



(RESEARCH ARTICLE)



SOCIO-DEMOGRAPHIC PROFILE, KNOWLEDGE AND PRACTICES FAVORING FOODBORNE TRANSMISSION OF TOXOPLASMOSIS AMONG MEAT SECTOR STAKEHOLDERS IN ABIDJAN SLAUGHTERHOUSE, CÔTE D'IVOIRE

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ABSTRACT

Toxoplasma gondii is a significant zoonotic parasite that can be transmitted to humans, primarily through the ingestion of undercooked meat containing tissue cysts. This study aimed to evaluate the level of knowledge regarding toxoplasmosis among meat supply chain stakeholders at the Abidjan slaughterhouse in Côte d'Ivoire. A survey was conducted with these workers to gather relevant data. The findings revealed that slaughterhouse employees in Abidjan are at a heightened risk of being exposed to *Toxoplasma gondii*. There is an alarming lack of screening, as 93% of the participants reported never having been tested, and a large portion of the workforce (74%) had never heard of the disease. The strongest factors linked to screening were previous awareness campaigns and information from healthcare professionals. These results indicate a considerable presence of the parasite within the livestock at the Abidjan slaughterhouse, raising serious concerns about the potential for zoonotic transmission associated with the consumption of undercooked meat. This situation underscores the urgent need to enhance food hygiene practices, launch consumer awareness initiatives, and establish a monitoring system for *T. gondii* in the meat sector of Côte d'Ivoire.

Keywords: Toxoplasmosis; Socio-demographic profile; Transmission; Contributing practices; Abidjan (Côte d'Ivoire).

1 INTRODUCTION

Toxoplasmosis is a widespread parasitic zoonotic infection found across the globe (Dubey, 2021). This illness is attributed to *Toxoplasma gondii*, an obligatory intracellular protozoan that can infect nearly all warm-blooded animals, including humans (Montoya et Liesenfeld, 2004). In pregnant women, this infection can lead to severe congenital abnormalities, posing significant risks in most instances (Weiss et Dubey, 2009). The primary hosts for this parasite are domestic and wild felids, which release infectious oocysts into their surroundings, while livestock can harbor tissue cysts that may manifest in both clinical and subclinical forms (Dubey, 2010). The transmission of the parasite through food, particularly via the ingestion of raw or undercooked meats containing viable cysts, plays a crucial role in the human cases of toxoplasmosis (Kijlstra et Jongert, 2008). Interestingly, livestock, traditionally viewed as less susceptible hosts due to the low detection rates of viable cysts, can still carry the parasite and contribute to transmission (Opsteegh et al., 2016). Various studies conducted in Africa have confirmed the presence of *T. gondii* in bovine tissues, highlighting the necessity of evaluating this risk in specific local settings (Deksne et Dubey, 2019). In Côte d'Ivoire, meat is a vital component of the urban diet, especially in Abidjan, where grilled and braised meats are popular, often cooked in ways that may not effectively eliminate tissue cysts (Koffi et al., 2015). From a genetic perspective, *T. gondii* shows greater diversity in Africa compared to Europe or North America (Shwab et al., 2014). Multiple studies have identified atypical or recombinant strains, frequently originating from lineages II/III or distinct African lineages, exhibiting varying levels of virulence (Mercier et al., 2010; Su et al., 2012). Thus, the genetic characterization of circulating strains is vital for comprehending local transmission patterns and the potential health risks they pose to humans. Considering the possible role of meat in the foodborne transmission of *T. gondii*, acquiring current data on the prevalence of the parasite in livestock meant for human consumption is essential. This study aimed to evaluate the awareness of meat sector employees regarding toxoplasmosis at the Abidjan slaughterhouse in Côte d'Ivoire. The results will be instrumental in risk assessment and in formulating prevention strategies tailored to the Ivorian context.

2 MATERIALS

For this study, a survey form was designed to evaluate the understanding of meat industry workers about toxoplasmosis and to pinpoint the factors that contribute to the spread of the parasite in slaughterhouses. The participants targeted in this research included bleeders/slaughterers, eviscerators, butchers, vendors, transporters, hygiene inspectors, veterinarians, and veterinary technicians.

3 METHODS

The research involved distributing a structured questionnaire to workers in the meat sector at the Abidjan slaughterhouse. This questionnaire aimed to gauge the participants' awareness of toxoplasmosis. Two groups of participants were established based on specific inclusion and exclusion criteria. Those who qualified for the epidemiological survey were individuals engaged in the production and distribution network of cattle, sheep, and goats at the Abidjan slaughterhouse, including livestock farmers, traders, handlers, butchers, and slaughterhouse personnel. To be included, participants needed to be at least 18 years old, have been involved in their roles for a minimum of six months, and voluntarily consent to participate after being informed about the study. Conversely, individuals were excluded if they were meat sector workers who declined to participate or failed to provide informed consent, those without direct interaction with cattle, sheep, goats, or their carcasses, workers with less than six months of experience, and individuals who could not respond adequately to the questionnaire or provided incomplete answers.

4 RESULTS

4.1 Socio-demographic profile of meat value chain stakeholders

The socio-demographic profile of stakeholders in the meat value chain are crucial for understanding the elements that contribute to the spread of toxoplasmosis. These characteristics help outline the profiles of individuals engaged in various stages of meat production, including slaughtering, processing, transport, and marketing activities within the slaughterhouse. Typically, this includes factors such as age, gender, educational background, duration of employment, and the specific sector of work. Table 1 illustrates the socio-demographic profile of these workers. In terms of gender, the findings revealed that a significant proportion of respondents were male, accounting for 74%. The average age of those surveyed was 44 years. Regarding marital status, the data indicated that most stakeholders were single, representing 62%, while married individuals made up 18%, those in polygamous relationships were 16%, and cohabiting individuals constituted 2.3%. The most common level of education attained was primary education, which comprised 46%, followed by secondary education at 11% and tertiary education, which accounted for 10% (n = 9).

Table 1: Sociodemographic characteristics of the participants

Variables	Categories	Frequency (n)	Proportion (%)
Length of service	< 1 year	3	3.40
	1–5 years	27	31.0
	6–10 years	23	26.0
	> 10 years	34	39.60
Occupational sector	Slaughterers / bleeders	8	9.20
	Butchers	20	23.0
	Eviscerators	9	10.3
	Hygiene workers	7	8.0
	Transporters	9	10.3
	Other	34	39.1
Educational level	None	25	28.5
	Primary education	43	49.5
	Secondary education	10	11.5
	Higher education	9	10.3
Age (years)	[17–30[	12	13.80
	[30–41[	24	28.0
	[41–60[	42	48.30
	≥ 60	9	10.30
Gender	Male	68	78.20
	Female	19	21.80

4.2 Assessment of contamination risk practices along the meat value chain

In general, Figure 1 outlines the primary risky practices related to contamination observed among stakeholders in the meat production chain at the slaughterhouse. Among the behaviors that could potentially expose workers to contamination, direct contact with animal viscera was the most commonly reported, affecting 64.4% of those surveyed. Additionally, 56% of participants acknowledged occasionally consuming undercooked meat, and 54% admitted that they did not consistently wash their hands after finishing their tasks. The presence of stray cats in the work environment was noted by 39.1% of the workforce. Moreover, the lack of use of personal protective equipment (PPE) remains an issue, with 39% of workers not wearing gloves and 35% not donning work coats.

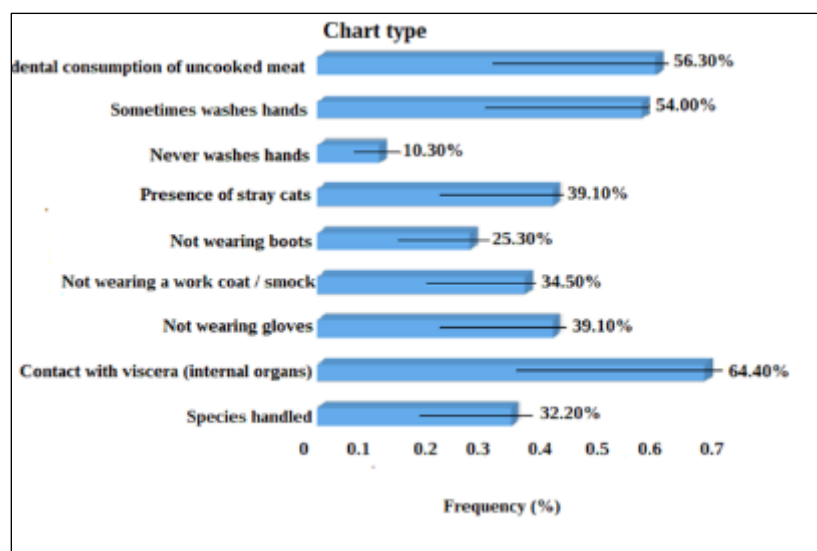


Figure 1: Contamination risk among actors in the meat production chain

4.3 Knowledge of stakeholders about toxoplasmosis

The findings illustrated in Table 2 indicate that stakeholders in the meat production chain, specifically those at the slaughterhouse, have a limited understanding of toxoplasmosis. In fact, a striking 80.5% of the individuals surveyed indicated that they were unaware of this zoonotic disease. Moreover, 87.4% of the participants did not recognize the ways in which the disease can be transmitted. Additionally, almost all workers, accounting for 96.6%, reported that they had never participated in a screening for toxoplasmosis.

Table 2: Knowledge levels regarding toxoplasmosis among meat value chain stakeholders

Variables	Slaughterers / Bleeders	Eviscerators	Butchers	Transporters	Hygiene workers	Others	Total (n)	Proportion (%)
Knowledge of toxoplasmosis								
Yes	0	2	1	1	1	12	17	19.50
No	7	9	19	10	8	17	70	80.50
Knowledge of transmission routes								
Yes	1	1	1	0	1	7	11	12.60
No	6	10	19	11	8	22	76	87.40
Prior toxoplasmosis testing history								
Yes	0	0	0	0	1	2	3	3.40
No	7	11	20	11	8	27	84	96.60

5 DISCUSSION

An examination of the socio-demographic traits of meat sector employees at the Abidjan slaughterhouse reveals a workforce largely comprised of seasoned individuals with limited educational backgrounds, who are deeply engaged in animal handling and meat-related tasks. These attributes are likely to affect their work behaviors and, in turn, the

likelihood of encountering zoonotic agents such as *Toxoplasma gondii*. The considerable tenure noted among a notable portion of the workforce, with 39.6% having over ten years of experience, signifies job stability and a wealth of expertise in areas like slaughtering, meat processing, and sales.

Nevertheless, this extended duration of work could also heighten the cumulative risk of exposure to zoonotic agents, including *Toxoplasma gondii* (Mohammed et al., 2024). While professional experience may enhance the development of specific technical skills, it does not automatically lead to a heightened awareness of health risks. In fact, repeated engagement in the same activities can result in the normalization of biological threats and a gradual decline in individual safety measures. This trend has been documented in various studies focusing on slaughterhouse employees and those in close proximity to animals (Adesokan et al., 2013; Cadmus and Adesokan, 2009). The categorization of workers by occupational sector indicates that retail traders represent the largest group at 39.1%, followed by butchers at 23%. This distribution aligns with the operational structure of slaughterhouses in sub-Saharan Africa, where processing and sales roles tend to involve more personnel than veterinary services. However, the minimal presence of veterinary staff, estimated at just 1.8%, may pose challenges for health monitoring and initiatives aimed at raising awareness about zoonoses. Veterinary services are crucial for preventing diseases that can spread from animals to humans, especially through health inspections of carcasses and the promotion of proper hygiene practices (FAO, 2014). When considering the educational backgrounds of the workers, nearly half reported only having completed primary education (49.5%), and 28.7% had not received any formal education. This scenario may contribute to a limited comprehension of how certain zoonotic diseases are transmitted. Research has shown that education plays a significant role in the adoption of preventive strategies and in the understanding of health risks linked to parasitic infections (Jones et al., 2007; Rostami et al., 2019). A lower educational attainment may restrict access to vital information and diminish the success of awareness initiatives (Dubey, 2022; FAO and WHO, 2023). The demographic profile is predominantly made up of individuals aged 41 to 60, who represent 48.3% of the workforce. This significant presence of middle-aged workers mirrors findings from various African slaughterhouses, where slaughtering, evisceration, and transportation tasks necessitate considerable professional experience and physical capability (Swai and Schoonman, 2010). Additionally, the male-dominated workforce, which comprises 78% of the total, aligns with existing literature, as occupations related to slaughtering are traditionally held by men in many sub-Saharan African nations (Adesokan et al., 2018; Mohammed et al., 2024). The evaluation of risk practices highlights various behaviors that are likely to facilitate the spread of *Toxoplasma gondii*. The primary exposure factor identified is direct contact with animal viscera, as noted by 64.4% of the workers. While direct transmission of the parasite through unbroken skin is improbable, the manipulation of animal organs and tissues raises the risk of indirect contamination, especially in the presence of skin injuries or inadequate hygiene practices. This issue is particularly alarming given that small ruminants serve as significant intermediate hosts for the parasite (Dubey, 2010). Moreover, the consumption of inadequately cooked meat, mentioned by over half of the respondents (56%), is another critical risk factor for human toxoplasmosis. Research by Dubey (2022) and Robert-Gangneux and Dardé (2012) indicates that the ingestion of tissue cysts found in undercooked meat is one of the primary pathways for human infection. Ovine and caprine meats are particularly associated with this mode of transmission due to their heightened vulnerability to *T. gondii* infection (Cook et al., 2000; Tenter et al., 2000). The lack of adherence to hygiene protocols noted in this study, particularly the absence of regular hand washing among 54% of workers, could facilitate the transmission of various pathogens present in the slaughterhouse setting. Hand washing is consistently recognized as one of the most effective strategies for minimizing cross-contamination risks in environments where biological agents are present (WHO, 2022). Additionally, the presence of stray cats, reported by 39.1% of participants, requires special consideration. Both domestic and wild felines are definitive hosts of *T. gondii* and are known to excrete oocysts into the environment. The contamination of soil, animal feed, and water sources with the feces of infected cats promotes the spread of the parasite among livestock and sustains the epidemiological cycle of toxoplasmosis (Elmore et al., 2010; Dubey, 2022; Elsheikha and Marra, 2022). Furthermore, the frequent neglect of personal protective equipment, such as gloves and work coats, points to a weak biosecurity culture among workers in the meat industry. This pattern has also been observed in various slaughterhouses across Africa, where financial limitations, lack of awareness, and inadequate oversight contribute to risky behaviors (Mirambo et al., 2018). Statistical analyses indicate that most risk behaviors are distributed significantly differently from a balanced distribution, confirming their high prevalence among this occupational group. The most notable discrepancies involve the lack of regular hand washing and the failure to wear boots, both of which likely heighten exposure to zoonotic agents. The findings regarding workers' knowledge levels reveal a troubling lack of awareness about toxoplasmosis. A striking 80.5% of respondents did not know of this zoonosis, and 87.4% were not familiar with its transmission methods. This scenario mirrors observations in several African nations, where toxoplasmosis continues to be overlooked despite its public health significance. The nearly total absence (96.6%) of serological screening documented in this study further reflects a low awareness level and a deficiency in surveillance initiatives aimed at occupational populations at risk (Pappas et al., 2009; Rostami et al., 2019).

6 CONCLUSION

The findings demonstrate a range of factors that facilitate the spread of *Toxoplasma gondii* in the Abidjan slaughterhouse setting. Risky practices, paired with a lack of understanding about the disease and the presence of stray cats, indicate a possible risk of exposure for both the workers and the livestock that are meant for human consumption. These insights strongly support the need for further research into how the parasite circulates among slaughtered animals. In fact, consuming infected meat is one of the primary means through which toxoplasmosis is transmitted to humans. Thus, assessing the seroprevalence of *Toxoplasma gondii* in cattle, sheep, and goats at the Abidjan slaughterhouse is crucial for understanding the level of infection in these animals and the potential risk to consumers. Conducting serological tests on these species will help identify the animal reservoirs that play a key role in sustaining the parasite and will be an important step before delving into the molecular analysis of the genetic diversity of the strains present in this environment.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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This study was done on my own initiative as part of a doctoral thesis.

Disclosure of conflict of interest

The authors declare that they have no competing interests.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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