kahl et al., 2018). Another factor that might influence is the use of PPE which in this study the majority of respondents have used PPE well even though OHS measures or other safety actions also individual hygiene are poor due to lack of farmers' knowledge (França et al., 2017; Ngajilo, Adams, & Jeebhay, 2018). The OHS measures or safety action studied included the ability to recognize danger, alertness, and the ability to handle GTS incidents (Acharya & Lee, 2018). In general, respondents did not recognize GTS and how to prevent it. This condition was found in the majority of respondents.

The results also indicate that workload is not related to the incidence of GTS. Workload includes both high and low-risk activities. A workload is high-risk if more than five work activities are carried out. The more activities, the higher the burden of exposure (Cargnin, Cezar-Vaz, Getelina, & Bonow, 2019; Fassa et al., 2014). The amount of workload measured by the quantity of tobacco handled will affect the risk of GTS (Fassa, Meucci, Fiori, Carrett, & Faria, 2018).

Research Limitations

This research has limitations. First, urine cotinine levels were assessed only once after the respondents finished work. Second, urine cotinine levels were assessed using qualitative instruments that only indicate positive and negative. This study only determined a diagnosis of GTS using urine

cotinine parameters, which was only carried out once. In future studies, it would be necessary to differentiate GTS with quantitative parameters for urine and salivary cotinine.

CONCLUSION

The majority of respondents who were positive suffering from GTS were over 45 years old, male, non-passive smoking, and had been working for <18 years with Kasturi and Rajang leaf. On other hand, the majority of respondents who were negative GTS were less than 45 years old, female, passive smoking, had been working for ≥18 years with Na Oogst and TBN leaf.

The majority of both the positive and negative GTS groups were did not consume alcohol, did not experience subjective complaints, and more likely use personal protective action, but categorized into the abnormal nutritional group (underweight and overweight), had poor individual hygiene, had a main job as farmers or landowners, had a additional job, had been working for ≥8 hours per day, engaged in high risk work, had a rest period ≤1 hours per day at work, and had poor OHS measures. The findings of this study indicate that sex and nutritional status are related to the incidence of GTS in tobacco farmers.

CONFLICT OF INTEREST

The authors declare that no conflict of interest in this study.

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