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Prevalence and risk factors of Soil-Transmitted Helminth infection among farmers in Gelgel Village, Klungkung Egency, Bali

Abstract. Soil transmitted helminthes infection remains a problem in tropical and subtropical regions worldwide. Indonesia is one of the tropical countries with high prevalence of STH infection in children and high risk population such as farmers. This study aimed to assess the prevalenceand risk factors of STH infection from farmers. STH infection was diagnosed by Kato-Katz modified technique, while risk factors relevant to STH infection were assessed by a questionnaire. Data were analyzed by logistic regression and multiple regression test. A total of 162 fecal-samples and questionnaires were obtained from 250 participants. Twenty-two subjects (13.5%) were positive and 140 subjects (86.5%) were negative for STH infection giving the prevalence rate of 13.5% among farmers. Several significant risk factors for STH infection were age, gender, level of study, income, eating fresh unwashed vegetable, hand washing without soap, defecation site, without wearing hand gloves and protective cloth, bare walking foot, and the use of syntetic fertilizer. So we can conclude that personal hygiene factors was the most contributed factors for STH infection.

Keywords: soil, transmitted, helminth

INTRODUCTION

The soil-transmitted helminths a group of parasitic nematode helminth causing the human infection through contact with parasite eggs or larvae (Bethony et al. 2006). These helminths grow in the warm and moist soil of the world's tropical and subtropical countries (Bethony et al. 2006). More than 1,5 billion population in the world infected by STH. Of particular worldwide importance species are the roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and Hookworms (*Necator americanus* and *Ancylostoma duodenale*) (WHO, 2017) Population at risk are children, farmers, gardeners and tea pickers (WHO, 2017). In Rural population of Indonesia, the prevalence of STH infection among farmer were 13.5% and immune protection was not be able to clear the parasite (Apsari et al. 2018). In Bali, during 2004-2011 the prevalence of STH infection in rural populations was relatively high, 74% for *A. lumbricoides*, 63% for *T. trichiura*, and 35% for Hookworm. In 2004 more than a thousand students from 37 primary schools in Singaraja, Badung, Denpasar, Klungkung, Gianyar and Bangli areas, showed an average prevalence of STH infection of 58.3% - 96.8% (Sudarmaja et al. 2011). The STH infection is related to poverty, low social-economic status and decreased productivity (WHO, 2017)

In Vietnam, the most prevalence of STH infection was in children aged less than 12 years compared with adults, related to the maturity of the immune system, knowledge and education, and better hygiene behavior in adults (Pham-Duc et al. 2013). The increased prevalence of STH infection also relates to individual education levels, land-related work such as agriculture, fish farming, and plantations (Ensink et al. 2005). Risk factors obtained in households include the use of latrines in households, building construction, sanitation, handwashing before meals (Pham-Duc et al. 2013). Risk factors associated with employment as farmers are the use of wastewater for land irrigation and the use of manure fertilizers as plant fertilizers, the use of personal protective equipment (footwear and gloves) during work, handwashing behavior after work (Ensink et al. 2005). In Indian fishing village, the parental occupation, the child's age and mother's education as the potential risk factors contributing to the high intensity of STH infection (Naish et al. 2004).

In addition to the above-mentioned climatic factors, Indonesia is a tropical climate with high humidity and temperature that supports the development of larva and worm eggs. The level of education, the majority of Indonesian people still live in villages with low levels of education, so that the understanding of personal hygiene and personal health and the environment is very low, such as large waste in any place (on land or river), do not use footwear in daily activities outside the house and often do not wash hands before eating (WHO, 2017; Widjana et al. 2000) Socio-economic, mostly Indonesians, low-income, causes the community's inability to provide individual and environmental sanitation (Widjana et al. 2000)

This study aimed to analyze prevalence and risk factors of STH infection focused on the adult population with high-risk occupation especially farmers. Klungkung regency was chosen because they had the largest population working in agricultural so the soil exposure must be frequent.

MATERIALS AND METHODS

This study was conducted in December 2017 until January 2018. The design of the study is descriptive-analytical research and implemented with a cross-sectional design. Data were collected from the adult farmer in Gelgel village, Klungkungregency, Bali, Indonesia.

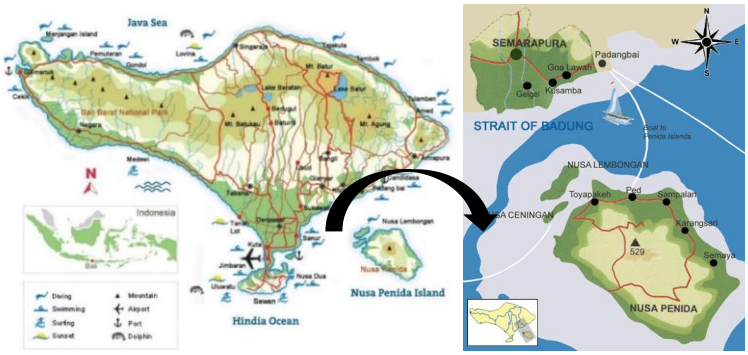

Figure 1. Map of Klungkung Regency
Source: Klungkung Government, 2008

Samples

A total of 250 farmers in Gelgel village were selected by simple random sampling. Fecal analyses with Kato-Kats methods were performed in the Parasitology laboratory Udayana University. The intensities of STH infection then categorized by the World Health Organization (for roundworms: Light [1–4999 epg], Moderate [5000–49.999], High [.49.999]; for hookworms: Light [1–1999 epg], Moderate [2000–3999], High (>3999]; and for whipworms: Light [1–999 epg], Moderate 1000–9999], High [>9999] (WHO, 1991; Levecke et al. 2010)

Ethical consideration

Faculty of Medicine Airlangga University approved this study and release ethical certificate number 294/EC/KEPK/FKUA/2017. The headman of Gelgel village also approved this study.

Data collection

One month before collecting data, we met the headman of farmers, we informed us how this study will be conducted. In the first step, we ask for approval to follow this study by signed in informed consent. Then the subject will be interviewed by systematical questionnares by the researcher and gave them a 50 ml fecal container. Tomorrow morning subjects must be defecated and put the fecal in container gave before. Fecal samples and questionnares were collected from farmers, and fecal sample will be added 10% formalin until 50 ml. The intensity of infection was determined by Kato-Katz thick smear method resulted in the number of eggs per gram of feces (EPG) (WHO, 1991). Fecal containers volume 50 ml were given to subjects, and these containers were collected back in the next morning. Fecal samples were then fixed with 10% formalin and stored in a sample box about 4^{o} C. Fecal specimen is examined by Kato-Katz thick smear use malachite green dying to define and count egg per gram (EPG) feces based on WHO counting method (1991). Morphology of egg per species was identified by microscopic analysis (Olympus, Tokyo, Japan) with an objective lens of 10x. The number of a positive egg was multiplied by 24 (WHO, 1991; Levecke et al. 2010).

Data analysis

The prevalence of STH infection was assessed using distribution frequency table and risk factor analyses then examined using Logistic regression and multiple regressions in SPSS 16.

Results

A total of 162 fecal samples were collected from 250 selected farmers at the Gelgel village, out of the 22 fecal samples were positive of STH infection and 140 samples were negative. The prevalence

of STH infection among famers was 13,5%. Most of the infected subjects were male age intervals of 54-64 years, the length of work for about 20 years and duration of work for about 9 hours. Most of the subject has passed an elementary school and also cattle owners with low income under 250 thousand rupiahs per month. All data shown are shown in Table 1.

Based on the helminth's egg identification, it could be stated that a single infection of *A. lumbricoides, T. trichiura* and Hookworm was 1.85% (3/162), 9.26% (15/162) and 0.61% (1/162). The mixed infection was detected in *A. lumbricoides* with *T. trichiura* was 1.23% (2/162) and *A. lumbricoides* with Hookworm was 0.61% (1/162). The highest mean EPG was found in *A. lumbricoides* infection where as many as 160 eggs per gram feces counted, then was followed by *Ascaris*+Hookworm mixed infection of 144 eggs per gram feces, *Trichuris+Ascaris* 132 eggs per gram of feces, while in single infection of Hookworm and *T. trichiura*was 48 and 53.5 eggs per gram ~~of~~ feces, respectively. The intensity of infection according to the WHO table is entirely mild intensity. All data are shown in Table 2.The significant risk factors affecting STH infection were eating raw vegetables of their yield (OR = 4.4 p <0.05) and the place of defecation in a river or rice field (OR = 4.7 p <0.05).

Table 1. Characteristic of subjects based on biography and social-economic conditions analyzed by cross-tabulation

Characteristic of subject	STH Positive (n* = 22)	STH negative (n = 140)
Age (year); mean ± SD*	55,59 ± 8,1	55,11± 10,9
Duration of work (year); mean ± SD	21,9±11,4	20,7± 13,8
Work hour (hour): mean ± SD	9,1± 1,6	8,6± 1,7
Gender; n (%)		
Male	12 (54,5)	90 (64,3)
Female	10 (45,5)	50 (35,7)
Level of study; n (%)		
Understudy	9(40,9)	39 (27,9)
Elementary	9 (40,9)	70 (50,0)
Junior high	1 (4,5)	12 (8,6)
High	3 (13,6)	18 (12,9)
University	0 (0)	1 (0,7)
Salary per month (IDR); n (%)		
<250 thousand	12 (54,5)	72 (51,4)
500-<1 milion	10 (45,5)	62 (44,3)
>1 milion	0 (0)	6 (4,3)
Cattle owner: n (%)		
Yes	17 (77,3)	117 (83,6)
No	5(22,7)	23 (16,4)

*n: total amount, SD: standard deviation

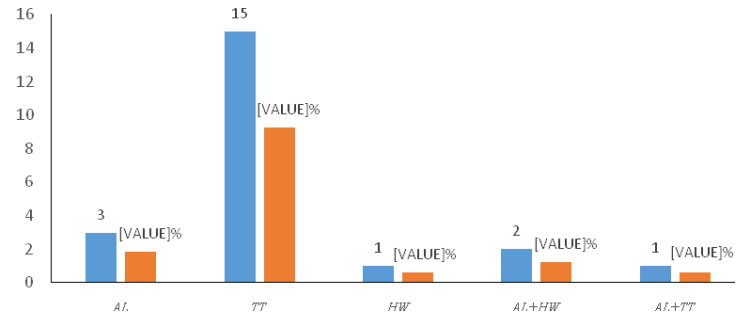

Figure 1. Prevalence of STH Infection
AL: *Ascaris lumbricoides* TT: *Trichuris trichiura*, HW: Hookworm

Table 2. Species distribution, mean of EPG and Intensity of STH infection

Species	n (%)	Mean±SD (EPG)	Intensity of infection*
A.lumbricoides	3(1,85)	160 ±176	Mild
T. trichiura	15(9,26)	53,5±27,9	Mild
Hookworm	1(0,61)	48	Mild
Ascaris+Trichuris	2(1,23)	132±118	Mild
Ascaris + Hookworm	1(0,61)	144	Mild

* Category based on WHO (2017)

Tabel 3. Characteristic of hygiene behaviour between infected subject versus non-infected subject

Characteristic of subjects	STH Positive n(%)	STH negative n(%)
Eating fresh unwashed vegetables		
Yes	18(12,4)	127(87,6)
No	4(23,5)	13(76,5)
Hand washing		
Yes	12(17,6)	56(82,4)
No	10(10,6)	84(89,4)
Boiling water		
Yes	18(14,9)	103(85,1)
No	4(9,8)	37(90,2)
Defecation site		
Toilet	12(9,2)	119(90,8)
River	10(32,3)	21(67,7)
Using hand gloves		
Yes	4(25)	12(75)
No	18(12,3)	128(87,7)
Using personal protective equipment		
Yes	6(9,5)	57(90,5)
No	16(16,2)	83(83,8)
Usingbooth shoes		
Yes	2(5,9)	32(94,1)
No	20(15,6)	108(84,4)
Using growth fertilizer		
Human feces	0(0)	0(0)
Animal feces	9(9,0)	91(91)
Synthetic fertilizer	13(21)	49(79)

Table 3. Risk factor of any STH species

Risk factor	**Species**				
	AL	**AL + HW**	**HW**	**TT**	**TT+AL**
Gender					
Male	2(16.7)	0(0)	0(0)	8(66.7)	2(16.7)
Female	1(12.5)	1(12.5)	1(12.5)	5(62.5)	0(0)
Level of study					
Understudy	1(11.1)	1(11.1)	1(11.1)	5(55.6)	1(11.1)
Elementary	2(28.6)	0(0)	0(0)	4(57.1)	1(14.3)
Junior high	0(0)	0(0)	0(0)	1(100)	0(0)
High	0(0)	0(0)	0(0)	3(100)	0(0)
University	0(0)	0(0)	0(0)	0(0)	0(0)
Salary per month					
<250 thousand	0(0)	1(8.3)	1(8.3)	9(75.0)	1(8.3)
500-<1 million	3(37.5)	0(0)	0(0)	4(50.0)	1(12.5)
>1 million	0(0)	0(0)	0(0)	0(0)	0(0)
Additional occupation beside farmer					
Labour	-	-	-	-	-
Housewife	-	-	-	-	-
Cattle owner	2(12.5)	0(0)	0(0)	12(75)	2(12.5)
Cattle owner					
No	1(25)	1(25)	1(25)	1(25)	0(0)
Yes	2(12.5)	0(0)	0(0)	12(75)	2(12.5)
Eating freesh unwashed vegetables					
Yes	3(18.8)	0(0)	1(6.2)	10(62.5)	2(12.5)
No	0(0)	1(25)	0(0)	3(75)	0(0)
Hand washing with soap					
Yes	2(20)	1(10)	0(0)	5(50)	2(20)
No	1(10)	0(0)	1(10)	8(80)	0(0)
Boiling water					
Yes	1(25)	0(0)	1(25)	2(50)	0(0)
No	2(12.5)	1(6.2)	0(0)	11(68.8)	2(12.5)
Defecation site					
Toilet	0(0)	0(0)	0(0)	0(0)	0(0)
River	3(15)	1(5)	1(5)	13(65)	2(10)
Using hand gloves					
Yes	2(66.7)	1(33.3)	0(0)	0(0)	0(0)
No	1(5.9)	0(0)	1(5.9)	13(76.5)	2(11.8)
Using personal protective equipment					
Yes	2(40)	1(20)	0(0)	2(40)	0(0)
No	1(67)	0(0)	1(6.7)	11(73.3)	2(13.3)
Using boat shoes					
Yes					
No	2(11.1)	1(5.6)	1(5.6)	12(66.7)	2(11.1)
Using fertilizer					
Human feces	-	-	-	-	-
Animal feces	-	-	-	-	-
Synthetic fertilizer	3(15)	1(5)	1(5)	13(65)	2(10)

Table 4. Multivariate risk factor of STH infection based on multinominal regression

Risk factor	P
Age	0.001*
Gender	0.057
Level of study	0.029*
Income	0.001*
Additional occupation	0.116
Cattle owner	0.998
Eating fresh unwashed vegetable	0.057
Hand washing without soap	0.024*
Boiling water	0.078
Defecation site	0.001*
Not wear hand gloves	0.000*
Not wear protective cloth	0.004*
Unprotected foot	0.030*
Using fertilizer	0.003*

*Significantly $p<0.05$

Statistical analysis of risk factors showed that significant risk factors for STH infection were age, gender, level of study, income, eating fresh unwashed vegetables, hand washing without soap, defecation site, not wear hand gloves, notwear protective cloth, unprotected foot, using fertilizer.

Table 5. Multivariate risk factor analyses of STH Infection were assessed in socio-demographic factors, behaviour, and personal hygiene factors

Risk factor		**95% confidence interval**	
	p	**Lower bound**	**Upper bound**
Gender			
Male	0.107	2.241	3.568
Female			
Level of study			
Unstudy	-	-	-
Elementary	0.179	0.277	917.8
Junior high	0.067	8.049	3.817
High	0.907	6.467	4.073
University	0.981	0.000	-
Salary per month			
<250 thousand	0.944	0.000	-
500-<1 milion	0.943	0.000	-
>1 milion	-	-	-
Additional occupation besides farmer			
Labour	0.992	0.000	-
Housewife	0.991	0.000	-
Cattle owner	0.993	0.000	-
Cattle owner			
No	0.995	0.000	-
Yes			
Eating fresh unwashed vegetables			
Yes	0.083	4.26	1.840
No	-	-	-
Handwashing with soap			
Yes			
No	0.139	3.487	8.003
Boiling water			
Yes			
No	0.094	0.444	2952
Defecation site			
Toilet	0.954	0.000	-
River	-	-	-
Using hand gloves			
Yes			
No	0.862	2.648	4.262
Using personal protective equipment			
Yes			
No	0.038	4.846	0.546
Using boat shoes			
Yes			
No	0.87	1.869	4.570
Using fertilizer			
Human feces	-	-	-
Animal feces	-	-	-
Synthetic fertilizer	0.025	0.001	0.634

Discussion

Prevalence of STH Infection

STH infection remains a major health problem in many poor and developing countries. Consistent with the findings of previous studies, this study shows that the prevalence of STH infection among farmers is 13,5% same with previous study in Kumasi, Ghana. Most of the farmer consume own vegetable product that increases the risk of STH ova exposure (OR=1,25, CI 95%) (Amoah et al. 2016). The prevalence of STH infection among adult also have been reported in Nyanza, Kenya, overall 15.7% adult positive for STH infection. The possibility for adults as carrier of STH was evaluated in Akonolinga, Cameroon, an infected adult might constitute a potential parasite reservoir and a source of dissemination and persistence of STH infection (Bopda et al. 2016).

The prevalence of *A. lumbricoides* infection in this study was 1,85%, this result is in accordance with the study conducted by Ensink et al (2005), the prevalence of *A. lumbricoides* infection was 1.9%. They also obtained *Hookworm* prevalence ranges from 0.6% in regular farmers similar to his study (0.6%). The prevalence of *T. Trichiura* infection in this study was 9.26%, in a study conducted by Pham-duc et al (2013) the *T. trichiura* prevalence was 40%, higher than this study. The reasonable cause must be the utilitation of human excreta as fertilizer in farmland in Vietnam, but in this study nobody farmers using human excreta as fertilizer. High transmission of STH infected egg also increased by fecal contains egg (Pham-Duc et al. 2013). This study obtained EPG ranged between 48-160, this result is accordance with research conducted by Amoah et al (2016) with the average number of eggs per gram of feces in the rainy season 4-223 EPG and in dry season 3 -124 EPG. The range of a number of the egg influenced by many factors, but the average of EPG was the same as the previous study. The farmers of rice, vegetables, and maize in Gelgel Village were similar to the vegetable farmers subject in Kumasi, Ghana. Because of the same pattern every day exposed to the soil, the risk of STH infection will be higher (OR = 3.99, 95% CI: 1, 15-13,86) among farmers than non-farmer subjects. The intensity of STH infection was entirely in the mild category according to Amoah et al. (2016).

The Risk factor of STH infection

Risk factors were analyzed include livestock ownership, eating self-produced vegetables, washing hands with soap, drinking water, using gloves when working, wearing footwear, wearing protective clothing and defecating. Significant risk factors that influence STH infection are eating self-produced vegetables (OR = 4.4 p <0.05) and defecation site (OR = 4.7 p <0.05).The results of this study are in accordance with research conducted by Amoah et al (2016). The similarity of the results obtained is because the sample used has similarities with this study. Rice, vegetable and pulses farmers in Gelgel Village are the same as the vegetable farmers sampled in Kumasi Ghana, with the same pattern of eating vegetables themselves. This can be caused by the worm eggs under the leaves of vegetables and protected from sunlight, thus getting optimal conditions for infections. The habit of farmers eating raw vegetables causes worm eggs to infect farmers (Amoah et al. 2016)

Consuming fresh unwashed vegetables was not significant risk factor in this study (p. 0.057), in contrary with research conducted by Anuar et al. 2014 which mentions several risk factors for STH infection in several tribes in Malaysia namely consuming raw vegetables (OR 3.36, p <0.005) and consuming contaminated fresh fruit (OR 5.19 p <0.017) (Anuar et al. 2014). In a study conducted by Jiragaankul et al. 2011, the risk factors for STH infection were walking barefoot (p <0.023) and raising cattle (p <0.001) (Jiragaankul et al. 2011). This result is also supported by research conducted by Campbell et al, 2016 which states that environmental hygiene and sanitation play an important role in the transmission of STH infections and are very important risk factor (Campbell et al. 2016). The striking behavior found in agriculture in Vietnam is the use of wastewater and the use of human

waste as fertilizer (Trang et al. 2007). The prevalence of STH infections in adults, especially those working as farmers, has also been reported in Nepal, with very poor hygiene and sanitation patterns, including not using soap for handwashing and not using footwear when walking out of the house (Parajuli et al. 2014). In contrary to the results of the study by Ross et al. women were more at risk of STH infection than men, with the highest number of education being elementary and high schools.There are no differences in health conditions in subjects infected with STH, good health conditions have the same risk for STH infection compared with less healthy conditions (Ross et al. 2017).

Conclusion

The significant risk factor for STH infection in this studi was age, level of study, income, hand washing without soap, defecation site, not use hand gloves, not use protective clothing, unprotective foot, using fertilizer. The low prevalence of STH infection among farmer who categorized as low-income populations in Klungkung Bali must not be neglected. The prompt strategy must be made by stakeholders for eliminating the infection. Several risk factors that must be anticipated divide into personal hygiene and sanitation**.**

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REFERENCE

Amoah, I. D., Abubakari, A. & Stenstrom, T. A., 2016. Contribution of Wastewater Irrigation to Soil Transmitted Helminths Infection among Vegetable Farmers in Kumasi, Ghana. *PLOS Neglected Tropical Diseases*, 10(12), pp. 1-12.

Anuar, TengkuShahrul. Fatmah Md Salleh & Norhayati Moktar. 2014. Soil-Transmitted Helminth Infections and Associated Risk Factors in Three Orang Asli Tribes in Peninsular Malaysia. Scientific Reports. Vol 4.pp 4101

Apsari, P I B, Arwati, H and Dachlan, Y P. Correlation of Eosinofil and Basophil count with intensity of soil transmitted helminth infection among farmers in Bali. 2018. *IOP Conference Series: Materials Science and Engineering*, Volume 434, Number 1

Bethony, J., Brooker, S. &Albonico, M., 2006. Soil-transmitted helminth infections: ascariasis, trichuriasis,and *Hookworm*. *Lancet*, Volume 367, p. 1521–1532.

Bopda, J., Nana-Djeunga, H. &Tenaguema, J., 2016. Prevalence and intensity of human soil transmitted helminth infections in the Akonolinga health district (Centre Region,Cameroon): Are adult hosts contributing in the persistence of the transmission?. *Parasite Epidemiology and Control*, Volume 1, pp. 199-204.

Campbell Suzy J., Susana V. Nery, Catherine A. D'Este, Darren J. Gray, James S. McCarthy, Rebecca J. Traub, Ross M. Andrews, Stacey Llewellyn, Andrew J. Vallely, Gail M. Williams, Salvador Amaral, Archie C.A. Clements. 2016. Water, sanitation and hygiene related risk factors for soil-transmitted helminth and Giardia duodenalis infections in rural communities in Timor-Leste.*International Journal for Parasitology*. Vol. 10, pp 1-9.

Ensink, J. H., Hoek, W. v. d. &Mukhtarb, M., 2005. High risk of hookworm infection among wastewater farmers in Pakistan. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, Volume 99, pp. 809-811.

Jiraanankul, V., Wongwarit A., Mathirut M., Rommanee K., Ram Rebecca J. Traub.,Phunlerd Piyaraj., Tawee Naaglor., Paanjit Taamasri, and Saovanee Leelayoova Rangsin. 2011. Incidence and Risk Factors of Hookworm Infection in a Rural Community of Central Thailand. *Am. J. Trop. Med.Hyg*. Vol. 84(4), pp. 594–598

Levecke, B. Behnke, Jerzy M.; Ajjampur, Sitara S. R.; Albonico, Marco; Ame, Shaali M.; Charlier, Johannes; Geiger, Stefan M.; Hoa, Nguyen T. V.; Ngassam, Romuald I. Kamwa; Kotze, Andrew C.; McCarthy, James S.; Montresor, Antonio; Maria V. Periago., 2010. A Comparison of the Sensitivity and Fecal Egg Counts of the McMaster Egg Counting and Kato-Katz Thick Smear Methods for Soil-Transmitted Helminths. *PLOS Neglected Tropical Disease*, 5(6), pp. 1-10.

Naish, S. J. McCarthy∗, G.M. Williams. 2004. Prevalence, intensity and risk factors for soil-transmitted helminth infection in a South Indian fishing village.Acta Tropica. Vol 91.pp 177–187

Parajuli, R.P. Fujiwara,T. M. Umezakia, S. Konishia, E. Takanea, M. Maharjan, K. Tachibana, H.W. Jiang, K. Pahari and C. Watanabe. 2014. Prevalence and risk factors of soil-transmitted helminth infection in Nepal. *Trans RSoc Trop Med Hyg*. Vol. 108, pp 228–236.

Pham-Duc, P., Nguyen-Viet, H. & Hattendorf, J., 2013. *Ascaris lumbricoides* and *Trichuris trichiura* infections associated with wastewater and human excreta use in agriculture in Vietnam. *Parasitology International*, Volume 62, pp. 172-180.

Ross Allen G.P. , Remigio M. Olveda , Donald P. McManus c, Donald A. Harn d, Delia Chy e, Yuesheng Li , Veronica Tallo b, Shu-Kay Ng. 2017. Risk factors for human helminthiases in rural Philippines. International Journal of Infectious Diseases. Vol 54.pp 150–155

Sudarmaja, I., 2011. Epidemology of Helminthic Infection in Bali, Bali: Laboratory of Parasitology UniversitasUdayana.

Trang, Do Thuy, KareMølbak, PhungDac Cam and Anders Dalsgaard. 2007. Helminth infections among people using wastewater and human excreta in peri-urban agriculture and aquaculture in Hanoi, Vietnam. *Tropical Medicine and International Health*. Volume 12 suppl. 2 pp 82–90.

Widjana, D. P. & Sutisna, P., 2000. Prevalence Of Soil-Transmitted Helminth Infection in the rural population of Bali, Indonesia. *Southeast Asian J Trop Med Public Health*, 31(3), pp. 454-459.

WHO, 2017. World Health Organization. www.who.int/intestinal_worms (Acessed 16 Augustus 2017).

WHO, 1991. *Basic Laboratory Method in Medical Parasitology*. 1 ed. Geneva: World Health Organzation.

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Kam, 27 Feb 2020 jam 12.40

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We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "PREVALENCE AND RISK FACTORS OF SOIL TRANSMITTED HELMINTH INFECTION AMONG FARMERS IN GELGEL VILLAGE, KLUNGKUNG EGENCY, BALI".

Our decision is: Revisions Required

Smujo Editors
editors@smujo.id

Reviewer W:

This paper is certainly worthless to be published and has no novelty. If so, a Deeply Major Revision is needed. There are many repetitions, the structure should be concise. English has to be edited profoundly. There is too much typo. There is an inconsistency between the results on the abstract and the result of the body text. The results should be rewritten in a grammatical manner. Several tables may write in several sentences or need an explanation of each table. A discussion should not be repetitive but only highlight the most pertinent findings and compare those to the literature and draw conclusions that add to the knowledge on STH.

Recommendation: Revisions Required

Prevalence and risk factors of soil transmitted helminth infection among farmers in Gelgel Village, Klungkung Egency, Bali

Abstract. Soil transmitted helminthes infection remains aproblem in tropical and subtropical regions worldwide. Indonesia is one of tropical countries with high prevalence of STH infection in children and high risk population such as farmers. This study aimed to assess prevalence and risk factors of STH infection from farmers. STH infection was diagnosed by Kato-Katz modified technique, while risk factors relevant to STH infection was assessed by a questionnaire. Data were analyzed by logistic regression and multiple regression test. A total of 162 fecal-samples and questionnaireswere obtained from 250 participants. Twenty two subjects (13.5%) were positive and 140 subjects (86.5%) were negative for STH infection giving the prevalence rateof 13.5% among farmers. Several significant risk factors for STH infection were age, gender, level of study, income, eating fresh unwashed vegetable, hand washing without soap, defecation site, without wearing hand gloves and protective cloth, bare walking foot, and the use of manure fertilizer.So we can conclude that personal hygiene factors was the most contributed factors for STH infection.

Keywords: Farmer, risk factors, STH

INTRODUCTION

The soil-transmitted helminths are group of parasitic nematode worms causing human infection through contact with parasite eggs or larvae (Bethony et al. 2006). These helminthsgrow in the warm and moist soil of the world's tropical and subtropical countries (Bethony et al. 2006). More than 1,5 billion population in the world infected by STH. Of particular worldwide importance species are the roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and Hookworms (*Necator americanus* and *Ancylostoma duodenale*) (WHO, 2017) Population at risk are children, farmers, gardeners and tea pickers (WHO, 2017). Rural population in Indonesia prevalence of STHinfection among farmer were low to moderate and immune protection was not be able to clear the parasite (Apsari et al. 2018). In Bali, during 2004-2011 the prevalence of STH infection in rural population was relatively high, 74% for *A. lumbricoides*, 63% for *T. trichiura*, and 35% for Hokworm. In 2004 more than thousand student from 37 primary schools in Singaraja, Badung, Denpasar, Klungkung, Gianyar and Bangli areas, showed an average prevalence of STH infection of 58.3% - 96.8% (Sudarmaja et al. 2011). The STH infection are related to poverty, low social economic status and decreased ~~of~~ productivity and imbalance of immunity responseto malaria, HIV/AIDS, TBC and response to vaccine (WHO, 2017)

In Vietnam, the most prevalence of STH infection was in children aged less than 12 years compared with adults,related to the maturity of the immune system, knowledge and education, and better hygiene behavior in adults (Pham-Duc et al. 2013). The increased prevalence of STH infection also relates to individual education levels, land-related work such as agriculture, fish farming, and plantations (Ensink et al. 2005). Risk factors obtained in households include the use of latrines in households, building construction, sanitation, hand washing before meals (Pham-Duc et al. 2013). Risk factors associated with employment as farmers are the use of waste water for land irrigation and the use of manure fertilizers as plant fertilizers, the use of personal protective equipment (footwear and gloves) during work, handwashing behavior after work (Ensink et al. 2005).In Indian fishing villagethe parental occupation, child's age and mother's education as the potential risk factors contributing to the high intensity of STH infection (Naish et al. 2004).

In addition to the above-mentioned climatic factors, Indonesia is a tropical climate with high humidity and temperature that support the development of larvaland worm eggs. The level of

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education, the majority of Indonesian people still live in villages with low levels of education, so that the understanding of personal hygiene and personal health and the environment is very low, such as large waste in any place (on land or river), do not use footwear in daily activities outside the house and often do not wash hands before eating (WHO, 2017; Widjana et al. 2000) Socio-economic, mostly Indonesians, low-income, causes the community's inability to provide individual and environmental sanitation (Widjana et al. 2000)

This study aimed to analyse prevalence and risk factor of STH infection focused on adult population with high risk occupation especially farmers. Klungkung regency was chosen because they had largest population working in agricultural so the soil exposure must be frequent.

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MATERIALS AND METHODS

This study was conducted in December 2017 until January 2018. The design of the study is a descriptive analytical research and implemented with the cross sectional design. Data were collected from adult farmer in Gelgel village, Klungkungregency, Bali, Indonesia.

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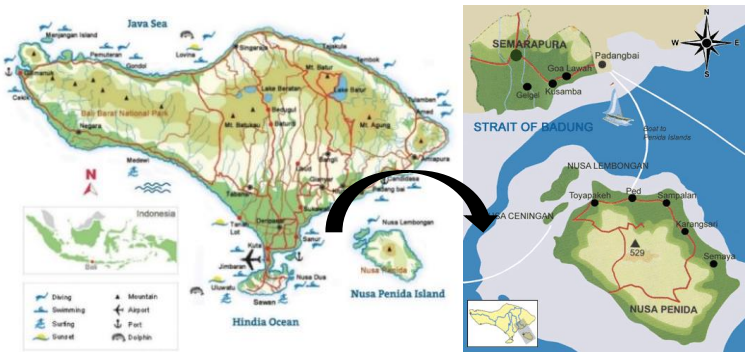

Figure 1. Map of Klungkung Regency
Source: Klungkung Government, 2008

Samples

Total 250 farmers in Gelgel village were selected by simplerandom sampling. Fecal analyses with Kato-Kats methods were performed in Parasitology laboratorium, Udayana University. The intensities of STH infection then categorized by the World Health Organization (for roundworms: Light [1–4999 epg], Moderate [5000–49.999], High [.49.999]; for hookworms: Light [1–1999 epg], Moderate [2000–3999], High (>3999]; and for whipworms: Light [1–999 epg], Moderate 1000–9999], High [>9999] (WHO, 1991; Levecke et al. 2010)

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Ethical consideration

Faculty of Medicine Airlangga University approved this study and release ethical certificate number 294/EC/KEPK/FKUA/2017. The headman of Gelgel village also approved this study.

Data collection

One month before collecting data, we met the headman of farmers, we informed us how this study will be counducted. First step we ask for approval to follow this study by signed in informed consent. Then the subject will be interviewed by systematical quistionaires by researcher and gave them 50 ml fecal container. Tomorrow morning subjects must defecated and put the fecal in container gave

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before. Fecal samples and quitionaires were collected from farmersfecal will be added 10% formaline until 50 ml. Intensity of infection was determined by Kato-Katz thick smear method resulted in the number of eggs per gram of feces (EPG) (WHO, 1991).Fecal containers volume 50 ml were gave to subjects, and these containers were collected back in the next morning. Fecal samples were then fixed with 10% formaldehydeand stored in sample box about 4^{o} C. Fecal specimen are examined by Kato-Katz thick smear use malachite green dying to define and count egg per gram (EPG) feces based on WHO counting method (1991). Morphology of egg per species was identified by microscopic analysis (Olympus, Tokyo, Japan) with objective lens of 10x. The number of positive egg was multiplied by 24 (WHO, 1991; Levecke et al. 2010).

Data analysis

The prevalence of STH infection was assessed using distribution frequency table and risk factor analyses then examined using Logistic regression and multiple regressionin SPSS 16.

Results

Total 162 fecal samples were collected from 250 selected farmers at the Gelgel village, out of the 22 fecal samples were positive of STH infection and 140 samples were negative. The prevalence of STH infection among famers were 13,5%. Most of infected subjects were male age interval of 54-64 years with length of work about 20 years and duration of work about 9 hours. Most of subject have passed elementary school and also cattle owners with low income under 250 thousand rupiahs per month. All data shown is shown in Table 1.

Based on the helmith's egg identification, it could be stated that single infection of *A. lumbricoides, T. trichiura* and Hookworm was 1.85% (3/162), 9.26% (15/162) and 0.61% (1/162), respectively.. The mixed infection was detected in *A. lumbricoides* with *T. trichiura* was 1.23% (2/162) and *A. lumbricoides* with Hookworm was 0.61% (1/162) of . The highest mean EPG was found in *A. lumbricoides* infection where as many as 160 eggs per gram feces counted, then was followed by *Ascaris*+Hookworm mixed infection of 144 eggs per gram feces, *Trichuris+Ascaris* 132 eggs per gram of feces, while in single infection of Hookworm and *T. trichiura*was 48 and 53.5 eggs per gram ~~of~~ feces, respectively. Intensity of infection according to WHO table is entirely mild intensity. All data are shown in Table 2.The significant risk factors affecting STH infection were eating raw vegetables of their ~~own~~ yield (OR = 4.4 p <0.05) and the place of defecation in a river or rice field (OR = 4.7 p <0.05).

Table 1. Characteristic of subjects based on biography and social-economic conditions analyzed by cross tabulation

Characteristic of subject	STH Positive (n* = 22)	STH negative (n = 140)
Age (year); mean ± SD*	55,59 ± 8,1	55,11± 10,9
Duration of work (year); mean ± SD	21,9±11,4	20,7± 13,8
Work hour (hour): mean ± SD	9,1± 1,6	8,6± 1,7
Gender; n (%)		
Male	12 (54,5)	90 (64,3)
Female	10 (45,5)	50 (35,7)
Level of study; n (%)		
Unstudy	9(40,9)	39 (27,9)
Elementary	9 (40,9)	70 (50,0)
Junior high	1 (4,5)	12 (8,6)
High	3 (13,6)	18 (12,9)
University	0 (0)	1 (0,7)
Salary per month (IDR); n (%)		
<250 thousand	12 (54,5)	72 (51,4)
500-<1 milion	10 (45,5)	62 (44,3)
>1 milion	0 (0)	6 (4,3)

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Cattle owner: n (%)		
Yes	17 (77,3)	117 (83,6)
No	5(22,7)	23 (16,4)

*n: total amount, SD: standart deviation

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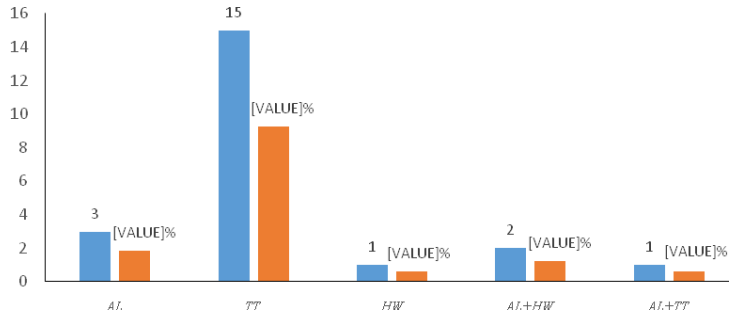

Figure 1. Prevalence of STH Infection
AL: *Ascaris lumbricoides* TT: *Trichuris trichiura*, HW: Hookworm

Table 2. Species distribution, mean of EPG and Intensity of STH infection

Species	**n (%)**	**Mean±SD (EPG)**	**Intensity of infection***
A.lumbricoides	3(1,85)	160 ±176	Mild
T. trichiura	15(9,26)	53,5±27,9	Mild
Hookworm	1(0,61)	48	Mild
Ascaris+Trichuris	2(1,23)	132±118	Mild
Ascaris + Hookworm	1(0,61)	144	Mild

* Category based on WHO (2017)

Tabel 3. Characteristic of hygiene behaviour between infected subject versus non infected subject

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Characteristic of subjects	**STH Positive**	**STH negative**
	n(%)	**n(%)**
Eating fresh unwashed vegetables		
Yes	18(12,4)	127(87,6)
No	4(23,5)	13(76,5)
Hand washing		
Yes	12(17,6)	56(82,4)
No	10(10,6)	84(89,4)
Boiling water		
Yes	18(14,9)	103(85,1)
No	4(9,8)	37(90,2)
Defecation site		
Toilet	12(9,2)	119(90,8)
River	10(32,3)	21(67,7)
Using hand gloves		
Yes	4(25)	12(75)
No	18(12,3)	128(87,7)

Using personal protective equipment		
Yes	6(9,5)	57(90,5)
No	16(16,2)	83(83,8)
Usingbooth shoes		
Yes	2(5,9)	32(94,1)
No	20(15,6)	108(84,4)
Using growth fertilizer		
Human feces	0(0)	0(0)
Animal feces	9(9,0)	91(91)
Synthetic fertilizer	13(21)	49(79)

Table 3. Risk factor of any STH species

Risk factor	Species				
	AL	AL + HW	HW	TT	TT+AL
Gender					
Male	2(16.7)	0(0)	0(0)	8(66.7)	2(16.7)
Female	1(12.5)	1(12.5)	1(12.5)	5(62.5)	0(0)
Level of study					
Unstudy	1(11.1)	1(11.1)	1(11.1)	5(55.6)	1(11.1)
Elementary	2(28.6)	0(0)	0(0)	4(57.1)	1(14.3)
Junior high	0(0)	0(0)	0(0)	1(100)	0(0)
High	0(0)	0(0)	0(0)	3(100)	0(0)
University	0(0)	0(0)	0(0)	0(0)	0(0)
Salary per month					
<250 thousand	0(0)	1(8.3)	1(8.3)	9(75.0)	1(8.3)
500-<1 milion	3(37.5)	0(0)	0(0)	4(50.0)	1(12.5)
>1 milion	0(0)	0(0)	0(0)	0(0)	0(0)
Additional occupation beside farmer					
Labour	-	-	-	-	-
Housewife	-	-	-	-	-
Cattle owner	2(12.5)	0(0)	0(0)	12(75)	2(12.5)
Cattle owner					
No	1(25)	1(25)	1(25)	1(25)	0(0)
Yes	2(12.5)	0(0)	0(0)	12(75)	2(12.5)
Eating freesh unwashed vegetables					
Yes	3(18.8)	0(0)	1(6.2)	10(62.5)	2(12.5)
No	0(0)	1(25)	0(0)	3(75)	0(0)
Hand washing with soap					
Yes	2(20)	1(10)	0(0)	5(50)	2(20)
No	1(10)	0(0)	1(10)	8(80)	0(0)
Boiling water					
Yes	1(25)	0(0)	1(25)	2(50)	0(0)
No	2(12.5)	1(6.2)	0(0)	11(68.8)	2(12.5)
Defecation site					
Toilet	0(0)	0(0)	0(0)	0(0)	0(0)
River	3(15)	1(5)	1(5)	13(65)	2(10)
Using hand gloves					
Yes	2(66.7)	1(33.3)	0(0)	0(0)	0(0)
No	1(5.9)	0(0)	1(5.9)	13(76.5)	2(11.8)
Using personal protective equipment					
Yes	2(40)	1(20)	0(0)	2(40)	0(0)
No	1(67)	0(0)	1(6.7)	11(73.3)	2(13.3)
Using boat shoes					
Yes					
No	2(11.1)	1(5.6)	1(5.6)	12(66.7)	2(11.1)
Using fertilizer					
Human feces	-	-	-	-	-
Animal feces	-	-	-	-	-
Synthetic fertilizer	3(15)	1(5)	1(5)	13(65)	2(10)

Table 4. Multivariate risk factor of STH infection based on multinominal regression

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Risk factor	P
Age	0.001*
Gender	0.057
Level of study	0.029*
Income	0.001*
Additional occupation	0.116
Cattle owner	0.998
Eating fresh unwashed vegetable	0.057
Hand washing without soap	0.024*
Boiling water	0.078
Defecation site	0.001*
Not wear hand gloves	0.000*
Not wear protective cloth	0.004*
Unprotected foot	0.030*
Using fertilizer	0.003*

*Significantly p<0.05

Statistical analysis of risk factors showed that significant risk factors for STH infection were age, gender, level of study, income, eating fresh unwashed vegetable, hand washing without soap, defecation site, not wear hand gloves, notwear protective cloth, unprotected foot, using fertilizer.

Table 5. Multivariate risk factor analyses of STH Infection were assesd in socio demographic factors, behavior and personal hygiene factors

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Risk factor		**95% confidence interval**	
	p	**Lower bound**	**Upper bound**
Gender			
Male	0.107	2.241	3.568
Female			
Level of study			
Unstudy	-	-	-
Elementary	0.179	0.277	917.8
Junior high	0.067	8.049	3.817
High	0.907	6.467	4.073
University	0.981	0.000	-
Salary per month			
<250 thousand	0.944	0.000	-
500-<1 milion	0.943	0.000	-
>1 milion	-	-	-
Additional occupation beside farmer			
Labour	0.992	0.000	-
Housewife	0.991	0.000	-
Cattle owner	0.993	0.000	-
Cattle owner			
No	0.995	0.000	-
Yes			
Eating freesh unwashed vegetables			
Yes	0.083	4.26	1.840
No	-	-	-
Hand washing with soap			
Yes			
No	0.139	3.487	8.003
Boiling water			
Yes			
No	0.094	0.444	2952
Defecation site			
Toilet	0.954	0.000	-
River	-	-	-
Using hand gloves			
Yes			
No	0.862	2.648	4.262
Using personal protective equipment			
Yes			
No	0.038	4.846	0.546
Using boat shoes			
Yes			
No	0.87	1.869	4.570
Using fertilizer			
Human feces	-	-	-
Animal feces	-	-	-
Synthetic fertilizer	0.025	0.001	0.634

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Discussion

Prevalence of STH Infection

STH infection remains a major health problem in many poor and developing countries. Consistent with the findings of previous studies, this study shows that prevalence of STH infection among farmer are 13,5% same with previous study in Kumasi, Ghana. Most of farmer consume own vegetable product that increase risk of STH ova exposure (OR=1,25, CI 95%) (Amoah et al. 2016). The prevalence of STH infection among adult also have been reported in Nyanza, Kenya, overall 15.7% adult positive for STH infection. The possibility for adult as carrier of STH was evaluated in Akonolinga, Cameroon, infected adult might constitute a potential parasite reservoir and a source of dissemination and persistence of STH infection (Bopda et al. 2016).

The prevalence of *A. lumbricoides* infection in this study was 1,85%, this result is in accordance with the study conducted by Ensink et al (2005), the prevalence of *A. lumbricoides* infection was 1.9%. They also obtained *Hookworm* prevalence ranges from 0.6% in regular farmer similar ~~with~~ this study (0.6%). The prevalence of *T. Trichiura* infection in this study was 9.26%, in a study conducted by Pham-duc et al (2013) the *T. trichiura* prevalence was 40%, higher than this study. The reasonable cause must be utilitation of human excreta as fertilizer in farmland in Vietnam, but in this study nobody farmers using human excreta as fertilizer. High transmission of STH infected egg also increased by fecal contains egg (Pham-Duc et al. 2013). This study obtained EPG ranged between 48-160, this result is in accordance with research conducted by Amoah et al (2016) with the average number of eggs per gram of feces in the rainy season 4-223 EPG and in dry season 3 -124 EPG. The range of number of the egg influenced by many factors, but the average of EPG was same with previous study. The farmers of rice, vegetables and maize in Gelgel Village was similar ~~with~~ vegetable farmers subject in Kumasi, Ghana. Because of same pattern every day exposed to the soil, the risk of STH infection will be higher (OR = 3.99, 95% CI: 1, 15-13,86) among farmer than non-farmer subject. Intensity of STH infection was entirely in the mild category according to Amoah et al. (2016).

Risk factor of STH infection

Risk factors were analyzed include livestock ownership, eating self-produced vegetables, washing hands with soap, drinking ~~drinking~~ water, using gloves when working, wearing footwear, wearing protective clothing and defecating. Significant risk factors that influence STH infection are eating self-produced vegetables (OR = 4.4 p <0.05) and defecation site (OR = 4.7 p <0.05).The results of this study are in accordance with research conducted by Amoah et al (2016). The similarity of the results obtained is because the sample used has similarities with this study. Rice, vegetable and pulses farmers in Gelgel Village are the same as the vegetable farmers sampled in Kumasi Ghana, with the same pattern of eating vegetables themselves. This can be caused by the worm eggs under the leaves of vegetables and protected from sunlight, thus getting optimal conditions for infections. The habit of farmers eating raw vegetables causes worm eggs to infect farmers (Amoah et al. 2016) Consuming fresh unwashed vegetables was not significant risk factor in this study (p. 0.057), in contrary with research conducted by Anuar et al. 2014 which mentions several risk factors for STH infection in several tribes in Malaysia namely consuming raw vegetables (OR 3.36, p <0.005) and consuming contaminated fresh fruit (OR 5.19 p <0.017) (Anuar et al. 2014). In a study conducted by Jiragaankul et al. 2011, the risk factors for STH infection were walking barefoot (p <0.023) and raising cattle (p <0.001) (Jiragaankul et al. 2011). This result is also supported by research conducted by Campbell et al, 2016 which states that environmental hygiene and sanitation play an important role in the transmission of STH infections and is a very important risk factor (Campbell et al. 2016). The striking behavior found in agriculture in Vietnam is the use of wastewater and the use of human waste as fertilizer (Trang et al. 2007). The prevalence of STH infections in adults, especially those

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working as farmers, has also been reported in Nepal, with very poor hygiene and sanitation patterns, including not using soap for hand washing and not using footwear when walking out of the house (Parajuli et al. 2014). In contrary ~~with~~ the results of study by Ross et al. women were more at risk of STH infection than men, with the highest number of education being elementary and high schools.There are no differences in health conditions in subjects infected with STH, good health conditions have the same risk for STH infection compared with less healthy conditions (Ross et al. 2017).

Conclusion

The significant risk factor for STH infection in this studi were age, level of study, income, hand washing without soap, defecation site, unwear hand gloves, unwear protective cloth, unprotective foot, using fertilizer. Low prevalence of STH infection among farmer whom categorized as lower income population in Klungkung Bali must not be neglected. Prompt strategy must be made by stakeholder for eliminating the infection. Several risk factor that must be anticipated divide to personal hygiene and sanitation**.**

ACKNOWLEDGEMENT

We would like to thank the Dean of Faculty of Medicine and Health Science, Warmadewa University, for funding this research.

REFERENCE

Amoah, I. D., Abubakari, A. & Stenstrom, T. A., 2016. Contribution of Wastewater Irrigation to Soil Transmitted Helminths Infection among Vegetable Farmers in Kumasi, Ghana. *PLOS Neglected Tropical Diseases*, 10(12), pp. 1-12.

Anuar, TengkuShahrul. Fatmah Md Salleh & Norhayati Moktar. 2014. Soil-Transmitted Helminth Infections and Associated Risk Factors in Three Orang Asli Tribes in Peninsular Malaysia. Scientific Reports. Vol 4.pp 4101

Apsari, P I B, Arwati, H and Dachlan, Y P. Correlation of Eosinofil and Basophil count with intensity of soil transmitted helminth infection among farmers in Bali. 2018. *IOP Conference Series: Materials Science and Engineering*, Volume 434, Number 1

Bethony, J., Brooker, S. &Albonico, M., 2006. Soil-transmitted helminth infections: ascariasis, trichuriasis,and *Hookworm*. *Lancet*, Volume 367, p. 1521–1532.

Bopda, J., Nana-Djeunga, H. &Tenaguema, J., 2016. Prevalence and intensity of human soil transmitted helminth infections in the Akonolinga health district (Centre Region,Cameroon): Are adult hosts contributing in the persistence of the transmission?. *Parasite Epidemiology and Control*, Volume 1, pp. 199-204.

Campbell Suzy J., Susana V. Nery, Catherine A. D'Este, Darren J. Gray, James S. McCarthy, Rebecca J. Traub, Ross M. Andrews, Stacey Llewellyn, Andrew J. Vallely, Gail M. Williams, Salvador Amaral, Archie C.A. Clements. 2016. Water, sanitation and hygiene related risk factors for soil-transmitted helminth and Giardia duodenalis infections in rural communities in Timor-Leste.*International Journal for Parasitology*. Vol. 10, pp 1-9.

Ensink, J. H., Hoek, W. v. d. &Mukhtarb, M., 2005. High risk of hookworm infection among wastewater farmers in Pakistan. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, Volume 99, pp. 809-811.

Jiraanankul, V., Wongwarit A., Mathirut M., Rommanee K., Ram Rebecca J. Traub.,Phunlerd Piyaraj., Tawee Naaglor., Paanjit Taamasri, and Saovanee Leelayoova Rangsin. 2011. Incidence and Risk Factors of Hookworm Infection in a Rural Community of Central Thailand. *Am. J. Trop. Med.Hyg*. Vol. 84(4), pp. 594–598

Levecke, B. Behnke, Jerzy M.; Ajjampur, Sitara S. R.; Albonico, Marco; Ame, Shaali M.; Charlier, Johannes; Geiger, Stefan M.; Hoa, Nguyen T. V.; Ngassam, Romuald I. Kamwa; Kotze, Andrew C.; McCarthy, James S.; Montresor, Antonio; Maria V. Periago., 2010. A Comparison of the Sensitivity and Fecal Egg Counts of the McMaster Egg Counting and Kato-Katz Thick Smear Methods for Soil-Transmitted Helminths. *PLOS Neglected Tropical Disease*, 5(6), pp. 1-10.

Naish, S. J. McCarthy⁎, G.M. Williams. 2004. Prevalence, intensity and risk factors for soil-transmitted helminth infection in a South Indian fishing village.Acta Tropica. Vol 91.pp 177–187

Parajuli, R.P. Fujiwara,T. M. Umezakia, S. Konishia, E. Takanea, M. Maharjan, K. Tachibana, H.W. Jiang, K. Pahari and C. Watanabe. 2014. Prevalence and risk factors of soil-transmitted helminth infection in Nepal. *Trans RSoc Trop Med Hyg*. Vol. 108, pp 228–236.

Pham-Duc, P., Nguyen-Viet, H. & Hattendorf, J., 2013. *Ascaris lumbricoides* and *Trichuris trichiura* infections associated with wastewater and human excreta use in agriculture in Vietnam. *Parasitology International*, Volume 62, pp. 172-180.

Ross Allen G.P. , Remigio M. Olveda , Donald P. McManus c, Donald A. Harn d, Delia Chy e, Yuesheng Li , Veronica Tallo b, Shu-Kay Ng. 2017. Risk factors for human helminthiases in rural Philippines. International Journal of Infectious Diseases. Vol 54.pp 150–155

Sudarmaja, I., 2011. Epidemology of Helminthic Infection in Bali, Bali: Laboratory of Parasitology UniversitasUdayana.

Trang, Do Thuy, KareMølbak, PhungDac Cam and Anders Dalsgaard. 2007. Helminth infections among people using wastewater and human excreta in peri-urban agriculture and aquaculture in Hanoi, Vietnam. *Tropical Medicine and International Health*. Volume 12 suppl. 2 pp 82–90.

Widjana, D. P. & Sutisna, P., 2000. Prevalence Of Soil-Transmitted Helminth Infection in the rural population of Bali, Indonesia. *Southeast Asian J Trop Med Public Health*, 31(3), pp. 454-459.

WHO, 2017. World Health Organization. www.who.int/intestinal_worms (Acessed 16 Augustus 2017).

WHO, 1991. *Basic Laboratory Method in Medical Parasitology*. 1 ed. Geneva: World Health Organzation.

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[biodiv] Editor Decision
Yahoo/Email Masuk

Nor Liza <smujo.id@gmail.com>

Kepada:budiapsari putu indah

Jum, 20 Mar 2020 jam 08.01

budiapsari putu indah:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "PREVALENCE AND RISK FACTORS OF SOIL TRANSMITTED HELMINTH INFECTION AMONG FARMERS IN GELGEL VILLAGE, KLUNGKUNG EGENCY, BALI".

Our decision is: Revisions Required

Nor Liza
sectioneditor2@smujo.id

Reviewer A:

This paper did not give an explanation of the real factor of why the STH exists in Gelgel Village and why the farmers can get the infection of STH.

The infection of STH occurs in a region because there is contaminated soil by infective eggs or infective larvae. The source of the infected eggs and larvae is solely by the fecal of invected people. This paper did not give emphasis to this.

This paper stated:
Risk factors were analyzed include livestock ownership, eating self-produced vegetables, washing hands with soap, drinking water, using gloves when working, wearing footwear, wearing protective clothing, and defecating.
However, there is no explanation about defecating.

Please add the discussion in the paper where the source of STH infection comes from.

I put my suggestions and comments in the text.

Recommendation: Revisions Required

Short Communication:
Prevalence and risk factors of soil-transmitted helminth infection among farmers in Gelgel Village, Klungkung District, Bali, Indonesia

Abstract. Soil transmitted helminths infection remains a problem in tropical and subtropical regions worldwide. Indonesia is one of the tropical countries with a high prevalence of STH infection in children and high risk population such as farmers. This study aimed to assess the prevalence and risk factors of STH infection from farmers. STH infection was diagnosed by Kato-Katz modified technique, while risk factors relevant to STH infection were assessed by a questionnaire. Data were analyzed by logistic regression and multiple regression test. A total of 162 fecal-samples and questionnaires were obtained from 250 participants. Twenty-two subjects (13.5%) were positive, and 140 subjects (86.5%) were negative for STH infection giving the prevalence rate of 13.5% among farmers. Several significant risk factors for STH infection were age, gender, level of study, income, eating fresh unwashed vegetable, hand washing without soap, defecation site, without wearing hand gloves and protective cloth, bare walking foot, and the use of synthetic fertilizer. So we can conclude that personal hygiene factors were the most contributed factors for STH infection.

Keywords: soil transmitted helminth, risk factors, prevalence, farmers, Bali.

Running title

Commented [A138]: The infection of STH occurs in a region because there is contaminated soil by infective eggs or infective larvae. The source of the infected eggs and larvae is solely by the fecal of invected people. This paper did not give emphasis to this.

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INTRODUCTION

The soil-transmitted helminths are a group of parasitic nematode helminth that are transmitted primariy through contaminated soil. This group causes human infection through contact with parasite eggs or larvae (Bethony et al. 2006). These helminths grow in the warm and moist soil of the world's tropical and subtropical countries (Bethony et al. 2006). More than 1,5 billion population in the world infected by STH. Of particular worldwide importance species are the roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and Hookworms (*Necator americanus* and *Ancylostoma duodenale*) (WHO, 2017) Population at risk are children, farmers, gardeners and tea pickers (WHO, 2017). In rural population of Indonesia, the prevalence of STH infection among farmer were 13.5% and immune protection was not be able to clear the parasite (Apsari et al. 2018). In Bali, during 2004-2011 the prevalence of STH infection in rural populations was relatively high, 74% for *A. lumbricoides*, 63% for *T. trichiura*, and 35% for Hookworm. In 2004 more than a thousand students from 37 primary schools in Singaraja, Badung, Denpasar, Klungkung, Gianyar, and Bangli areas showed an average prevalence of STH infection of 58.3% - 96.8% (Sudarmaja et al. 2011). The STH infection is related to poverty, low social-economic status, and decreased productivity (WHO, 2017) In Vietnam, the most prevalence of STH infection was in children aged less than 12 years compared with adults, related to the maturity of the immune system, knowledge and education, and better hygiene behavior in adults (Pham-Duc et al. 2013). The increased prevalence of STH infection also relates to individual education levels, land-related work such as agriculture, fish farming, and plantations (Ensink et al. 2005). Risk factors obtained in households include the use of latrines in households, building construction, sanitation, handwashing before meals (Pham-Duc et al. 2013).

Risk factors associated with employment as farmers are the use of wastewater for land irrigation and the use of manure fertilizers as plant fertilizers, the use of personal protective equipment (footwear and gloves) during work, handwashing behavior after work (Ensink et al. 2005). In Indian fishing village, the parental occupation, the child's age, and mother's education as the potential risk factors contributing to the high intensity of STH infection (Naish et al. 2004).

In addition to the above-mentioned climatic factors, Indonesia is a tropical climate with high humidity and temperature that supports the development of larva and worm eggs. The level of education, the majority of Indonesian people still live in villages with low levels of education, so that the understanding of personal hygiene and personal health and the environment is very low, such as large waste in any place (on land or river), do not use footwear in daily activities outside the house and often do not wash hands before eating (WHO 2017; Widjana et al. 2000) Socio-economic, mostly Indonesians, low-income, causes the community's inability to provide individual and environmental sanitation (Widjana et al. 2000)

This study aimed to analyze prevalence and risk factors of STH infection focused on the adult population with high-risk occupation, especially farmers. Klungkung regency was chosen because they had the largest population working in agricultural so the soil exposure will be frequent.

MATERIALS AND METHODS

This study was conducted in December 2017 until January 2018. The design of the study is descriptive-analytical research and implemented with a cross-sectional design. Data were collected from the adult farmer in Gelgel village, Klungkungregency, Bali, Indonesia.

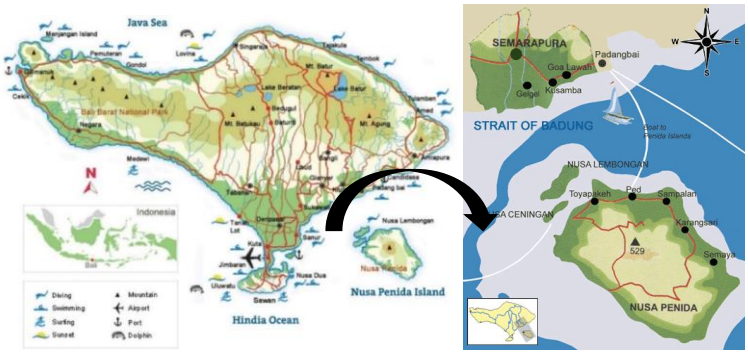

Figure 1. Map of Klungkung Regency
Source: Klungkung Government, 2008

Samples

A total of 250 farmers in Gelgel village were selected by simple random sampling. Fecal analyses with Kato-Kats methods were performed in the Parasitology laboratory at Udayana University. The intensities of STH infection then categorized by the World Health Organization (for roundworms: Light [1–4999 epg], Moderate [5000–49.999], High [>49.999]; for hookworms: Light [1–1999 epg], Moderate [2000–3999], High (>3999]; and for whipworms: Light [1–999 epg], Moderate 1000–9999], High [>9999] (WHO 1991; Levecke et al. 2010)

Ethical consideration

Faculty of Medicine Airlangga University approved this study and release ethical certificate number 294/EC/KEPK/FKUA/2017. The headman of Gelgel village also approved this study.

Data collection

One month before collecting data, we met the headman of farmers and informed him how this study would be conducted. In the first step, we asked for approval to follow this study by signed in informed consent. Then the subjects would be interviewed by systematical questionnares by the researchers and gave them a 50 ml fecal container. Tomorrow morning after subjects defecated, they should put the fecal in container gave before. Fecal samples and questionnaires were collected from farmers, and the fecal sample will be added 10% formalin until 50 ml. The intensity of infection was determined by Kato-Katz thick smear method resulted in the number of eggs per gram of feces (EPG) (WHO, 1991). Fecal containers volume 50 ml were given to subjects, and these containers were collected back in the next morning. Fecal samples were then fixed with 10% formalin and stored in a sample box about 4^{o} C. Fecal specimen is examined by Kato-Katz thick smear use malachite green dying to define and count egg per gram (EPG) feces based on WHO counting method (1991). Morphology of egg per species was identified by microscopic analysis (Olympus, Tokyo, Japan) with an objective lens of 10x. The number of a positive egg was multiplied by 24 (WHO, 1991; Levecke et al. 2010).

Data analysis

The prevalence of STH infection was assessed using distribution frequency table, and risk factor analyses then examined using Logistic regression and multiple regressions in SPSS 16.

Results

A total of 162 fecal samples were collected from 250 selected farmers at the Gelgel village, out of the 22 fecal samples were positive of STH infection, and 140 samples were negative. The prevalence of STH infection among farmers was 13.5%. Most of the infected subjects were male age intervals of 54-64 years, the length of work for about 20 years, and the duration of work for about 9 hours. Most of the subject has passed an elementary school and also cattle owners with low income under 250 thousand rupiahs per month (Data 2017). All data are shown in Table 1.

Based on the helminth's egg identification, it could be stated that a single infection of *A. lumbricoides, T. trichiura,* and Hookworm was 1.85% (3/162), 9.26% (15/162), and 0.61% (1/162), respectively. The mixed infection was detected in *A. lumbricoides* with *T. trichiura* (1.23%), and *A. lumbricoides* with Hookworm (0.61%) (1/162). The highest mean EPG was found in *A. lumbricoides* infection where as many as 160 eggs per gram feces counted, then was followed by *Ascaris*+Hookworm mixed infection of 144 eggs per gram feces, *Trichuris+Ascaris* 132 eggs per gram of feces, while in single infection of Hookworm and *T. trichiura* was 48 and 53.5 eggs per gram ~~of~~ feces, respectively. The intensity of infection according to the WHO table is entirely mild. All data are shown in Table 2. The significant risk factors affecting STH infection were eating raw vegetables of their yield (OR = 4.4 p <0.05) and the place of defecation in a river or rice field (OR = 4.7 p <0.05).

Table 1. Characteristic of subjects based on biography and social-economic conditions analyzed by cross-tabulation

Characteristic of subject	STH Positive (n* = 22)	STH negative (n = 140)
Age (year); mean ± SD*	55.59 ± 8.1	55.11± 10.9
Duration of work (year); mean ± SD	21.9±11.4	20.7± 13.8
Work hour (hour): mean ± SD	9.1± 1.6	8.6± 1.7
Gender; n (%)		
Male	12 (54.5)	90 (64.3)
Female	10 (45.5)	50 (35.7)

Level of study; n (%)		
Understudy	9(40.9)	39 (27.9)
Elementary	9 (40.9)	70 (50.0)
Junior high	1 (4.5)	12 (8.6)
High	3 (13.6)	18 (12.9)
University	0 (0)	1 (0.7)
Salary per month (IDR); n (%)		
<250 thousand	12 (54.5)	72 (51.4)
500-<1 milion	10 (45.5)	62 (44.3)
>1 milion	0 (0)	6 (4.3)
Cattle owner: n (%)		
Yes	17 (77.3)	117 (83.6)
No	5(22.7)	23 (16.4)

*n: total amount, SD: standard deviation

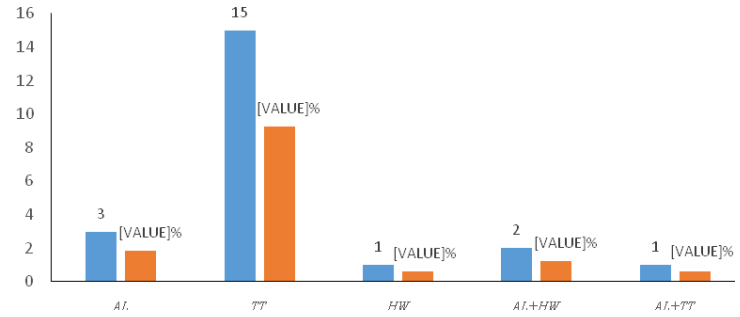

Figure 1. Prevalence of STH Infection. AL: *Ascaris lumbricoides* TT: *Trichuris trichiura*, HW: Hookworm

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Please add a note what the meaning of blue and orange color?

Please add notation at the y-axis, what are 0, 2, 4, 6,.....

Table 2. Species distribution, mean of EPG and Intensity of STH infection

Species	**n (%)**	**Mean±SD (EPG)**	**Intensity of infection***
A.lumbricoides	3(1.85)	160 ±176	Mild
T. trichiura	15(9.26)	53.5±27.9	Mild
Hookworm	1(0.61)	48	Mild
Ascaris+Trichuris	2(1.23)	132±118	Mild
Ascaris + Hookworm	1(0.61)	144	Mild

* Category based on WHO (2017)

Tabel 3. Characteristic of hygiene behaviour between infected subject versus non-infected subject

Characteristic of subjects	**STH Positive**	**STH negative**
	n(%)	**n(%)**
Eating fresh unwashed vegetables		
Yes	18(12.4)	127(87.6)
No	4(23.5)	13(76.5)
Hand washing		
Yes	12(17.6)	56(82.4)
No	10(10.6)	84(89.4)
Boiling water		
Yes	18(14.9)	103(85.1)
No	4(9.8)	37(90.2)
Defecation site		
Toilet	12(9.2)	119(90.8)
River	10(32.3)	21(67.7)

Using hand gloves		
Yes	4(25)	12(75)
No	18(12.3)	128(87.7)
Using personal protective equipment		
Yes	6(9.5)	57(90.5)
No	16(16.2)	83(83.8)
Usingbooth shoes		
Yes	2(5.9)	32(94.1)
No	20(15.6)	108(84.4)
Using growth fertilizer		
Human feces	0(0)	0(0)
Animal feces	9(9.0)	91(91)
Synthetic fertilizer	13(21)	49(79)

Table 3. Risk factor of any STH species

Risk factor	**Species**				
	AL	**AL + HW**	**HW**	**TT**	**TT+AL**
Gender					
Male	2(16.7)	0(0)	0(0)	8(66.7)	2(16.7)
Female	1(12.5)	1(12.5)	1(12.5)	5(62.5)	0(0)
Level of study					
Understudy	1(11.1)	1(11.1)	1(11.1)	5(55.6)	1(11.1)
Elementary	2(28.6)	0(0)	0(0)	4(57.1)	1(14.3)
Junior high	0(0)	0(0)	0(0)	1(100)	0(0)
High	0(0)	0(0)	0(0)	3(100)	0(0)
University	0(0)	0(0)	0(0)	0(0)	0(0)
Salary per month					
<250 thousand	0(0)	1(8.3)	1(8.3)	9(75.0)	1(8.3)
500-<1 million	3(37.5)	0(0)	0(0)	4(50.0)	1(12.5)
>1 million	0(0)	0(0)	0(0)	0(0)	0(0)
Additional occupation beside farmer					
Labour	-	-	-	-	-
Housewife	-	-	-	-	-
Cattle owner	2(12.5)	0(0)	0(0)	12(75)	2(12.5)
Cattle owner					
No	1(25)	1(25)	1(25)	1(25)	0(0)
Yes	2(12.5)	0(0)	0(0)	12(75)	2(12.5)
Eating freesh unwashed vegetables					
Yes	3(18.8)	0(0)	1(6.2)	10(62.5)	2(12.5)
No	0(0)	1(25)	0(0)	3(75)	0(0)
Hand washing with soap					
Yes	2(20)	1(10)	0(0)	5(50)	2(20)
No	1(10)	0(0)	1(10)	8(80)	0(0)
Boiling water					
Yes	1(25)	0(0)	1(25)	2(50)	0(0)
No	2(12.5)	1(6.2)	0(0)	11(68.8)	2(12.5)
Defecation site					
Toilet	0(0)	0(0)	0(0)	0(0)	0(0)
River	3(15)	1(5)	1(5)	13(65)	2(10)
Using hand gloves					
Yes	2(66.7)	1(33.3)	0(0)	0(0)	0(0)
No	1(5.9)	0(0)	1(5.9)	13(76.5)	2(11.8)
Using personal protective equipment					
Yes	2(40)	1(20)	0(0)	2(40)	0(0)
No	1(67)	0(0)	1(6.7)	11(73.3)	2(13.3)
Using boat shoes					
Yes					
No	2(11.1)	1(5.6)	1(5.6)	12(66.7)	2(11.1)
Using fertilizer					
Human feces	-	-	-	-	-
Animal feces	-	-	-	-	-
Synthetic fertilizer	3(15)	1(5)	1(5)	13(65)	2(10)

Table 4. Multivariate risk factor of STH infection based on multinominal regression

Risk factor	P
Age	0.001*
Gender	0.057
Level of study	0.029*
Income	0.001*
Additional occupation	0.116
Cattle owner	0.998
Eating fresh unwashed vegetable	0.057
Hand washing without soap	0.024*
Boiling water	0.078
Defecation site	0.001*
Not wear hand gloves	0.000*
Not wear protective cloth	0.004*
Unprotected foot	0.030*
Using fertilizer	0.003*

*Significantly $p<0.05$

Statistical analysis of risk factors showed that significant risk factors for STH infection were age, gender, level of study, income, eating fresh unwashed vegetables, hand washing without soap, defecation site, not wear hand gloves, not wear protective cloth, unprotected foot, and using fertilizer (Table 4).

Table 5. Multivariate risk factor analyses of STH Infection were assessed in socio-demographic factors, behaviour, and personal hygiene factors

Risk factor		95% confidence interval	
	p	Lower bound	Upper bound
Gender			
Male	0.107	2.241	3.568
Female			
Level of study			
Unstudy	-	-	-
Elementary	0.179	0.277	917.8
Junior high	0.067	8.049	3.817
High	0.907	6.467	4.073
University	0.981	0.000	-
Salary per month			
<250 thousand	0.944	0.000	-
500-<1 milion	0.943	0.000	-
>1 milion	-	-	-
Additional occupation besides farmer			
Labour	0.992	0.000	-
Housewife	0.991	0.000	-
Cattle owner	0.993	0.000	-
Cattle owner			
No	0.995	0.000	-
Yes			
Eating fresh unwashed vegetables			
Yes	0.083	4.26	1.840
No	-	-	-
Handwashing with soap			
Yes			
No	0.139	3.487	8.003
Boiling water			
Yes			
No	0.094	0.444	2952
Defecation site			
Toilet	0.954	0.000	-
River	-	-	-
Using hand gloves			
Yes			
No	0.862	2.648	4.262
Using personal protective equipment			
Yes			
No	0.038	4.846	0.546
Using boat shoes			
Yes			
No	0.87	1.869	4.570
Using fertilizer			
Human feces	-	-	-
Animal feces	-	-	-
Synthetic fertilizer	0.025	0.001	0.634

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Commented [A141]: How many respondents who defect at river?

You can discuss it in the discussion

Discussion

Prevalence of STH Infection

STH infection remains a major health problem in many poor and developing countries. Consistent with the findings of previous studies, this study shows that the prevalence of STH infection among farmers is 13.5%, the same as the previous study in Kumasi, Ghana. Most of the farmers consume their own vegetable product that increases the risk of STH ova exposure (OR=1.25, CI 95%) (Amoah et al. 2016). The prevalence of STH infection among adult also have been reported in Nyanza, Kenya, overall 15.7% adult positive for STH infection. The possibility for adults as the carrier of STH was evaluated in Akonolinga, Cameroon, an infected adult, might constitute a potential parasite reservoir and a source of dissemination and persistence of STH infection (Bopda et al. 2016).

The prevalence of *A. lumbricoides* infection in this study was 1.85%, this result is in accordance with the study conducted by Ensink et al. (2005), the prevalence of *A. lumbricoides* infection was 1.9%. They also obtained *Hookworm* prevalence ranges from 0.6% in regular farmers, similar to his study (0.6%). The prevalence of *T. trichiura* infection in this study was 9.26%. In a study conducted by Pham-duc et al (2013), the *T. trichiura* prevalence was 40%, higher than this study. The reasonable cause must be the utilization of human excreta as fertilizer in farmland in Vietnam but in this study, nobody farmers using human excreta as fertilizer. High transmission of STH infected egg also increased by fecal contains egg (Pham-Duc et al. 2013). This study obtained EPG ranged between 48-160. This result is in accordance with research conducted by Amoah et al. (2016) with the average number of eggs per gram of feces in the rainy season 4-223 EPG and in dry season 3 -124 EPG. The range of a number of the egg influenced by many factors, but the average of EPG was the same as the previous study. The farmers of rice, vegetables, and maize in Gelgel Village were similar to the vegetable farmers subject in Kumasi, Ghana. Because of the same pattern every day exposed to the soil, the risk of STH infection will be higher (OR = 3.99, 95% CI: 1, 15-13,86) among farmers than non-farmer subjects. According to Amoah et al. (2016), the intensity of STH infection was entirely in the mild category.

Commented [A142]: You should not compare the result of your study with others. Different region has different characteristic not only the habit but also the environment. The intensitas and prevalency of STH in a region were caused by many factors. The comparison should be made for the same condition.

Suggestion: you should only present the data from other regions and no need to compare them.

The Risk factor of STH infection

Risk factors were analyzed include livestock ownership, eating self-produced vegetables, washing hands with soap, drinking water, using gloves when working, wearing footwear, wearing protective clothing, and defecating. Significant risk factors that influence STH infection are eating self-produced vegetables (OR = 4.4 p <0.05) and defecation site (OR = 4.7 p <0.05).The results of this study are in accordance with research conducted by Amoah et al. (2016). The similarity of the results obtained is because the sample used has similarities with this study. Rice, vegetable, and pulses farmers in Gelgel Village are the same as the vegetable farmers sampled in Kumasi Ghana, with the same pattern of eating vegetables themselves. This can be caused by the worm eggs under the leaves of vegetables and protected from sunlight, thus getting optimal conditions for infections. The habit of farmers eating raw vegetables causes worm eggs to infect farmers (Amoah et al. 2016)

Consuming fresh unwashed vegetables was not a significant risk factor in this study (p. 0.057), in contrary with research conducted by Anuar et al. 2014 which mentions several risk factors for STH infection in several tribes in Malaysia namely consuming raw vegetables (OR 3.36, p <0.005) and consuming contaminated fresh fruit (OR 5.19 p <0.017) (Anuar et al. 2014). In a study conducted by Jiragaankul et al. 2011, the risk factors for STH infection were walking barefoot (p <0.023) and raising cattle (p <0.001) (Jiragaankul et al. 2011). This result is also supported by research conducted by Campbell et al, 2016 which states that environmental hygiene and sanitation play an important role in the transmission of STH infections and are very important risk factor (Campbell et al. 2016). The striking behavior found in agriculture in Vietnam is the use of wastewater and the use of human

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waste as fertilizer (Trang et al. 2007). The prevalence of STH infections in adults, especially those working as farmers, has also been reported in Nepal, with very poor hygiene and sanitation patterns, including not using soap for handwashing and not using footwear when walking out of the house (Parajuli et al. 2014). In contrary to the results of the study by Ross et al. women were more at risk of STH infection than men, with the highest number of education being elementary and high schools.There are no differences in health conditions in subjects infected with STH, good health conditions have the same risk for STH infection compared with less healthy conditions (Ross et al. 2017).

Conclusion

The significant risk factor for STH infection in this studi was age, level of study, income, hand washing without soap, defecation site, not use hand gloves, not use protective clothing, unprotective foot, using fertilizer. The low prevalence of STH infection among farmer who categorized as low-income populations in Klungkung Bali must not be neglected. The prompt strategy must be made by stakeholders for eliminating the infection. Several risk factors that must be anticipated divide into personal hygiene and sanitation**.**

ACKNOWLEDGMENTS

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REFERENCE

Amoah ID, Abubakari A, Stenstrom T A. 2016. Contribution of wastewater irrigation to soil transmitted helminths infection among vegetable farmers in Kumasi, Ghana. PLOS Negl Trop Dis 10(12): 1–12.

Anuar, TS, Salleh FMd, Moktar N. 2014. Soil-transmitted helminth infections and associated risk factors in three Orang Asli Tribes in Peninsular Malaysia. Sci Rep 4: 4101

Apsari PIB, Arwati H, Dachlan YP. Correlation of eosinofil and basophil count with intensity of soil transmitted helminth infection among farmers in Bali. 2018. IOP Conference Series: Materials Science and Engineering 434 (1):

Bethony J, Brooker S, Albonico M. 2006. Soil-transmitted helminth infections: Ascariasis, trichuriasis, and Hookworm. Lancet 367: 1521–1532.

Bopda J, Nana-Djeunga H, Tenaguema J. 2016. Prevalence and intensity of human soil transmitted helminth infections in the Akonolinga health district (Centre Region,Cameroon): Are adult hosts contributing in the persistence of the transmission? Parasite Epidemiol Control (1): 199–204.

Campbell SJ, Susana V. Nery, Catherine A. D'Este, Darren J. Gray, James S. McCarthy, Rebecca J. Traub, Ross M. Andrews, Stacey Llewellyn, Andrew J. Vallely, Gail M. Williams, Salvador Amaral, Archie C.A. Clements. 2016. Water, sanitation and hygiene related risk factors for soil-transmitted helminth and Giardia duodenalis infections in rural communities in Timor-Leste. Int J Parasitol 10: 1–9.

Ensink JH, Hoek Wvd, Mukhtarb M. 2005. High risk of hookworm infection among wastewater farmers in Pakistan. Trans R Soc Trop Med Hyg 99: 809-811.

Jiraanankul V, Wongwarit A, Mathirut M, Rommanee K, Rangsing R, Traub RJ, Piyaraj P, Naaglor T, Taamasri P, Leelayoova S. 2011. Incidence and risk factors of Hookworm infection in a rural community of central Thailand. Am J Trop Med Hyg 84(4): 594–598.

Levecke B, Behnke JM.Sitara SRA, Albonico M, Ame SM, Johannes C,Geiger, SM. Hoa NTV. Ngassam RIK, Kotze AC; McCarthy JS, Montresor A, Periago MV. 2010. A comparison of the sensitivity and fecal egg counts of the McMaster Egg Counting and Kato-Katz Thick Smear Methods for Soil-Transmitted Helminths. PLOS Negl Trop Dis 5(6): 1-10.

Naish SJ McCarthy, Williams GM. 2004. Prevalence, intensity and risk factors for soil-transmitted helminth infection in a South Indian fishing village. Acta Trop 91: 177–187

Parajuli RP, FujiwaraT, Umezakia M, Konishia S, Takanea E, Maharjan M, Tachibana K, Jiang HW, Pahari K, Watanabe C. 2014. Prevalence and risk factors of soil-transmitted helminth infection in Nepal. Trans R Soc Trop Med Hyg 108: 228–236.

Pham-Duc P, Nguyen-Viet H. Hattendorf J. 2013. *Ascaris lumbricoides* and *Trichuris trichiura* infections associated with wastewater and human excreta use in agriculture in Vietnam. Parasitol Int 62: 172-180.

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Ross AG., Olveda RM, McManus DP, Harn DA, Chy D, Li Y, Tallo V, Ng SK. 2017. Risk factors for human helminthiases in rural Philippines. Int J Infect Dis 54: 150–155.
Sudarmaja I. 2011. Epidemology of Helminthic Infection in Bali, Bali: Laboratory of Parasitology UniversitasUdayana.
Do TT, Mølbak K, Phung-Dac C, Dalsgaard A. 2007. Helminth infections among people using wastewater and human excreta in peri-urban agriculture and aquaculture in Hanoi, Vietnam. Trop Med Int Health12 Suppl. 2: 82–90.
Widjana DP, Sutisna P. 2000. Prevalence of Soil-ransmitted Helminth infection in the rural population of Bali, Indonesia. Southeast Asian J Trop Med Public Health 31(3): 454-459.
WHO. 2017. World Health Organization. www.who.int/intestinal_worms (Acessed 16 Augustus 2017).
WHO. 1991. Basic Laboratory Method in Medical Parasitology. 1st ed. Geneva: World Health Organzation.

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Short Communication: Prevalence and Risk Factors of Soil-Transmitted Helminth Infection among Farmers in Gelgel Village, Klungkung District, Bali, Indonesia

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Abstract. *Apsari PIB, Indraningrat AAG, Arwati H, Dachlan YP. 2020. Short Communication: Prevalence and risk factors of soil-transmitted helminth infection among farmers in Gelgel Village, Klungkung District, Bali, Indonesia. Biodiversitas 21: xxxx.* Soil transmitted helminths infection remains a problem in tropical and subtropical regions worldwide. Indonesia is one of the tropical countries with a high prevalence of STH infection in children and high risk population such as farmers. This study aimed to assess the prevalence and risk factors of STH infection from farmers. STH infection was diagnosed by Kato-Katz modified technique, while risk factors relevant to STH infection were assessed by a questionnaire. Data were analyzed by logistic regression and multiple regression test. A total of 162 fecal-samples and questionnaires were obtained from 250 participants. Twenty-two subjects (13.5%) were positive, and 140 subjects (86.5%) were negative for STH infection giving the prevalence rate of 13.5% among farmers. Several significant risk factors for STH infection were age, gender, level of study, income, eating fresh unwashed vegetable, hand washing without soap, defecation site, without wearing hand gloves and protective cloth, bare walking foot, and the use of synthetic fertilizer. So we can conclude that personal hygiene factors were the most contributed factors for STH infection.

Keywords: Bali, soil transmitted helminth, risk factors, prevalence, farmers,

INTRODUCTION

The soil-transmitted helminths are a group of parasitic nematode helminth that are transmitted primariy through contaminated soil. This group causes human infection through contact with parasite eggs or larvae (Bethony et al. 2006). These helminths grow in the warm and moist soil of the world's tropical and subtropical countries (Bethony et al. 2006). More than 1,5 billion population in the world infected by STH. Of particular worldwide importance species are the roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and Hookworms (*Necator americanus* and *Ancylostoma duodenale*) (WHO 2017) Population at risk are children, farmers, gardeners and tea pickers (WHO 2017). In rural population of Indonesia, the prevalence of STH infection among farmer were 13.5% and immune protection was not be able to clear the parasite (Apsari et al. 2018). In Bali, during 2004-2011 the prevalence of STH infection in rural populations was relatively high, 74% for *A. lumbricoides*, 63% for *T. trichiura*, and 35% for Hookworm. In 2004 more than a thousand students from 37 primary schools in Singaraja, Badung, Denpasar, Klungkung, Gianyar, and Bangli areas showed an average prevalence of STH infection of 58.3% - 96.8%

(Sudarmaja et al. 2011). The STH infection is related to poverty, low social-economic status, and decreased productivity (WHO 2017)

In Vietnam, the most prevalence of STH infection was in children aged less than 12 years compared with adults, related to the maturity of the immune system, knowledge and education, and better hygiene behavior in adults (Pham-Duc et al. 2013). The increased prevalence of STH infection also relates to individual education levels, land-related work such as agriculture, fish farming, and plantations (Ensink et al. 2005). Risk factors obtained in households include the use of latrines in households, building construction, sanitation, handwashing before meals (Pham-Duc et al. 2013). Risk factors associated with employment as farmers are the use of wastewater for land irrigation and the use of manure fertilizers as plant fertilizers, the use of personal protective equipment (footwear and gloves) during work, handwashing behavior after work (Ensink et al. 2005). In Indian fishing village, the parental occupation, the child's age, and mother's education as the potential risk factors contributing to the high intensity of STH infection (Naish et al. 2004).

In addition to the above-mentioned climatic factors, Indonesia is a tropical climate with high humidity and temperature that supports the development of larva and worm eggs. The level of education, the majority of Indonesian people still live in villages with low levels of education, so that the understanding of personal hygiene and personal health and the environment is very low, such as large waste in any place (on land or river), do not use footwear in daily activities outside the house and often do not wash hands before eating (WHO 2017; Widjana et al. 2000) Socio-economic, mostly Indonesians, low-income, causes the community's inability to provide individual and environmental sanitation (Widjana et al. 2000)

This study aimed to analyze prevalence and risk factors of STH infection focused on the adult population with high-risk occupation, especially farmers. Klungkung regency was chosen because they had the largest population working in agricultural so the soil exposure will be frequent.

MATERIALS AND METHODS

This study was conducted in December 2017 until January 2018. The design of the study is descriptive-analytical research and implemented with a cross-sectional design. Data were collected from the adult farmer in Gelgel village, Klungkungregency, Bali, Indonesia.

Samples

A total of 250 farmers in Gelgel village were selected by simple random sampling. Fecal analyses with Kato-Kats methods were performed in the Parasitology laboratory at Udayana University. The intensities of STH infection then categorized by the World Health Organization (for roundworms: Light [1–4999 epg], Moderate [5000–49.999], High [>49.999]; for hookworms: Light [1–1999 epg], Moderate [2000–3999], High (>3999]; and for whipworms: Light [1–999 epg], Moderate 1000–9999], High [>9999] (WHO 1991; Levecke et al. 2010)

Ethical consideration

Faculty of Medicine Airlangga University approved this study and release ethical certificate number 294/EC/KEPK/FKUA/2017. The headman of Gelgel village also approved this study.

Data collection

One month before collecting data, we met the headman of farmers and informed him how this study would be conducted. In the first step, we asked for approval to follow this study by signed in informed consent. Then the subjects would be interviewed by systematical questionnares by the researchers and gave them a 50 ml fecal container. Tomorrow morning after subjects defecated, they should put the fecal in container gave before. Fecal samples and questionnaires were collected from farmers, and the fecal sample will be added 10% formalin until 50 ml. The intensity of infection was determined by

Kato-Katz thick smear method resulted in the number of eggs per gram of feces (EPG) (WHO 1991). Fecal containers volume 50 ml were given to subjects, and these containers were collected back in the next morning. Fecal samples were then fixed with 10% formalin and stored in a sample box about 4° C. Fecal specimen is examined by Kato-Katz thick smear use malachite green dying to define and count egg per gram (EPG) feces based on WHO counting method (1991). Morphology of egg per species was identified by microscopic analysis (Olympus, Tokyo, Japan) with an objective lens of 10x. The number of a positive egg was multiplied by 24 (WHO 1991; Levecke et al. 2010).

Data analysis

The prevalence of STH infection was assessed using distribution frequency table, and risk factor analyses then examined using Logistic regression and multiple regressions in SPSS 16.

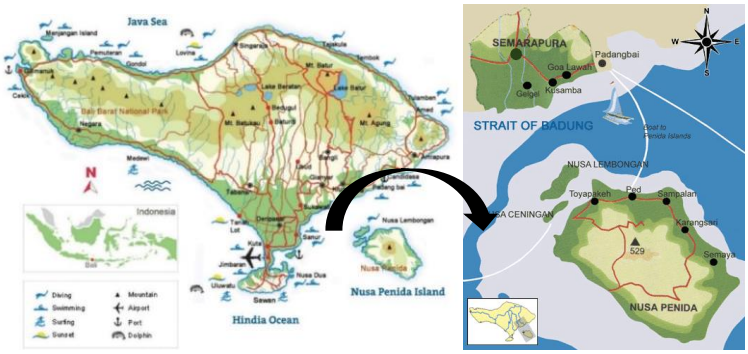

Figure 1. Map of Klungkung Regency
Source: Klungkung Government, 2008

Results

A total of 162 fecal samples were collected from 250 selected farmers at the Gelgel village, out of the 22 fecal samples were positive of STH infection, and 140 samples were negative. The prevalence of STH infection among farmers was 13.5%. Most of the infected subjects were male age intervals of 54-64 years, the length of work for about 20 years, and the duration of work for about 9 hours. Most of the subject has passed an elementary school and also cattle owners with low income under 250 thousand rupiahs per month (Data 2017). All data are shown in Table 1.

Based on the helminth's egg identification, it could be stated that a single infection of *A. lumbricoides, T. trichiura,* and Hookworm was 1.85% (3/162), 9.26% (15/162), and 0.61% (1/162), respectively. The mixed infection was detected in *A. lumbricoides* with *T. trichiura* (1.23%), and *A. lumbricoides* with Hookworm (0.61%) (1/162). The highest mean EPG was found in *A. lumbricoides* infection where as many as 160 eggs per gram feces counted, then was followed by *Ascaris*+Hookworm mixed infection of 144 eggs per gram feces, *Trichuris+Ascaris* 132 eggs per gram of feces, while in single infection of Hookworm and *T. trichiura* was 48 and 53.5 eggs per gram ~~of~~ feces,

respectively. The intensity of infection according to the WHO table is entirely mild. All data are shown in Table 2. The significant risk factors affecting STH infection were eating raw vegetables of their yield (OR = 4.4 p <0.05) and the place of defecation in a river or rice field (OR = 4.7 p <0.05).

Statistical analysis of risk factors showed that significant risk factors for STH infection were age, gender, level of study, income, eating fresh unwashed vegetables, hand washing without soap, defecation site, not wear hand gloves, not wear protective cloth, unprotected foot, and using fertilizer (Table 4).

Table 1. Characteristic of subjects based on biography and social-economic conditions analyzed by cross-tabulation

Characteristic of subject	STH Positive (n* = 22)	STH negative (n = 140)
Age (year); mean ± SD*	55.59 ± 8.1	55.11± 10.9
Duration of work (year); mean ± SD	21.9±11.4	20.7± 13.8
Work hour (hour): mean ± SD	9.1± 1.6	8.6± 1.7
Gender; n (%)		
Male	12 (54.5)	90 (64.3)
Female	10 (45.5)	50 (35.7)
Level of study; n (%)		
Understudy	9(40.9)	39 (27.9)
Elementary	9 (40.9)	70 (50.0)
Junior high	1 (4.5)	12 (8.6)
High	3 (13.6)	18 (12.9)
University	0 (0)	1 (0.7)
Salary per month (IDR); n (%)		
<250 thousand	12 (54.5)	72 (51.4)
500-<1 milion	10 (45.5)	62 (44.3)
>1 milion	0 (0)	6 (4.3)
Cattle owner: n (%)		
Yes	17 (77.3)	117 (83.6)
No	5(22.7)	23 (16.4)

*n: total amount, SD: standard deviation

Table 2. Species distribution, mean of EPG and Intensity of STH infection

Species	n (%)	Mean±SD (EPG)	Intensity of infection*
A. lumbricoides	3(1.85)	160 ±176	Mild
T. trichiura	15(9.26)	53.5±27.9	Mild
Hookworm	1(0.61)	48	Mild
Ascaris+Trichuris	2(1.23)	132±118	Mild
Ascaris + Hookworm	1(0.61)	144	Mild

Note: * Category based on WHO (2017)

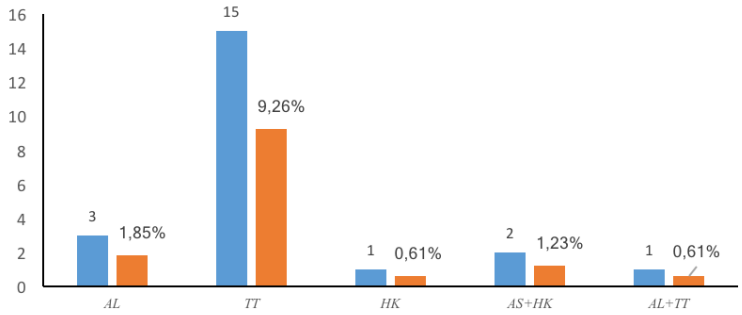

Figure 1. Prevalence of STH Infection. AL: *Ascaris lumbricoides* TT: *Trichuris trichiura*, HW: Hookworm. The blue bars showed the number of positive infection of each species, and the orange one showed the prevalence of each infection.

Tabel 3. Characteristic of hygiene behaviour between infected subject versus non-infected subject

Characteristic of subjects	**STH Positive**	**STH negative**
	n(%)	**n(%)**
Eating fresh unwashed vegetables		
Yes	18(12.4)	127(87.6)
No	4(23.5)	13(76.5)
Hand washing		
Yes	12(17.6)	56(82.4)
No	10(10.6)	84(89.4)
Boiling water		
Yes	18(14.9)	103(85.1)
No	4(9.8)	37(90.2)
Defecation site		
Toilet	12(9.2)	119(90.8)
River	10(32.3)	21(67.7)
Using hand gloves		
Yes	4(25)	12(75)
No	18(12.3)	128(87.7)
Using personal protective equipment		
Yes	6(9.5)	57(90.5)
No	16(16.2)	83(83.8)
Usingbooth shoes		
Yes	2(5.9)	32(94.1)
No	20(15.6)	108(84.4)
Using growth fertilizer		
Human feces	0(0)	0(0)
Animal feces	9(9.0)	91(91)
Synthetic fertilizer	13(21)	49(79)

Table 3. Risk factor of any STH species

Risk factor	**Species**				
	AL	**AL + HW**	**HW**	**TT**	**TT+AL**
Gender					
Male	2(16.7)	0(0)	0(0)	8(66.7)	2(16.7)
Female	1(12.5)	1(12.5)	1(12.5)	5(62.5)	0(0)
Level of study					
Understudy	1(11.1)	1(11.1)	1(11.1)	5(55.6)	1(11.1)
Elementary	2(28.6)	0(0)	0(0)	4(57.1)	1(14.3)
Junior high	0(0)	0(0)	0(0)	1(100)	0(0)
High	0(0)	0(0)	0(0)	3(100)	0(0)
University	0(0)	0(0)	0(0)	0(0)	0(0)

Salary per month					
<250 thousand	0(0)	1(8.3)	1(8.3)	9(75.0)	1(8.3)
500-<1 million	3(37.5)	0(0)	0(0)	4(50.0)	1(12.5)
>1 million	0(0)	0(0)	0(0)	0(0)	0(0)
Additional occupation beside farmer					
Labour	-	-	-	-	-
Housewife	-	-	-	-	-
Cattle owner	2(12.5)	0(0)	0(0)	12(75)	2(12.5)
Cattle owner					
No	1(25)	1(25)	1(25)	1(25)	0(0)
Yes	2(12.5)	0(0)	0(0)	12(75)	2(12.5)
Eating freesh unwashed vegetables					
Yes	3(18.8)	0(0)	1(6.2)	10(62.5)	2(12.5)
No	0(0)	1(25)	0(0)	3(75)	0(0)
Hand washing with soap					
Yes	2(20)	1(10)	0(0)	5(50)	2(20)
No	1(10)	0(0)	1(10)	8(80)	0(0)
Boiling water					
Yes	1(25)	0(0)	1(25)	2(50)	0(0)
No	2(12.5)	1(6.2)	0(0)	11(68.8)	2(12.5)
Defecation site					
Toilet	0(0)	0(0)	0(0)	0(0)	0(0)
River	3(15)	1(5)	1(5)	13(65)	2(10)
Using hand gloves					
Yes	2(66.7)	1(33.3)	0(0)	0(0)	0(0)
No	1(5.9)	0(0)	1(5.9)	13(76.5)	2(11.8)
Using personal protective equipment					
Yes	2(40)	1(20)	0(0)	2(40)	0(0)
No	1(67)	0(0)	1(6.7)	11(73.3)	2(13.3)
Using boat shoes					
Yes					
No	2(11.1)	1(5.6)	1(5.6)	12(66.7)	2(11.1)
Using fertilizer					
Human feces	-	-	-	-	-
Animal feces	-	-	-	-	-
Synthetic fertilizer	3(15)	1(5)	1(5)	13(65)	2(10)

Table 4. Multivariate analyses of risk factor of STH infection based on multinominal regression

Risk factor	**P**
Age	0.001*
Gender	0.057
Level of study	0.029*
Income	0.001*
Additional occupation	0.116
Cattle owner	0.998
Eating fresh unwashed vegetable	0.057
Hand washing without soap	0.024*
Boiling water	0.078
Defecation site	0.001*
Not wear hand gloves	0.000*
Not wear protective cloth	0.004*
Unprotected foot	0.030*
Using fertilizer	0.003*

*Significantly $p<0.05$

Table 5. Risk factor significance by analyses of each variable

Risk factor		**95% confidence interval**	
	p	**Lower bound**	**Upper bound**
Gender			
Male	0.107	2.241	3.568
Female			
Level of study			
Unstudy	NA	NA	NA
Elementary	0.179	0.277	917.8
Junior high	0.067	8.049	3.817
High	0.907	6.467	4.073
University	0.981	0.000	NA
Salary per month			
<250 thousand	0.944	0.000	NA
500-<1 milion	0.943	0.000	NA
>1 milion	NA	NA	NA
Additional occupation besides farmer			
Labour	0.992	0.000	NA
Housewife	0.991	0.000	NA
Cattle owner	0.993	0.000	NA
No	0.995	0.000	NA
Yes			
Eating fresh unwashed vegetables			
Yes	0.083	4.26	1.840
No	NA	NA	NA
Handwashing with soap			
Yes			
No	0.139	3.487	8.003
Boiling water			
Yes			
No	0.094	0.444	2952
Defecation site			
Toilet	0.954	0.000	NA
River	NA	NA	NA
Using hand gloves			
Yes			
No	0.862	2.648	4.262
Using personal protective equipment			
Yes			
No	0.038	4.846	0.546
Using boat shoes			
Yes			
No	0.87	1.869	4.570
Using fertilizer			
Human feces	NA	NA	NA
Animal feces	NA	NA	NA
Synthetic fertilizer	0.025	0.001	0.634

Discussion

Prevalence of STH infection

STH infection remains a major health problem in many poor and developing countries. Consistent with the findings of previous studies, this study shows that the prevalence of STH infection among farmers is 13.5%, the same as the previous study in Kumasi, Ghana. Most of the farmers consume their own vegetable product that increases the risk of STH ova exposure (OR=1.25, CI 95%) (Amoah et al. 2016). The prevalence of STH infection among adult also have been reported in Nyanza, Kenya, overall 15.7% adult positive for STH infection. The possibility for adults as the carrier of STH was evaluated in Akonolinga, Cameroon, an infected adult, might constitute a potential parasite reservoir and a source of dissemination and persistence of STH infection (Bopda et al. 2016). The prevalence of *A. lumbricoides* infection in this study was 1.85%, this result is in accordance with the study conducted by Ensink et al. (2005), the prevalence of *A. lumbricoides* infection was 1.9%. They also obtained *Hookworm* prevalence ranges from 0.6% in regular farmers, similar to his study (0.6%). The prevalence of *T. trichiura* infection in this study was 9.26%. In a study conducted by Pham-duc et al. (2013), the *T. trichiura* prevalence was 40%, higher than this study. The reasonable cause must be the utilization of human excreta as fertilizer in farmland in Vietnam but in this study, nobody farmers using human excreta as fertilizer. High transmission of STH infected egg also increased by fecal contains egg (Pham-Duc et al. 2013). This study obtained EPG ranged between 48-160. This result is in accordance with research conducted by Amoah et al. (2016) with the average number of eggs per gram of feces in the rainy season 4-223 EPG and in dry season 3 -124 EPG. The range of a number of the egg influenced by many factors, but the average of EPG was the same as the previous study. The farmers of rice, vegetables, and maize in Gelgel Village were similar to the vegetable farmers subject in Kumasi, Ghana. Because of the same pattern every day exposed to the soil, the risk of STH infection will be higher (OR = 3.99, 95% CI: 1, 15-13,86) among farmers than non-farmer subjects. According to Amoah et al. (2016), the intensity of STH infection was entirely in the mild category.

The Risk factor of STH infection

Risk factors were analyzed include livestock ownership, eating self-produced vegetables, washing hands with soap, drinking water, using gloves when working, wearing footwear, wearing protective clothing, and defecating. Livestock ownership could increased the posibility of egg exposure that carried by their cattle, then human will infected by egg or larva by ingestion or penetration (Bethony et al. 2006). Significant risk factors that influence STH infection are eating self-produced vegetables (OR = 4.4 $p < 0.05$) and defecation site (OR = 4.7 $p < 0.05$).The results of this study are in accordance with research conducted by Amoah et al. (2016). The similarity of the results obtained is because the sample used has similarities with this study. Rice, vegetable, and pulses farmers in Gelgel Village are the same as the vegetable farmers sampled in Kumasi Ghana, with the same pattern of eating vegetables themselves. This can be caused by the worm eggs under the leaves of vegetables and protected from sunlight, thus getting optimal conditions for infections. The habit of farmers eating raw vegetables and defecating in the river (32.3% of positive case) also increase the probability of worm eggs could infect the farmers (Amoah et al. 2016)

Consuming fresh unwashed vegetables was not a significant risk factor in this study (p. 0.057), in contrary with research conducted by Anuar et al. 2014 which mentions several risk factors for STH infection in several tribes in Malaysia namely consuming raw vegetables (OR 3.36, $p < 0.005$) and consuming contaminated fresh fruit (OR 5.19 $p < 0.017$) (Anuar et al. 2014). In a study conducted by Jiraanankul et al. 2011, the risk factors for STH infection were walking barefoot ($p < 0.023$) and raising cattle ($p < 0.001$) (Jiragaankul et al. 2011). This result is also supported by research conducted by Campbell

et al. 2016 which states that environmental hygiene and sanitation play an important role in the transmission of STH infections and are very important risk factor (Campbell et al. 2016). The striking behavior found in agriculture in Vietnam is the use of wastewater and the use of human waste as fertilizer (Trang et al. 2007). The prevalence of STH infections in adults, especially those working as farmers, has also been reported in Nepal, with very poor hygiene and sanitation patterns, including not using soap for handwashing and not using footwear when walking out of the house (Parajuli et al. 2014). In contrary to the results of the study by Ross et al. women were more at risk of STH infection than men, with the highest number of education being elementary and high schools.There are no differences in health conditions in subjects infected with STH, good health conditions have the same risk for STH infection compared with less healthy conditions (Ross et al. 2017).

Conclusion

The significant risk factor for STH infection in this studi was age, level of study, income, hand washing without soap, defecation site, not use hand gloves, not use protective clothing, unprotective foot, using fertilizer. The low prevalence of STH infection among farmer who categorized as low-income populations in Klungkung Bali must not be neglected. The prompt strategy must be made by stakeholders for eliminating the infection. Several risk factors that must be anticipated divide into personal hygiene and sanitation.

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REFERENCES

Amoah ID, Abubakari A, Stenstrom T A. 2016. Contribution of wastewater irrigation to soil transmitted helminths infection among vegetable farmers in Kumasi, Ghana. PLOS Negl Trop Dis 10(12): 1–12.

Anuar, TS, Salleh FMd, Moktar N. 2014. Soil-transmitted helminth infections and associated risk factors in three Orang Asli Tribes in Peninsular Malaysia. Sci Rep 4: 4101.

Apsari PIB, Arwati H, Dachlan YP. 2018. Correlation of eosinofil and basophil count with intensity of soil transmitted helminth infection among farmers in Bali. IOP Conference Series: Materials Science and Engineering 434 (1).

Bethony J, Brooker S, Albonico M. 2006. Soil-transmitted helminth infections: *Ascariasis*, *trichuriasis*, and Hookworm. Lancet 367: 1521–1532.

Bopda J, Nana-Djeunga H, Tenaguema J. 2016. Prevalence and intensity of human soil transmitted helminth infections in the Akonolinga health district (Centre Region,Cameroon): Are adult hosts contributing in the persistence of the transmission? Parasite Epidemiol Control. Pp: 199–204.

Campbell SJ, Nery SV, D'Este CA, Gray DJ. 2016. Water, sanitation and hygiene related risk factors for soil-transmitted helminth and Giardia duodenalis infections in rural communities in Timor-Leste. Int J Parasitol 10: 1–9.

Ensink JH, Hoek Wvd, Mukhtarb M. 2005. High risk of hookworm infection among wastewater farmers in Pakistan. Trans R Soc Trop Med Hyg 99: 809-811.

Jiraanankul V, Wongwarit A, Mathirut M, Rommanee K, Rangsing R, Traub RJ, Piyaraj P, Naaglor T, Taamasri P, Leelayoova S. 2011. Incidence and risk factors of Hookworm infection in a rural community of central Thailand. Am J Trop Med Hyg 84(4): 594–598.

Levecke B, Behnke JM.Sitara SRA, Albonico M, Ame SM, Johannes C,Geiger, SM. Hoa NTV. Ngassam RIK, Kotze AC; McCarthy JS, Montresor A, Periago MV. 2010. A comparison of the sensitivity and fecal egg counts of the McMaster Egg Counting and Kato-Katz Thick Smear Methods for Soil-Transmitted Helminths. PLOS Negl Trop Dis 5(6): 1-10.

Naish SJ McCarthy, Williams GM. 2004. Prevalence, intensity and risk factors for soil-transmitted helminth infection in a South Indian fishing village. Acta Trop 91: 177–187

Parajuli RP, FujiwaraT, Umezakia M, Konishia S, Takanea E, Maharjan M, Tachibana K, Jiang HW, Pahari K, Watanabe C. 2014. Prevalence and risk factors of soil-transmitted helminth infection in Nepal. Trans R Soc Trop Med Hyg 108: 228–236.

Pham-Duc P, Nguyen-Viet H. Hattendorf J. 2013. *Ascaris lumbricoides* and *Trichuris trichiura* infections associated with wastewater and human excreta use in agriculture in Vietnam. Parasitol Int 62: 172-180.

Ross AG, Olveda RM, McManus DP, Harn DA, Chy D, Li Y, Tallo V, Ng SK. 2017. Risk factors for human helminthiases in rural Philippines. Int J Infect Dis 54: 150–155.

Sudarmaja I. 2011. Epidemology of Helminthic Infection in Bali. Laboratory of Parasitology Universitas Udayana, Bali. [Indonesian]

Trang DT, Mølbak K, Phung-Dac C, Dalsgaard A. 2007. Helminth infections among people using wastewater and human excreta in peri-urban agriculture and aquaculture in Hanoi, Vietnam. Trop Med Int Health 12 Suppl 2: 82–90.

Widjana DP, Sutisna P. 2000. Prevalence of Soil-ransmitted Helminth infection in the rural population of Bali, Indonesia. Southeast Asian J Trop Med Public Health 31(3): 454-459.

WHO. 2017. World Health Organization. www.who.int/intestinal_worms

WHO. 1991. Basic Laboratory Method in Medical Parasitology. 1st ed. World Health Organzation, Geneva.