

**ASSESSMENT OF AWARENESS OF
WATERBORNE TYPHOID RISK
AMONG MOBILE SUGARCANE
VENDORS IN JOS-BUKURU
METROPOLIS**

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Abstract

Mobile sugarcane vendors in Nigerian cities frequently moisten their produce with water from diverse sources, creating significant public health concerns. This study investigated the awareness of waterborne typhoid risk among 384 mobile vendors in the Jos-Bukuru metropolis using a cross-sectional survey design. The Health Belief Model (HBM) served as the theoretical framework, allowing for an analysis of how psychological constructs; specifically perceived susceptibility, severity, benefits, and barriers shape the health behaviors of this informal workforce. Data were gathered through face-to-face interviews using a structured questionnaire. Key findings reveal a severe knowledge deficit, with 72.7% of vendors demonstrating a poor understanding of typhoid transmission and symptoms. While many vendors have access to piped water, a significant number rely on hazardous sources such as unprotected wells and roadside drainage channels. The study further identifies that economic and physical barriers (such as the cost and weight of clean water) significantly outweigh the perceived benefits of safe water use. However, vendors showed high responsiveness to cues to action, particularly regarding peer-based outcomes and health worker engagement. To address these challenges, the study recommends structural interventions, such as

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establishing low-cost or free water access points near major vending locations, to ensure that safe practices are economically and physically feasible for vendors.

Keywords: Typhoid fever, Mobile sugarcane vendors, Health Belief Model, Waterborne disease, Informal food sector

INTRODUCTION

The call of the sugarcane vendor is a familiar soundtrack to daily life in Jos-Bukuru metropolis. Pushing wheelbarrows laden with white stalks, vendors service traffic jams, school gates and market walkways, offering a cheap, sweet snack. After peeling and chopping the cane, they dip the pieces into water carried in the wheelbarrow, ostensibly to remove dust and dirt. Yet this apparently innocuous practice raises a critical public health question: where does that water come from?

Mobile vendors refill from whatever sources are available: neighbourhood taps, roadside drainage channels, streams or public boreholes. The water serves not only a final rinse but also continuous wetting throughout the day, as vendors believe this preserves sweetness and prevents drying in the sun. This repeated contact creates a direct pathway for pathogens. If a container is refilled from a source contaminated with *Salmonella* Typhi, the bacteria can transfer to the sugarcane and subsequently to the consumer.

Typhoid fever, caused by *Salmonella enterica* serovar Typhi, is a severe systemic infection rather than a minor gastrointestinal illness (Zafar et al., 2017). The bacterium is a human-specific pathogen, with humans as its

only natural reservoir (Bula-Rudas et al., 2015). Mahmoud et al. (2022) note high prevalence and transmission rates in Sub-Saharan Africa, including Nigeria, which records over 7.2 million annual typhoid cases and an incidence rate of 762 per 100,000. Jos-Bukuru metropolis, despite its temperate climate, is not immune. The area has a history of poor waste management, with refuse dumpsites compromising groundwater quality (Salami et al., 2001). Consequently, the practice of continuously wetting sugarcane with water from varied sources poses significant food safety concerns (Khanal et al., 2024; Moreira et al., 2024). This study therefore seeks to uncover the gap between perception and knowledge among sugarcane vendors in Jos-Bukuru regarding water-related health risks to the consuming public.

Statement of the Problem

The link between contaminated water and typhoid is well established in public health (Afere et al., 2025; Nada et al., 2025). *Salmonella* Typhi spreads via the faecal-oral route—through consumption of food or water contaminated with human waste (Oludairo et al., 2023). In Jos-Bukuru, vendors rely on diverse water sources. While piped water or protected boreholes are likely safe, open streams and drainage channels are

highly probable sites of faecal contamination, particularly during the rainy season when runoff carries waste into water bodies.

The practice of reusing the same water throughout the day amplifies risk, creating a cycle of contamination. Even initially clean water can be contaminated by a single piece of sugarcane that touches a dirty surface or a vendor's unwashed hand, spreading bacteria to every subsequent piece. Yet the practice persists at scale across the metropolis, suggesting a breakdown in health communication. The vital message about water safety and typhoid transmission may not be reaching this group, or, if it is, it fails to resonate.

Critically, there is a paucity of data on vendors' awareness. To the best of the reserachers' knowledge, little evidence exists regarding what they know, believe or do concerning typhoid transmission, water safety perceptions, or the reasons behind their water-sourcing choices. Without this baseline understanding from the vendors' perspective, public health campaigns risk missing the mark entirely, failing to address actual concerns, constraints and knowledge gaps. This study seeks to fill that void, providing the foundational communication research

needed to inform effective, targeted interventions.

RESEARCH OBJECTIVES

This study investigated the level of awareness of waterborne typhoid risk among mobile sugarcane vendors in Jos-Bukuru metropolis. The study's specific objectives are to:

1. assess the level of knowledge among sugarcane vendors regarding the causes, symptoms;
2. identify the sources of water used by vendor, and
3. explore the vendors' perceptions of the risks associated with their water-use practices.

LITERATURE REVIEW

Three concepts underpin this research: awareness, health communication, and food safety practices within the informal sector.

Awareness

In health communication, 'awareness' extends beyond mere disease recognition to encompass a multi-layered understanding that includes knowledge, risk perception, and health behaviours (Trevethan, 2017). This aligns with frameworks such as the Knowledge-Attitude-Practice (KAP) model

and the Health Belief Model (HBM), where awareness is viewed as a dynamic construct shaped by factual knowledge and perceived susceptibility (Samsudin et al., 2025).

Knowledge serves as the foundational layer, which for typhoid fever includes identifying the causal agent (*Salmonella Typhi*) and understanding faecal-oral transmission routes (Ravi & Ayando, 2024; Khaki et al., 2024). In the Nigerian context, Barnabas et al. (2024) observed that while food vendors possess some level of awareness, their specific knowledge and attitudes are significantly improved by access to formal education and media. However, significant gaps persist; for example, in endemic regions of Africa, knowledge deficits regarding symptoms and prevention contribute to disease persistence (Tawfiq et al., 2024). Furthermore, Afere et al. (2025) emphasise that understanding the epidemiological trends and dynamics of typhoid in North-Central Nigeria is vital for effective localised prevention.

Risk perception bridges abstract knowledge and personal relevance (Majid et al., 2020; Schmälzle et al., 2017). It refers to subjective beliefs about the likelihood of threat, often influenced by optimism bias. As noted by Wenndt et al. (2025) in their study of market

vendors in Northwest Nigeria, vendors may believe their own water supply is "clean enough" despite inherent microbiological risks. This is compounded by the fact that many vendors rely on visual cleanliness rather than microbiological safety when choosing water sources (Thanh et al., 2021; Wenndt et al., 2025).

Health Communication

Health communication is an interdisciplinary, strategic, and audience-centred process (Glass & Giles, 2019). It recognises that effective communication goes beyond information transfer to co-creating solutions that acknowledge sociocultural contexts and structural barriers. In Nigeria, audience segmentation and message tailoring are critical; interventions must resonate with specific values and address unique local barriers (Stehr et al., 2022).

Channel selection—including radio, religious gatherings, and community health workers—must align with the specific media habits and trust networks of the target population (Rahman et al., 2019; Igwe & Obeagu, 2024; Choi et al., 2024). The application of theoretical frameworks such as the HBM is particularly valuable for predicting health intentions in the Nigerian

informal sector, as Braide (2022) demonstrates that HBM constructs effectively predict health-seeking behaviours. For mobile vendors, whose primary barrier may be a lack of accessible clean water, communication must integrate motivational messaging with practical structural solutions (Gupta et al., 2021). Ultimately, as Oludairo et al. (2023) argue, communication strategies must address the specific epidemiological factors of *Salmonella* transmission unique to the Nigerian environment to be truly effective

Theoretical Framework

This study adopts the Health Belief Model (HBM) as its analytical lens. Developed in the 1950s, the HBM posits that health decisions emerge from a subjective cost-benefit calculus shaped by personal beliefs (Ragin & Keenan, 2021). Despite critiques of its individualistic focus (Sheeran & Abraham, 1996), the model remains valuable for understanding preventive action among hard-to-reach populations.

The HBM comprises six constructs. Perceived susceptibility and severity together form threat perception, generating motivational impetus. Perceived benefits and barriers are then weighed; action is most probable when benefits outweigh barriers

(Braide, 2022). Cues to action trigger behaviour, while self-efficacy determines initiation and maintenance of change.

For this investigation, the HBM structured the interrogation of vendors' water-use practices. The questionnaire operationalised constructs through specific items. For example, perceived susceptibility (likelihood of a customer contracting typhoid from unclean water), perceived severity (impact on work or school), and perceived barriers (difficulties in using only safe water). This enabled systematic examination of psychological drivers, informing predictions about which interventions, addressing misconceptions, reducing barriers, or enhancing cues to action, might most effectively shift practices within this mobile, informal workforce.

METHODS

This study utilized a cross-sectional survey design, which is an established approach for capturing a descriptive "snapshot" of a target population's awareness, risk perceptions, and health practices at a single point in time (Ragin & Keenan, 2021). This design was specifically chosen as the most practical and efficient methodology for investigating the Jos-Bukuru metropolis, where no official register exists for the itinerant workforce of

mobile sugarcane vendors. By employing this design, the study was able to systematically describe the prevailing situation and identify critical knowledge gaps within this hard-to-reach population, providing the foundational baseline data required to inform future, targeted public health interventions.

The target population included every individual selling freshly cut sugarcane from a wheelbarrow or cart within the metropolis. As the population size could not be precisely determined, the required sample was estimated using the standard formula for cross-sectional studies aiming to estimate a proportion. Assuming 50% prevalence (which maximises sample size), a 95% confidence level, and a 5% margin of error, the calculation yielded a target sample of approximately 384 vendors.

A multi-stage sampling procedure was implemented. First, the Jos-Bukuru metropolis was stratified into its two main administrative areas: Jos North and Jos South. Within each stratum, high-density vendor locations were purposively selected. In Jos North, these comprised the Terminus Market area and Bauchi Road extending to the University of Jos campuses. In Jos South, the selected locations were Bukuru Market

through to Kugiya Kara Markets, and Anguldi down to Police Staff College. These sites concentrate the highest numbers of mobile sugarcane vendors.

Following purposive site selection, quota sampling was applied, with quotas roughly proportional to the estimated vendor population at each site: 119 vendors in Terminus Market, 102 in Bukuru Market–Kugiya Kara, 96 on Bauchi Road–University of Jos, and 67 in the Anguldi–Police Staff College corridor. Within each location, convenience sampling was used: researchers approached vendors who were present and willing to participate until the site-specific quota was fulfilled. This non-probability approach was unavoidable given the lack of a sampling frame.

Data were collected through face-to-face interviews using a structured questionnaire. Interviewer administration was preferred over self-completion because of expected variation in literacy levels, ensuring consistent comprehension. The questionnaire comprised four sections: Section A captured socio-demographic characteristics; Section B assessed knowledge of typhoid fever; Section C examined water sources and self-reported practices; and Section D measured risk perceptions and health information sources

using Likert-scale items anchored in the Health Belief Model.

Data analysis relied on descriptive statistics. Frequencies, percentages, means and standard deviations were used to summarise vendors' socio-demographic profiles and address each research objective. Tabulated results were subsequently interpreted in plain language, with findings consistently linked back to the study's research questions and the Health Belief Model framework.

RESULTS AND DISCUSSION

Socio-Demographic Profile

The study surveyed 384 mobile sugarcane vendors in the Jos-Bukuru metropolis, revealing a predominantly young male workforce (98.7%), with 40.4% aged 18–25 years, 28.6% aged 26–35 years, and only 2.3% aged 46 or older. Educational attainment is severely limited: 73.4% had only Quranic or informal education, and a further 8.1% had no formal schooling; none had completed senior secondary or tertiary education. Most vendors had 1 to 6 years of experience (80.8% combined), and the majority serve between 31 and 50 customers daily, exposing dozens of consumers to potential typhoid risk.

Typhoid knowledge, measured on an eight-item scale, was poor for 72.7% of vendors, moderate for 24.0%, and high for only 3.4%. Although faecal-oral transmission was widely understood, confusion persisted regarding asymptomatic infection and the chronic carrier state. Suggesting gaps that hinder recognition of apparently healthy individuals, including vendors themselves, as potential transmitters.

Water sourcing practices are problematic: while 93.5% reported using public taps or piped water, 81.3% also relied on unprotected wells, 53.4% on neighbours' taps, and 8.9% acknowledged using roadside drainage channels. Water refilling practices are troubling, as 34.9% change water only when visibly dirty, 22.7% never change it (simply adding more), and none reported changing it with every refill. Vendors justified their water choices primarily by perceptions that water “appears clean” (95.6%), long-term use without observed problems (94.8%), social proof (90.6%), proximity (83.6%), and low cost (81.0%), reflecting optimism bias.

Only 10.7% had received any training on safe food or water handling; among these, local government environmental health officers (85.4%) and Ministry of Health officers

(78.0%) were the main sources. Regarding routine health information, radio was most widely accessed (96.6%), followed by religious gatherings (91.4%) and community meetings (81.3%). However, trust was highest for religious leaders (52.6%), then radio (24.0%) and health workers (18.0%). Only 14.1% had encountered any message about typhoid or clean water for vending in the preceding six months. Vendors overwhelmingly desired practical guidance on accessing free or affordable clean water near selling locations (99.5%), simple disease transmission explanations (94.0%), and container-cleaning demonstrations (91.4%).

Applying the Health Belief Model, perceived susceptibility was undermined by optimism bias: although 66.1% agreed that a customer could contract typhoid from sugarcane washed with unclean water, only 18.0% believed someone in their local area had likely become ill from vendor-sold sugarcane, and 77.6% considered their own customers at lower risk. Perceived severity was high for health consequences (91.9% agreed typhoid requires hospitalisation; 94.8% agreed it causes prolonged work absence), but only 29.9% agreed that a customer's illness would seriously damage their business reputation. Perceived benefits were acknowledged, whereas 77.6% agreed

that using only clean, treated water reduces risk, yet 68.0% disagreed that more frequent water changes would help, and 63.3% disagreed that handwashing with soap protects customers, indicating weak mechanistic understanding of bacterial transmission. Economic barriers dominated: 89.8% strongly agreed that buying clean water would significantly reduce profits, while physical barriers (weight and inconvenience) were cited by 91.2%, and accessibility barriers (difficulty finding reliable clean water near vending locations) by 62.5%. Moreover, 52.9% agreed that the absence of customer complaints justified no change. However, vendors showed high responsiveness to cues to action: observing another vendor facing consequences because a customer fell sick would prompt 92.2% to change their water sources; health worker visits would influence 81.3%; and radio programming about water safety would make 95.9% reconsider their practices. These findings suggest that vendors are not inherently resistant to change but lack sufficient environmental cues, with peer-based or visible enforcement interventions likely to prove particularly effective.

FINDINGS

The study used both survey data and face-to-face interviews to understand vendor behaviour. By comparing these two sets of data, several points of convergence and divergence emerged.

Knowledge of Typhoid Fever (Objective 1): The survey and interview data converge on a significant knowledge gap. Quantitative results show that 72.7% of vendors have poor knowledge of typhoid. Interviews confirm this, revealing that vendors confuse "visual cleanliness" with "microbiological safety". While most vendors could identify the term 'faecal-oral transmission,' they failed to recognise how it applies to their own containers. This shows that knowing a term does not mean they understand the risk.

Water Sources and Practices (Objective 2): There is a notable divergence regarding water access. While 93.5% of vendors reported having access to piped water, the interview responses show they rarely use it exclusively. Instead, 81.3% rely on unprotected wells and 8.9% use roadside drainage. The interviews explain why: vendors prioritise proximity and low cost over safety.

Furthermore, the data converge on dangerous refilling habits. The survey shows that 22.7% never change their water, only adding more.

During interviews, vendors justified this by stating that the water "appears clean". This highlights a dangerous reliance on sight rather than science.

Health Information and Risk Perceptions (Objective 3): The findings show a divergence between media reach and actual trust. Radio has the highest reach at 96.6%, yet only 24% of vendors trust it. Conversely, religious leaders are trusted by 52.6% of vendors despite having less frequent contact. This suggests that while vendors hear the news, they only believe the "in-group" messengers.

Finally, the survey and interviews converge on the power of economic barriers. A total of 92.9% of vendors agreed that buying clean water would ruin their profits. Interview comments supported this, with vendors citing the physical weight and cost of water as their biggest hurdles. This confirms that for these vendors, financial survival often outweighs health concerns.

RECOMMENDATIONS

The findings warrant targeted interventions across public health practice, policy, and research.

Health communication: With 72.7% of vendors demonstrating poor knowledge and

89.3% never having received training, substantial investment in communication is urgently needed. Interventions should leverage channels that vendors both access and trust: radio (accessed by 96.6%) for initial dissemination, and religious leaders (trusted by 52.6%) for reinforcement. The finding that 81.3% would consider changing practices following a health worker visit suggests that adequately resourced community health worker programmes could prove highly effective. Critically, messages must adopt oral and visual formats rather than written materials, given the absence of senior secondary education among the sample.

Addressing perceived barriers: The dominant barrier, which is 92.9% believe purchasing clean water would significantly reduce profits, cannot be overcome through communication alone. Structural interventions are essential, including establishing low-cost or free water access points near major vending locations through public-private partnerships or subsidised vendor water schemes. The physical burden of water weight and inconvenience (cited by 91.2%) could be mitigated by designing wheelbarrow-mounted water containers with rolling mechanisms.

Leveraging cues to action: Since 92.2% would change practices upon witnessing another vendor face consequences for customer illness, visible accountability mechanisms may be highly effective. Given the informal sector's nature, alternatives to formal enforcement include peer observer programmes that train and visibly recognise hygiene champions, or customer-facing hygiene certification stickers that create market incentives.

Future research: Longitudinal studies should assess whether documented knowledge deficits translate into actual typhoid infection risk through serological testing. Intervention research ought to compare the effectiveness of radio messaging alone versus radio combined with religious leader engagement versus peer education models. Economic research is needed to quantify the actual cost of transitioning to exclusive use of protected water sources and to model potential subsidy mechanisms.

Conclusion

This study investigated awareness of waterborne typhoid risk among mobile sugarcane vendors in Jos-Bukuru metropolis, addressing a significant gap in health communication literature on itinerant food vendors in informal economies. The findings

reveal that the vast majority of vendors lack basic knowledge about typhoid transmission, risky water-sourcing and handling practices are nearly universal, and formal health information has reached only one in ten vendors. Nevertheless, important opportunities for intervention exist. Vendors are not indifferent to risk: they recognise typhoid as a serious illness and express openness to changing practices if provided with feasible alternatives. The barriers they face are primarily structural, which include a lack of affordable clean water, the physical impracticality of transporting sufficient water, and absence of compelling cues to action.

From a theoretical perspective, the findings validate the Health Belief Model's utility for understanding vendor behaviour while also highlighting its limitations. Although perceived susceptibility, severity, benefits, barriers, and cues to action all demonstrated relevance, the most powerful predictors of practice were structural barriers, particularly economic constraints, which lie outside the individual psychological domain that the HBM emphasises. Comprehensive behaviour change frameworks integrating both individual-level beliefs and structural determinants may thus be necessary for

understanding informal sector food safety practices.

From a public health standpoint, communication interventions alone will be insufficient. While tailored messaging delivered through trusted channels (radio, religious leaders, and health workers) can address knowledge deficits and shift risk perceptions, such efforts must be accompanied by structural interventions that make safer practices economically and physically feasible. The vendors' strong preference for information about accessing affordable clean water near their selling locations represents a rational response to their material conditions, not a deficit in health motivation.

The study has limitations. The cross-sectional design precludes causal inferences; self-reported practices may have introduced social desirability bias; the non-probability sampling limits generalisability; and the absence of microbiological testing precluded objective validation of self-reported risk. Notwithstanding these constraints, this research makes an important contribution by centring the perspectives of a previously unstudied occupational group and documenting the specific knowledge deficits, practices, and barriers that must be addressed

to reduce typhoid risk in Jos-Bukuru metropolis. The findings underscore a fundamental lesson for health communication in informal sector contexts: effective intervention requires not only changing minds but also changing the material conditions within which those minds operate. When a vendor knows that clean water would reduce disease risk but also knows that buying clean water would eliminate their profit margin, no amount of messaging will change their behaviour. It is this intersection of awareness, economics, and infrastructure that must become the focus of integrated public health action.

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