

## Influence of Work Duration on Helminthiasis in Pig Farmers in Tabanan

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### Abstract

**Background:** Helminthiasis is a group of diseases caused by parasitic worms that remains a persistent public health challenge in Indonesia, with the heaviest burden borne by agricultural communities. Due to frequent exposure to contaminated environments, pig farming poses a high risk for parasitic infection, including those caused by nematodes.

**Methods:** A cross-sectional performed in 30 pig farmers from Bongan Village, Tabanan. Data were collected through laboratory examination of fecal samples and structured interviews using questionnaires. A descriptive analysis was conducted, followed by Fisher's Exact Test to assess the association between work duration and helminthiasis.

**Result:** Proportion of helminthiasis was 10% (3 of 30 respondents). Three respondents tested positive for helminthiasis (two respondents tested positive for the eggs of *Taenia* Sp, one respondent tested positive for the eggs of *Ascaris lumbricoides*). The result of bivariate analysis showed an increased risk of helminthiasis in the group with more than 35 years of work duration (POR: 16.1; 95% CI: 1.8–145.3, *p*-value: 0.032) compared with those with 35 years or less. Fisher's Exact Test indicated a statistically significant association between work duration and helminthiasis.

**Conclusion:** Proportion of helminthiasis was 10%. Two respondents tested positive for the eggs of *Taenia* Sp, one respondent tested positive for the eggs of *Ascaris lumbricoides*. The result showed an increased risk of helminthiasis in the group with more than 35 years of work duration compared with those with 35 years or less. Fisher's Exact Test indicated a statistically significant association between work duration and helminthiasis.

**Keywords:** Helminthiasis, Occupational exposure, Pig farmers, Work duration

### INTRODUCTION

Helminthiasis refers to a group of diseases caused by parasitic worms, including nematodes (e.g., *Ascaris lumbricoides*), cestodes (e.g., *Taenia solium*, which causes taeniasis and cysticercosis), and trematodes (e.g., *Schistosoma* species). These infections, typically transmitted through contaminated soil, food, or direct contact with fecal matter, are prevalent in many regions and pose a significant public health threat by contributing to malnutrition, impaired cognitive function, and reduced productivity in affected populations.<sup>1</sup> In Indonesia, the burden of helminth infections is particularly concerning due to its tropical climate and ecological diversity, which create an ideal environment for parasite survival and transmission. The country's fertile land supports extensive agricultural activity, with approximately 29% of the population engaged in farming and traditional livestock breeding.<sup>2</sup> These occupations frequently involve direct contact with soil, animal waste, and unhygienic conditions, increasing the risk of exposure to helminthic infections.

Livestock farming in Indonesia—whether through modern or traditional methods—continues to face serious challenges from helminth infections. These parasitic infestations compromise animal health and productivity and constitute a significant source of zoonotic transmission to humans, particularly among farmers. Among the most prevalent helminths affecting livestock are nematodes such as *Strongyloides* and *Ascaris* species, which can thrive in poorly sanitized environments.<sup>3</sup> Additionally, intestinal cestode infections, particularly those caused by *Taenia solium*, remain a public

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health concern in Indonesia, owing to favorable climatic conditions and the consumption of undercooked pork.<sup>4</sup> Species within the genus *Taenia* are responsible for taeniasis, a parasitic infection commonly found in regions where raw or undercooked beef and pork are consumed. In setting with inadequate hygiene and sanitation, human fecal matter may contaminate animal feed, thereby increasing the risk of zoonotic transmission from livestock to humans.<sup>5</sup>

Helminthiasis is particularly prevalent in populations living in areas with poor sanitation, inadequate hygiene practices, and frequent exposure to contaminated environments. Common behavioral risk factors include the consumption of undercooked meat, especially pork, as well as regular contact with soil and animal waste—conditions commonly encountered by livestock farmers. Among this occupational group, personal protective measures such as gloves and boots are often neglected, and hand hygiene following activities like pen cleaning, animal grazing, and feeding is frequently inadequate.<sup>6</sup> These behaviors significantly elevate the risk of helminth transmission from contaminated soil or animal feces to humans, especially in limited sanitation infrastructure.

In Indonesia, helminthiasis remains highly endemic, particularly in areas with dense agricultural and livestock activities.<sup>7</sup> Bali is an endemic province for helminth-related infections, including taeniasis and cysticercosis, due to the widespread practice of pig farming and the frequent consumption of pork. According to the Directorate General of Animal Husbandry, Bali accounted for the highest pork production in the country. By 2022, pork demand in the province reached approximately 5,218 tonnes, distributed across all nine districts.<sup>8</sup> This high demand is driven by local dietary customs and religious rituals in which pork plays a central role. Tabanan Regency, in particular, recorded pork consumption of 879 tonnes in 2022, making it one of the leading pig-farming areas in Bali.<sup>9</sup> The village of Bongan, where this study was conducted, is a rural agricultural area within Tabanan that exemplifies these livestock-reliant communities.

Pig farming involves routine tasks such as cleaning animal pens, feeding, watering, and monitoring animal health, exposing farmers to contaminated soil and animal waste.<sup>8</sup> While work duration is a key factor influencing helminthiasis risk, it operates in conjunction with other significant variables. Poor personal hygiene, limited access to sanitation facilities, barefoot practices during work, irregular use of personal protective equipment (PPE), and the consumption of undercooked pork have all been identified as significant contributors to the transmission of helminths among livestock farmers. In tropical regions such as Bali, where environmental conditions support parasite survival, these risks are further compounded by cultural practices and resource limitations. Previous research by Nurfalq *et al.* emphasizes that prolonged occupational exposure increases the cumulative risk of Soil-Transmitted Helminth (STH) infection, particularly in unsanitary environments.<sup>10</sup> Accordingly, this study aims to examine the association between work duration and the incidence of helminthiasis among pig farmers in Bongan Village, Tabanan, to inform the development of targeted interventions for reducing infection risks in similar rural communities.

## METHODS

### Participant and Study Design

This study employed an analytical observational approach with a cross-sectional design, which was appropriate for examining the association between work duration and the incidence of helminthiasis among pig farmers. This research took place in Bongan Village, Tabanan Regency, Bali, a rural area characterized by active pig farming practices. A total of 30 pig farmers were recruited using purposive sampling based on predefined inclusion and exclusion criteria.<sup>11</sup> Participants were eligible if they had worked in pig farming for at least 15 years and routinely performed farm activities without wearing protective footwear or gloves. Individuals who had consumed anthelmintic drugs within the preceding six months did not meet the eligibility criteria. These criteria were determined based on prior literature identifying prolonged occupational exposure and poor hygiene practices as key risk factors for helminth infection.<sup>12</sup> Basic demographic information, including gender and age group, was collected to describe the characteristics of the study population.

### Measurements and Procedures

Data collection involved three primary tools: a structured questionnaire, a field observation checklist, and laboratory analysis of fecal samples. The questionnaire gathered information on

demographic characteristics, hygiene behaviors, and work practices. It was developed concerning relevant literature and reviewed for content validity by public health professionals.<sup>13</sup> Observational data were recorded using a standardized checklist to document hygiene-related practices and environmental conditions during farming activities. In addition, stool samples were collected from participants using sterile containers and examined microscopically at the Parasitology Laboratory of STIKES Wira Medika Bali to identify helminth eggs. Data collection was carried out by trained research assistants under the supervision of academic staff, and all participants received a clear explanation of the study before providing written informed consent.

### Statistical Analysis and Ethical Clearance

Quantitative data collected through questionnaires, observations, and laboratory examinations were processed and analyzed using statistical software. Descriptive statistics were applied to summarize the participants' demographic and occupational profiles<sup>14</sup>, while Fisher's Exact Test was used for bivariate analysis to assess the relationship between work duration and helminthiasis incidence, considering the small sample size and expected cell distribution. A p-value less than 0.05 was considered statistically significant.<sup>15</sup> Ethical principles were strictly adhered to throughout the study in accordance with accepted research standards. Written informed consent was obtained from all participants, and confidentiality was maintained through the use of anonymized coding and restricted access to personal data. Participation was voluntary, and the research team informed participants of their right to withdraw from the study at any stage without consequence. This article was already obtained ethical approval (Ref: 430/E1.STIKESWIK/EC/III/2025)

## RESULTS

This section presents the study's findings, beginning with descriptive data on pig farmers' demographic and occupational characteristics, followed by inferential analysis assessing the association between work duration and helminthiasis incidence. A total of 30 pig farmers from Bongan Village participated in this study. The median work duration was 16 years, which was used as the cut-off point to distinguish between long-term and short-term occupational exposure. The demographic characteristics and distribution of helminthiasis cases are summarized in Table 1.

**Table 1. Demographic and Occupational Characteristics of Respondents**

Variable	Category	N	%
Gender	Male	13	43.3
	Female	17	56.7
Age Group	26—35 years	1	3.3
	36—45 years	5	16.7
	46—55 years	6	20.0
	56—65 years	7	23.4
	>65 years	11	36.6
Work Duration	≤35 years	28	93.3
	>35 years	2	6.7
Helminthiasis Incidence	Positive	3	10.0
	Negative	27	90.0

The sample consisted predominantly of female participants (56.7%), and more than one-third of participant were aged over 65 (36.6%). Most respondents (66.7%) reported working as pig farmers for 16 years or less. Helminthiasis was detected in 10.0% of participants (n = 3), all of whom had work durations exceeding 16 years. Fisher's exact test was applied to assess the association between work duration and helminthiasis incidence, as shown in Table

**Table 2. Association Between Work Duration and Helminthiasis Incidence**

Work Duration	Helminthiasis (+)		Helminthiasis (-)		Total		POR (95% CI)	p-value
	n	%	n	%	n	%		
≤35 tahun	1	3.6	27	96.4	28	100.0	1.00	0.032
>35 tahun	2	100.0	0	0.0	2	100.0	16.1 (1.8—145.3)	

All positive helminthiasis cases were found among respondents with work durations exceeding 16 years, representing 30.0% of that subgroup. No cases were identified among those with shorter work histories. Statistical analysis confirmed that workers with a work duration of more than 35 years had a 16.1 times higher risk of experiencing helminthiasis than workers with a work duration of 35 years or less. This association was statistically significant ( $p = 0.032$ ), indicating a significant relationship between work duration and the incidence of helminthiasis.

## DISCUSSION

This study investigated the association between work duration and helminthiasis incidence among pig farmers in Bongan Village, Tabanan Regency. The findings confirmed a significant relationship, as all cases of helminth infection were found exclusively among individuals with more than 16 years of occupational exposure, supporting the initial hypothesis. This result is consistent with prior studies, including research by Debby *et al.*, which reported a significant relationship between work duration and helminthiasis among waste management workers, further noting the role of inadequate personal protective equipment (PPE) usage in increasing infection risk.<sup>16</sup> Similarly, a study by Idayani and Putri in Jembrana Regency also found that prolonged exposure in barefoot conditions was associated with higher helminthiasis rates among brickmakers.<sup>17</sup>

Parasitological examination identified *Taenia solium* and *Ascaris lumbricoides* in three long-term pig farmers, pointing to zoonotic and soil-transmitted helminth (STH) infections. *T. solium*, commonly transmitted through undercooked pork or contact with contaminated environments, reflects poor sanitation and hygiene in pig farming contexts.<sup>18,19</sup> Meanwhile, *Ascaris lumbricoides*, a predominant STH in tropical regions, underscores the role of environmental exposure and limited sanitation infrastructure.<sup>20,21</sup> These findings align with global evidence that identifies *Ascaris*, *Trichuris trichiura*, and hookworm as prevalent helminths in low-resource settings.<sup>22</sup> Qualitative data reinforced these findings, revealing that infected individuals typically worked for over 30 years and regularly neglected hygiene practices, such as handwashing and using PPE. These behaviors have been linked to helminth transmission via contaminated fingernails and prolonged skin contact with infected soil.<sup>23,24</sup>

These findings' alignment with regional and international literature reinforces that occupational helminthiasis remains a significant public health concern in underserved agricultural communities. From a nursing and public health standpoint, targeted interventions are urgently needed. These include structured hygiene education, provision and use of PPE, and implementation of routine deworming programs, particularly for long-term agricultural workers. Such measures are critical not only for individual health but also for broader community protection and health promotion.

Despite its contributions, this study is subject to several limitations. The small sample size may limit generalizability, while reliance on self-reported data introduces potential recall bias. Moreover, as the study was conducted in a single rural village, its contextual transferability may be constrained. Nevertheless, these limitations do not diminish the study's relevance in highlighting occupational risk factors for helminthiasis. Future research should include multi-site studies with larger samples and longitudinal designs to examine additional determinants such as sanitation infrastructure, nutritional practices, and health literacy. Building such an evidence base is essential for developing comprehensive public health policies to reduce helminth burdens in rural farming communities. A limitation of this study is that the bivariate chi-square analysis was constrained by zero cell counts, resulting from the small number and low proportion of helminth-positive cases. Therefore, the prevalence odds ratios (PORs) and p-values should be interpreted with caution.

## CONCLUSIONS

This study demonstrates a statistically association between prolonged work duration and helminthiasis incidence among pig farmers in Tabanan, highlighting occupational exposure as a critical risk factor for parasitic infection in rural agricultural settings. These findings contribute to the growing body of evidence emphasizing the role of occupational health practices in helminth prevention and highlight the need for targeted health interventions. From a public health and nursing perspective, integrating structured hygiene education, consistent use of personal protective equipment, and periodic deworming programs into local health initiatives could mitigate helminthiasis risk and enhance disease prevention among vulnerable farming populations. While the study was limited by its small sample size and single-site design, which may affect the generalizability of results, it provides critical insights that can inform policy development and community-based health promotion strategies. Future research should employ larger, multi-site, longitudinal approaches to examine additional environmental and behavioral determinants of helminthiasis, thereby supporting more comprehensive and context-sensitive interventions within local and broader regional health systems. In addition, using a larger sample size is important to strengthen the analysis, minimize bias, and produce findings that are more accurate and representative of the population as a whole. Employing a case-control design in future studies would help ensure an adequate number of helminth-positive cases, thereby strengthening the robustness and representativeness of risk factor analyses.

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