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Research Article

Relationship Between the Practice of Consuming Pork Lawar and the Prevalence of Taeniasis in Kerobokan Village, Badung Regency, Bali

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Abstract
Background: Taeniasis is an infection brought on by Taenia sp. Tapeworms, one of which is Taenia solium, whose intermediate host is swine. Adult tapeworms develop in the intestines of the host (human) after consuming infected pork that was not properly prepared. **Objective:** To determine the relationship between the consumption of pork lawar and the incidence of taeniasis in the village of Kerobokan, Badung Regency, Bali. **Methods:** This is a correlative categorical research with a cross sectional design. The study population is people in Kerobokan Village, Bali Province. Using power of 0.8 strength of linear correlation of 0.25, and additional 10% for incomplete data, we obtain sample size of 128 people who meet inclusion criteria. Data was obtained by filling out a set of validated questionnaire. **Results:** Sixty-five out of 128 respondents (50.8%) were found to possess a positive inclination towards the consumption of pork lawar, and only 1 (one) respondent (0.08%) had a history of taeniasis. The significance value of the correlation (p) between the habit of eating pork lawar and a history of taeniasis was 0.312. **Conclusion:** There is a lack of correlation between the practise of consuming pork lawar and the prevalence of taeniasis among the population.

Keywords: pork lawar, taenia saginata, taenia solium, taeniasis

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1. Introduction

Taeniasis is caused by *Taenia solium* when raw or undercooked pork is consumed [1]. Tapeworm infection is associated with numerous clinical symptoms. The eggs of tapeworms excreted in the faeces of human carriers are infectious to swine. *Taenia solium* eggs can also infect humans if they are ingested via the faecal-oral route or by consuming contaminated food or water, resulting in tissue infection with parasitic larvae [2]. Taenia infection in adult worms is diagnosed by the presence of gravid segments in a stool sample. Tissue cysts in worm larvae can be identified via biopsies, radiography (calcified cysts), and computed tomography (brain cysts). The sensitivity and specificity of serology utilising the indirect hemagglutination test and ELISA are beneficial but variable. The 2010 Global Burden of Disease (GBD) Survey estimated that human taeniasis and cysticercosis caused by *Taenia solium* result in 503,000 (95% confidence interval [CI]: 379,000–663,000) disability-adjusted life years (DALYs) lost annually. Extrapolating DALYs associated with epilepsy from the 2010 GDB survey reveals that the DALYs associated with *Taenia solium* are approximately 2.7 million (95% CI: 2.16-3.6 million). *Taenia solium* is also believed to be responsible for up to 28,000 fatalities annually (95% CI: 21,000–36,000) [3, 4].

Indonesia is a tropical region with a significant population infected with taeniasis, and the prevalence of cysticercosis and taeniasis ranges between 2% and 48% [5]. North Sumatra, Bali, and Papua are the three most prevalent endemic regions. In Indonesia, the spread of tapeworms is largely influenced by the cultural and religious context of each island. One of them is the island of Bali, which is home to many popular local and tourist dishes, such as pork lawar. This cuisine contains pork that is cooked, undercooked, or raw [6]. Consuming pork lawar fresh or undercooked can increase the risk of intestinal tapeworm infection. Therefore,

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this study aimed to see the relationship between intestinal taeniasis and the habit of pork lawar consumption in Bali.

2. Methods

The is a cross-sectional study, focused on correlational analysis within categorical variables. The study was carried out during the period of July to November 2022. The study population consisted of the people residing in Kerobokan Village, located in the Badung Regency of Bali Province. A total of 128 patients were enrolled in the study using the sequential sampling method, with a statistical power of 0.8, a linear correlation strength of 0.25, and an additional 10% inclusion to account for potential missing data. The process of data collecting involved the completion of online questionnaires that had undergone rigorous testing to ensure their validity and reliability. The data was subjected to analysis using the SPSS statistical package for Windows version 25.0, developed by IBM Corp. in Armonk, NY. The study included both univariate and bivariate techniques, specifically employing Spearman's rho correlation coefficient.

3. Results

The 128 questionnaires collected were examined for completeness. The data was subsequently presented in tabular format, providing information on the distribution of sociodemographic characteristics, the distribution of risk factors, the distribution of taeniasis cases, and a cross- tabulation of both variables.

Table 1. Sociodemographic distribution of respondents

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	55	43
Female	73	57
Age (years)		
<30	59	46,1
30-50	55	43
51-70	11	8,6
>70	3	2,3
Last education		
College	53	41,4
Senior high school	57	44,5
Junior high school	9	7
Elementary school	6	4,7
No school	3	2,3
Type of work		
Government employees	8	6,3
Private employees	25	19,5
Self-employed	45	35,2
Farmer	2	1,6
Housewife	17	13,3
Student	18	14,1
No work	12	9,4
Total	128	100

Table 2. Distribution of risk factors

Characteristics	Frequency (n)	Percentage (%)
Ownership of livestock		
Pigs	13	10,2
Cattle	8	6,3
Others	40	31,3
None	67	52,3
Maintenance of pig farm		
Good	12	92,3
Moderate	1	7,7
Bad	0	0
Habit of consuming pork lawar		
Good	65	50,8
Bad	63	49,2
Habit of processing pig meet		
Good	5	3,9
Moderate	123	96,1
Bad	0	0
Total	128	100

Taeniasis is made based on the respondent's history of expelling proglottids from the anal voluntarily or involuntarily (thru defecation).

Table 3. Distribution of taeniasis

Characteristics	Frequency (n)	Percentage (%)
Negative history of expelling proglottids	127	99,2
Positive a history of expelling proglottids	1	0,8
Total	128	100

The bivariate analysis conducted using Spearman's rho test yielded a significance value of 0.312 ($p > 0.05$), indicating that there is no statistically significant link between the consumption of pork lawar and the occurrence of taeniasis.

Table 4. The relationship between the habit of consuming pork lawar and the incidence of taeniasis

Variable		Incident Taeniasis				Total		Score
		Negative History		Positive History				
		n	%	n	%	n	%	*p*
The habit of consuming	Good	65	100	0	0	65	100	
Pork lawar	Bad	62	98,4	1	1,6	63	100	0,31
Total		127	99,2	1	0,8	128	100	

4. Discussion

The majority of participants indicated that they did not possess agricultural land. A small proportion of individuals possessed pigs or animals. The majority of pig farmers demonstrated a high level of farm management, as seen by their diligent maintenance of their farms. This included the frequent cleaning of pig pens and the provision of specialised animal feed to ensure the well- being of the pigs. This finding suggests that the participants demonstrated a strong knowledge of effective agricultural practises, particularly in the

domain of pig farming [7]. A study conducted in Denpasar, Bali, revealed that pig farms in the area have been effectively managed and maintained. These farms have adhered to proper protocols for pig rearing, ensuring the animals' protection from parasite illnesses [8]. This phenomenon may also be attributed to the extensive health promotion efforts conducted by healthcare professionals, village leaders, and other extension organisations or community groups.

Based on the observed dietary behaviour pertaining to the consumption of pork lawar, it was found that a majority of the participants continued to consume this dish in its raw or undercooked form. The cultural and customary practises of the Balinese people have an impact on the consumption of raw or undercooked pork lawar. Lawar is a customary culinary offering originating from the Balinese culture, typically presented during significant Hindu festivities in Bali. However, it is not uncommon for lawar to be served on ordinary occasions as well [6].

The survey revealed that a significant proportion of participants demonstrated proper handling and preparation techniques for pork, hence ensuring compliance with hygiene regulations. Nevertheless, the community continues to offer pork in its raw or undercooked state, so presenting a potential health risk. The observed phenomenon can be attributed to the pervasive impact of Balinese culture and customs [6, 9]. During significant cultural observances like Galungan and Kuningan, it is customary for the community to make arrangements for the procurement and preparation of high-quality pigs to be ceremonially slaughtered [7]. Pork lawar is traditionally employed as a culinary component within ceremonial contexts. A diverse range of pig lawar preparations are presented as offerings to the deities, encompassing both cooked and uncooked variations. Following its utilisation as an offering, the food will subsequently be distributed and consumed collectively by the community.

Notwithstanding the aforementioned risk factors, the present study revealed that a significant proportion of participants did not possess a previous medical record of taeniasis. There was a singular individual with a documented medical history of taeniasis, who happened to be in the advanced stages of life, nearing the age of 100. This phenomenon can be comprehended by taking into account additional risk factors apart from the intake of raw pork lawar that were prevalent in the past. For instance, the limited utilisation of sanitary latrines and inadequate livestock management practises were also significant contributors. Historically, it was common practise to allow pigs and other livestock to roam freely or remain uncaged, primarily due to the abundance of available open space that might serve as a supplementary food source for these animals. During that period, there was a significant dearth of public knowledge regarding health matters, specifically in relation to taeniasis. Currently, the residents of Bali possess a heightened level of knowledge on taeniasis and its associated risk factors. The declining prevalence of taeniasis in Bali over time is evident.

A study conducted in multiple districts and cities in Bali revealed a fluctuating prevalence of taeniasis over a period of time. The prevalence in Gianyar regency experienced a significant decline of sixfold over a four-year period, specifically from 2002 to 2006. A similar pattern was also observed in the regencies of Denpasar, Badung, and Karangasem. This is due to advancements in personal hygiene practises, enhanced management techniques in pig farming, and the spread of metropolitan regions. Consequently, individuals who formerly engaged in unrestricted livestock rearing are now compelled to either cease farming activities altogether or confine their free-range operations within enclosures [10]. A study conducted in a distinct city in Indonesia, with by comparable socio-demographic traits, revealed a complete absence of taeniasis cases in recent years. This outcome can likely be attributed to the population's practise of abstaining from the intake of raw or undercooked meat. The thorough cooking of meat to the point of being well done has the capacity to fully deactivate the cysticercus, hence eliminating the potential risk of contracting a taeniasis infection [11].

The present investigation did not identify any significant association between the practice of consuming pork lawar and the occurrence of taeniasis. In contrast, empirical investigations conducted in Peru have established a correlation between the consumption of pork and the prevalence of taeniasis [12]. This is due to the ingestion of pork contaminated with the *Taenia solium* parasite. The porcine subjects in the research were reared in an environment devoid of enclosures, while the local populace had limited availability of sanitary amenities, particularly in terms of hygienic latrines. The presence of freely wandering swine and inadequate sanitary facilities is likely to heighten the susceptibility to *Taenia solium* infection [13].

Although there is a common practise of consuming raw meat, it is important to note that pigs that are not infected with Taenia sp. do not pose a risk of transmitting taeniasis. Pigs that are reared under appropriate conditions, housed in enclosures situated at a considerable distance from human dwellings, and are restricted from unrestricted movement, in addition to being provided with adequate nutrition, will yield pigs of superior grade [14].

5. Conclusion

Majority of people in Kerobokan Village, Badung Regency, Bali still consumed undercooked or raw pig meat. However, it is worth noting that a significant proportion of the individuals surveyed did not report any previous instances of taeniasis. There is a lack of correlation between the practise of consuming pork lawar and the prevalence of taeniasis in Kerobokan Village, located in the Badung Regency of Bali.

6. Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to privacy and ethical considerations but are available from the corresponding author upon reasonable request.

7. Ethical Statement

This study was approved by the Ethics Committee for Health Research at Universitas Sumatera Utara. The research was conducted in Kerobokan Village, Badung Regency, Bali Province, from July to November 2022.

8. Author Contributions

All authors contributed to the design and implementation of the research, data analysis, and finalizing the manuscript.

9. Funding

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10. Conflict of Interest

Authors declares no conflict of interest.

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