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Seroepidemiology of Taeniasis in the Land of Papua

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Abstract

Taeniasis is a disease caused by tapeworm infection such as *T. solium, T. saginata* and T. asiatica. Papua is an endemic area for T. solium. The purpose of the study was to find out the proportions and factors that influenced tapeworm infection in Papua Province. The study was cross-sectional research design and conducted in March-December 2016. Beside the 7,874 samples of serum taken from fingertip blood samples, interviews were also conducted in the community. Data were analyzed descriptively and Chi Square was also used. We used capture sandwich immunoassay magnetic micro particle technique to analyze the samples for taeniasis antibody examination (rES33). Based on the results of the study, it could be concluded that the prevalence of taeniasis in Papua was 4.6% with variables related to the incidence of taeniasis including: footwear usage (p = 0.035), washing vegetables using river water (p = 0.001), and headache (p = 0,0001). .

Introduction

Taenia spp. is a tapeworm with a long, flat body shape, and consists of a series of segments, each of which is called a proglotid. Scolex is a part of a tapeworm head which contains a sucker with a hook (rostelum). Tapeworm is part of Taeniidae family, Cestoda subclass, and *Taenia* genus. Some specieses of Taenia worms include *Taenia solium, T. saginata, T. crassiceps, T. ovis, T. taeniaeformis* or *T. hydatigena*, *T. serialis, T. brauni* (Estuningsih, 2009)

Taeniasis is a tapeworm infection (*Taenia* spp.) which cause health problems in several regions in Indonesia. The types of cestode causing community infections are *T. solium, T. saginata* and *T. asiatica*. Taeniasis cases caused by *T. solium* and *T. saginata* are found in Bali, taeniasis cases caused by *T. asiatica* are found in Samosir Island in North Sumatra while taeniasis cases caused by *T. solium* are found in Irian Jaya (now Papua) (Sandy, 2014). Taeniasis is distributed worldwide (Laranjo-gonzález et al., 2017) and is often found in people with a habit of consuming undercooked beef or pork contaminated with cysts. In addition, poor hygiene and environmental sanitation, or breeding pigs without pens could cause contamination of the livestock feed with infected human or pig stools which perpetuates the disease's transmission. (Estuningsih, 2009) (Bimi, Kankponang and Anto, 2012) (Mwanjali et al., 2013)

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Taeniasis is closely related to community's sociocultural factors and habits, including not keeping livestock inside pens, eating undercooked beef and pork, unhealthy eating habits and lack of knowledge on environmental sanitation (Estuningsih, 2009) (Wandra et al., 2016) (Wandra et al., 2015).

Research conducted by the Papua Provincial Health Office in 2007 found about 8.6-15.9% of taeniasis and 23.5-56.9% of cysticercosis cases; the provincial health office had provided recommendations for treating helminthiasis to the district health office and conducted cross-sector collaboration with Livestock Services and Animal Health Department (Salim et al., 2009). In 2016, seroepidemiological research on taeniasis and cysticercosis was planned to investigate whether there has been any change in the number of cases for the last 9 years. Another important factor is the high population mobilization from mountainous areas to coastal areas, which resulted in more even distribution of taeniasis and cysticercosis cases in West Papua and Papua provinces (Salim et al., 2009). Pig breeding methods also played an important role as a risk factor for cysticercosis in pigs. According to Assa. et al. (2012), pigs that were not kept inside pens had a 4.6 times higher risk of being infected with cysticercosis. Pigs that were not confined could forage places contaminated with human feces that contains *T. solium* eggs, which would subsequently be eaten by the pigs, continuing the life cycle of *T. solium* (Assa et al., 2012). The aim of the study was to find out the latest prevalence data of taeniasis in Papua and the risk factors for transmission of the disease, so that optimal preventive measures can be carried out to reduce its prevalence.

Method

This research was a project by Papua Biomedical Research and Development Center in 2016 and had obtained research ethics approval from the Health Research Ethics Commission of the Indonesian Health Research and Development Agency Number LB.02.01 / 5.2 / KE. 086 / 2016. (Sandy, 2017) The study design was cross sectional with Descriptive Analysis since we descriptively analyzed the data and bivariate statistics on factors that played a role in taeniasis and cysticercosis transmission. The samples needed was calculated based on hypotheses that require the highest sample size, and was calculated according to the formula below (Lemeshow et al., 1997). The selection of research samples was carried out in 10 districts in Papua. The research area was divided into 2 (two), at Papua and West Papua. The prevalence of tapeworms at Papua was estimated at 20-25.6% based on the results from Papua Central Bureau of Statistics. The desired margin of error was equal to 20 percent, with a confidence interval of 95 percent. Calculation of sample size was as follows (Z value = 1.96 for 95% confidence level)

$$N = \frac{z^2 p\,(1-p)(deff)x}{EP^2\ x\ k\ (X)}$$

From the calculation, the number of households that should be included in the study was 200 households / districts. If the average number of household members is 4 people, then the total sample would be approximately 800 samples.

Serological examination of blood serum specimens was carried out using immunoassay method with Luminex's MagPix tool. Control of data validity was done using standard antigen of *Taenia solium* for taeniasis using recombinant rES33 antigen. Data interpretation was performed by observing the output data of the device in the form of a median fluorescence intensity (MFI) and the quantitative magnetic data of the bead that reacted. Cut-off value was determined by measuring the standard deviation where the cut=off value = mean MFI + 2*SD negative MFI standard.

Result and Discussion

Research on taeniasis seroepidemiology was carried out in several districts in the Papua Province which included Biak Numfor, Nabire, Paniai, Deyai, Ndunga, Intan Jaya, Jayawijaya, Yalimo, Lanny Jaya, and Central Membramo Districts, and Pegunungan District of West Papua Province.

The above districts were chosen for their high prevalence of cysticercosis among pigs, which could have an impact on the transmission of *T.solium* tapeworms to humans. Taeniasis and cysticercosis transmission in Papua was first reported in 1972 where H. nana tapeworm

Tabel 1. Overview of community environmental sanitation in Papua Province

No	Risk Factor		Papua Province	
	Number of RT		1720	
			N	(%)
1	Water source	bottled water	406	23.5
		Refilled water	176	10.2
		Tap water / PDAM	177	10.2
		Retail tap water / buy	3	0.2
		Drilled / pumped well	6	0.3
		Protected dug well	197	11.4
		Unprotected dug well	270	15.6
		Protected spring	96	5.6
		unprotected spring	140	8.1
		Rainwater storage	834	48.2
		River / lake / irrigation water	57	3.3
2	Private toilet ownership	Owned	1274	73.7
		Shared	169	9.8
		Public property	22	1.3
		No toilet	261	15.1
3	Types of toilet	Goose neck	1225	70.9
		Plengsengan/ Aqua privy	213	12.3
		Cublukan/ Pit privy without floor	106	6.1
		Cublukan with floor	1	0.1
4	Disposal of final feces	Septic tank	1156	66.9
		SPAL	22	1.3
		Pond	18	1.0
		River	64	3.7
		Ground Hole	372	21.5
		Garden	92	5.3
5	Disposal of organic waste	Closed trash bin	363	21.0
		Open trash can	1363	78.8
6	Handling of household waste	Transported by janitor	60	3.5
		Hoarded in land	21	1,2
		Composted	6	0.3
		Burned	1058	61.2
		Dumped to the river / ditch	205	11.9
		Dumped at any place	364	21.1
7	Shower/wash/kitchen waste water disposal site	Closed shelter in the yard	199	11.5
		Open Shelter in the yard	96	5 , 6
		Shelter outside of the yard	98	5.7
		Some hole in land	652	37.7
		Directly into ditches / streams / rivers	681	39.4
8	Waste water disposal facilities	Owned by households	1140	65.9
		Shared / communal ownership	198	11.5

9	Types of widest house floors	Cement / ceramics, marble	316	18.3
		Plastered cracked cement	367	21.2
		Boards / rattan	801	46.3
		Land	242	14.0
10	Pig ownership	Yes	912	52.7
		No	813	47.0
11	Livestock raised in	Uncaged	72	4.2
		In pen	740	42.8
		Sometimes released	100	5.8
12	Existence of wild pigs	Yes	1452	84.0
		No	277	16.0

Source: Primary Data (Sandy, 2017)

was found in Manokwari and in the highlands of the Paniai area around the lake where taeniasis and cysticercosis were found among the people of Irian Jaya (now Papua). Taeniais cases were found around Tia Paniai area, Paniai Ekagi area, and Kepauku area (Gunawan, Subianto and Tumada, 1976). Taeniasis epidemiological studies on its risk factors that was carried out in ten districts in Papua Province showed us that there was still many people with low education level.

The survey results showed that the number of households visited was 1,720 and the 7,874 fingertip blood samples from respondents. Table 1 shows the results of household environmental sanitation surveys in Papua Province that used rainwater (48.2%) and bottled water (23.5%).

The availability of Latrine in households in Papua were is 73.7% whereas the others did not have any Latrine (15.1%). Thus, most of the respondents already knew the importance of making their own Latrine to maintain environmental sanitation. The most common type toilets used in Papua was goose neck toilet (70.9%) and "cublukan" type of toilet without cement floors (12.3%). Fecal waste disposal sites were mostly household septic tanks (66.9%), followed by self-made soil holes for final disposal of feces in 21.5%.

In Papua, community organic waste was handled by disposing garbage bag in open trash bins (78.8%). Waste handling was done by burning (61.2%), followed by removing organic waste in a closed garbage bin (21.0%). Household waste water was handled by making waste storage facilities (37.7%), followed by direct disposal of waste into rivers/ditches (39.4%). 65.9% of wastewater disposal facilities belong to individual households whereas 11.5% were shared household waste disposal facilities. The construction of household waste water disposal facilities was intended to prevent water stagnancy around the house, so as not to become a place for insects breeding or polluting the environment and water sources around the houses (Mafazah, 2013).

The type of floor in the house were wood board / bamboo (46.3%), followed by cement floor (21.2%), while 14.0% still used ground floor.

52.7% of households in Papua own pigs; 42.8% were kept inside pens while 4.2% were left roaming in the environment. In household areas of Papua, pigs were often around houses and gardens (84%). The roaming pigs could consume contaminated foods; combined with poor environmental sanitation, and improper disposal of stools causes tapeworm lifecycle in humans as hosts and pigs as intermediary hosts to be maintained (Okello et al., 2014).

Results of taeniasis research conducted in the Papua Province in ten districts including Biak Numfor, Nabire, Paniai, Deiyai, Intan Jaya, Jayawijaya, Yalimo, Nduga, Lanny Jaya and Memberamo Tengah with a total sample of 7,874 respondents showed taeniasis seroprevalence of 4.6%. The highest proportion of taeniasis was found in Nduga District (12.4%) and Central Memberamo (12.1%) (Figure 1 and Figure 2). Due to the expansion of the district regency, the distribution of taeniasis cases followed the new district territory. As in the case in Yalimo Regency, Lanny Jaya, Central Memberamo

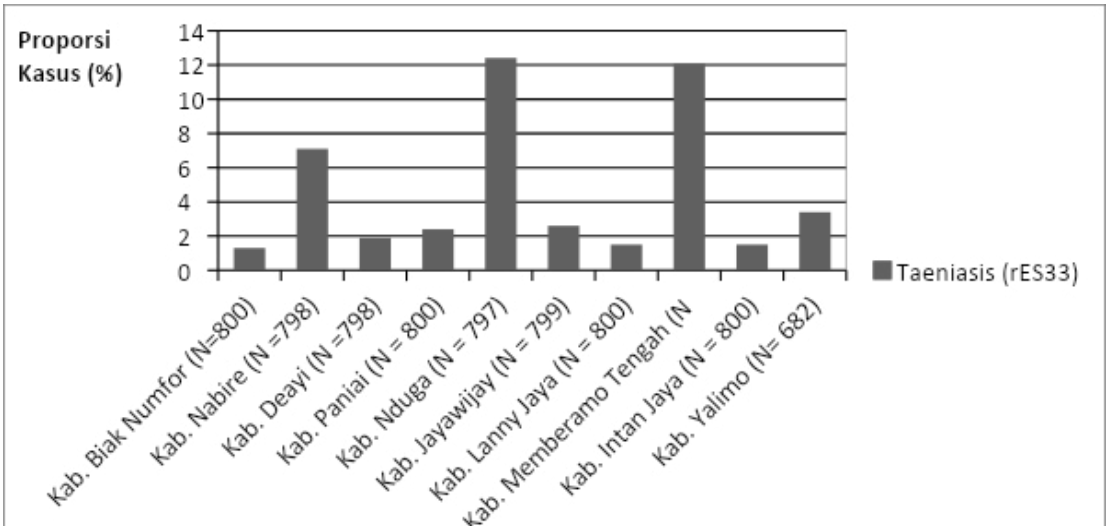

Figure 1. Prevalence in several districts in Papua province
Source: Primary data (Sandy, 2017)

which was once the Jayawijaya Regency area, whereas Paniai Regency and Deayi Regency were inside Nabire District areas. The result of taeniasis prevalence conducted in Papua were still in the range of 1.3% - 12.4%. This showed that taeniasis was still a health problem in Papua, although at present the prevalence had decreased in areas with the acceleration of health development coordinated by the central and local governments. The mass albendazole therapy for people with helminthiasis and filariasis in Papua also helped reduce taeniasis cases.

Results of bivariate statistical analysis using Chi Square statistics on risk factors for taeniasis obtained a significant correlation of several risk factors, such as: footwear usage, washing vegetables with river water, and headache symptoms from the respondents (Table 1).

The proportion of respondents who used footwear regularly but positive for taeniasis was 5.1% (N = 3,955) while in those who did not wear footwear was 4.1% (N = 3,917), thus this factor contributed significantly towards taeniasis incidence. Geographical and climate conditions in Papua had caused several districts to experience a year-long rainy season with unpaved road causing the soil to become muddy, as well as in the gardens and houses' yards, which would make the mud to stick on the feet even when footwear was worn. If this condition was not followed by hygiene behavior (washing feet before entering the house), it could contaminate the house with *T. solium* eggs, aiding taeniasis transmission.

The proportion of respondents who used river water to wash vegetables and positive for taeniasis was 7.2% (N = 682) while those who did not use river water but were still positive for Taeniasis was 4.4% (N = 7,140). The results of the statistical analysis showed a significant relationship between taeniasis and washing vegetables using river water. Humans could be infected with tapeworms because they consume undercooked pork contaminated with cysts / larvae of *T. solium*. Pigs that are kept inside pens are usually fed with vegetables such as sweet potato leaves or any other tubers which are usually washed with river water or well water. If the river water was contaminated with human feces containing eggs or prologtid of *T.solium*, it could cause the pig to be infected with cysts / larvae of *T. solium*.

The proportion of respondents experiencing headaches and positive for taeniasis was 7.1% (N = 1,854) while those without headaches were 2.9% (N = 6,019). From statistical analysis, there was a significant relationship between headache, as risk factors, and the incidence of taeniasis. People who were infected with taeniasis might experience autoinfection which can cause cysticercosis, which, when present in brain tissue, will cause

Table 2 Bivariate test of risk factors for Taeniasis occurrence in communities in Papua Province

No	Variable		N Positive	Taeniasis (rES33)		p
				Negative		
1	Gender	Male	3623	159 (4.4%)	3464 (95.6%)	0.336
		Women	4251	206 (4,%)	4045 (95.2%)	
2	Education	Unschooled	3047	144 (4.7%)	2903 (95.3%)	0.079
		Not graduating from elementary school	1059	38 (3.6%)	1021 (96.4%)	
		Elementary School	1042	53 (5.1%)	989 (94.9%)	
		Junior High School	878	28 (3.2%)	850 (96.8%)	
		Senior High School	1241	66 (5.3%)	1175 (94.7%)	
		Diploma	200	11 (5.5%)	189 (94.5%)	
		Bachelor	400	25 (6.3%)	375 (93 , 8%)	
3	Footwear usage	Yes	3955	203 (5.1%)	3752 (94.9)	0.035 *
		No	3917	162 (4.1%)	3755 (95.9%)	
4	Washing hands with soap and water before eating	Yes	3487	165 (4.7%)	3322 (95.3%)	0.719
		No	4386	200 (4.6%)	4186 (95.4%)	
5	Washing hands with water and soap after defecation	Yes	3369	161 (4.8%)	3208 (95.2%)	0.602
		No	4504	204 (4.5%)	4300 (95.5%)	
6	Nail hygiene	Clean	2261	113 (5 %)	2148 (95%)	0.334
		Not clean	5610	252 (4.5%)	5358 (95.5%)	
7	Raw Vegetables / consumed directly	Yes	632	25 (4%)	607 (96.0%)	0.653
		No	7135	336 (4.7%)	6799 (95.3%)	
		Don't know	101	4 (4%)	97 (96%)	
8	Washing vegetables with river water	Yes	682	49 (7.2%)	633 (92.8%)	0.001 *
		No	7140	315 (4.4%)	6825 (95.6%)	
9	Meat roasted with hot stones	Yes	5147	247 (4.8%)	4900 (95.2%)	0.622
		No	2422	104 (4.3%)	2318 (95.7%)	
		Don't know	304	14 (4.6%)	290 (95.4%)	
10	Decreased appetite last month	Yes	1137	56 (4.9%)	1081 (95.1%)	0.618
		No	6734	309 (4.6%)	6452 (95.4%)	
11	Distended stomach	Yes	721	31 (4.3%)	690 (95.7%)	0.652
		No	7151	334 (4.7%)	6817 (95.3%)	
12	Headaches last month	Yes	1854	132 (7.1%)	1722 (92.9)	0,0001 *
		No	6019	233 (2.9%)	5786 (96.1%)	

Notes : * Bivariate tests usingstatistics *Chi Square*; significant p <0.05
Source: Primary Data (Sandy, 2017)

headaches, and when in large quantities will cause seizures (Ng-nguyen, Stevenson and Traub, 2017).

Improvement of environmental sanitation facilities such as breeding pigs inside pens, availability of latrines, availability of clean water, and providing anti-helminthic treatment every 6 months to the community (especially school-age children) are needed to prevent taeniasis transmission. Providing education on clean and healthy behavior to elementary school students can prevent infectious diseases such as helminthiasis (Solehati et al., 2015). Transmission of cysts / larvae of *T. solium*

from pigs to humans could be prevented by vaccinating and treating livestock, and avoid eating undercooked pork and vegetables (Sandy, 2014).

Conclusion

Based on the results of the study, it could be concluded that the prevalence of taeniasis in Papua was 4.6% and variables that had a significant relationship with taeniasis infections were: footwear usage (p = 0.035), washing vegetables using river water (p = 0.001) and headache symptoms (p = 0.0001).

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