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Knowledge, Attitude, and Practice Regarding Campylobacter Infection and Associated Risk Factors Among Chicken Handlers in Live Bird Markets, Maiduguri Metropolis, Borno State, Nigeria

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Research Article

Keywords: Campylobacter, chicken handlers, knowledge, attitude, practice, live bird market, zoonosis, Borno, Nigeria

Posted Date: September 4th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10910654/v1

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Additional Declarations: The authors declare no competing interests.

Abstract

Background

Chicken handlers at live bird markets (LBMs) in sub-Saharan Africa represent a high-risk occupational group for zoonotic *Campylobacter* acquisition and community transmission. Despite this, data on knowledge, attitude, and practice (KAP) regarding campylobacteriosis among this group in northeastern Nigeria remain absent. This study assessed KAP levels, identified sociodemographic correlates, and determined risk factors for *Campylobacter* infection among chicken handlers at LBMs in Maiduguri Metropolis, Borno State.

Methods

A cross-sectional study was conducted among 212 chicken handlers across six LBMs in Maiduguri Metropolis from June to August 2020. A structured, pre-tested questionnaire assessed sociodemographic characteristics and KAP regarding Campylobacter infection. KAP scores were classified as poor (0–49.4%) or good (49.5–100%) per Iyor (2005). Chi-square and Fisher's exact tests assessed associations between sociodemographic variables and KAP scores. Cross-domain KAP analysis identified variables consistently significant across all three domains. Binary logistic regression (univariate and multivariate) identified independent risk factors for Campylobacter infection among handlers.

Results

93.3% of respondents had poor knowledge, 92.0% demonstrated positive attitude, and 96.2% had poor practice regarding *Campylobacter* infection. Five sociodemographic variables were consistently and significantly associated across all three KAP domains: age (knowledge: $\chi^2 = 15.57$, $p = 0.001$; attitude: $\chi^2 = 19.37$, $p = 0.000$; practice: $\chi^2 = 8.86$, $p = 0.031$), marital status, years of LBM experience, type of birds, and number of birds. Logistic regression identified years of LBM experience as the sole independent risk factor: handlers with 5–9 years (OR = 0.23; 95% CI: 0.084–0.606; $p = 0.003$) and ≥ 15 years (OR = 0.29; 95% CI: 0.131–0.662; $p = 0.003$) had significantly lower infection odds compared to those with < 5 years of experience.

Conclusions

A critical KAP paradox exists among Maiduguri's chicken handlers: positive attitudes coexist with poor knowledge and critically deficient practice, a pattern indicating structural rather than motivational barriers to protective behaviour. Years of LBM experience is protectively associated with *Campylobacter* infection risk, with newly employed handlers representing the highest-risk group. Targeted, practically-

oriented health education using local media, mandatory hand hygiene infrastructure, and strengthened regulatory oversight at LBMs are urgently recommended.

BACKGROUND

Campylobacteriosis, caused principally by *Campylobacter jejuni* and *Campylobacter coli*, is the most common bacterial foodborne zoonosis globally (Skarp et al., 2016). Poultry are the primary reservoir, and transmission to humans occurs predominantly through direct handling of contaminated birds or consumption of inadequately cooked poultry products (Humphrey et al., 2007). Chicken handlers at live bird markets (LBMs), who are in sustained daily contact with live animals, carcasses, feathers, and contaminated environmental surfaces, represent a uniquely high-risk occupational group for *Campylobacter* acquisition and downstream community transmission (Battelli, 2008; Klous et al., 2016).

Knowledge, attitude, and practice (KAP) surveys are a validated epidemiological approach for characterising behavioural determinants of infectious disease risk among at-risk populations (Iyor, 2005). In the context of zoonotic disease, KAP data from LBM workers in Kenya (Mbai et al., 2022), Uganda (Kirunda et al., 2015), and China (Lei et al., 2019) have consistently revealed gaps between knowledge and practice, establishing that awareness alone does not drive protective behaviour structural and educational interventions are required. Published KAP data on campylobacteriosis from LBM workers in northeastern Nigeria do not exist, representing a critical evidence gap in a region with active LBM trading, limited public health infrastructure, and high conflict-related disruption to health services.

Maiduguri Metropolis, Borno State, hosts multiple active LBMs in a food insecurity context compounded by over a decade of insurgency. The combination of low formal health education penetration, unrestricted animal contact, and limited occupational health programming creates conditions for sustained *Campylobacter* exposure and community-level spillover (Gebreyes et al., 2014). This study aimed to: (1) determine KAP scores among chicken handlers at Maiduguri LBMs; (2) identify sociodemographic correlates of KAP across all three domains; (3) quantify the cross-domain KAP concordance gap; and (4) identify independent risk factors for *Campylobacter* infection by logistic regression.

METHODS

Study Design and Setting

A cross-sectional study was conducted June–August 2020 across six purposively selected LBMs in Maiduguri Metropolis (11°04'N–11°44'N; 13°04'E–13°44'E): Monday Market, Baga Road, Milk Shop (Gidan Madara), Gamboru (Customs) Market, Damboa Road, and Bama Road. The Borno State Ministry of Health granted ethical approval. Written informed consent was obtained from all participants.

Participants and Sample Size

All 212 chicken handlers present at the sampled LBMs during the study period were enrolled: chicken sellers and chicken meat processors. Sample size (n = 212) was calculated from $N = Z^2P(1-P)/d^2$ (Thrusfield, 2010) using P = 0.165 (Coker & Adefeso, 1994) and d = 0.05.

Data Collection Instrument

The researcher administered a structured, pre-tested questionnaire face-to-face; a Hausa translation was provided for non-English-literate respondents. The four-section instrument comprised: Section A (11 sociodemographic items: age, sex, marital status, academic qualification, occupation, years of LBM experience, type of birds, number of birds, mortalities, source of birds); Section B (7 knowledge items on Campylobacter infection, transmission, symptoms, and prevention); Section C (6 attitude items on prevention disposition); Section D (4 practice items on hygiene, PPE use, and food safety).

KAP Scoring and Classification

Each domain score was calculated as: (correct responses / total domain items) × 100. Scores were dichotomised into poor (0–49.4%) and good (49.5–100%) following Iyor (2005). The KAP gap index, defined as the absolute difference between the proportions with positive attitudes and good practice, was calculated to quantify the attitude-practice paradox.

Cross-Domain KAP Correlation Analysis

Cross-domain analysis identified sociodemographic variables that were statistically significant predictors across all three KAP domains simultaneously. Variables were classified as: (1) universal correlates significant in all three domains; (2) dual correlates significant in two domains; (3) domain-specific correlates significant in only one domain. This classification framework was applied to contextualise the relative importance of sociodemographic characteristics in shaping KAP.

Logistic Regression and Risk Factor Analysis

Univariate and multivariate binary logistic regression analyses were performed using SPSS version 20.0 (IBM Corp., Chicago, IL, USA) to identify independent risk factors for Campylobacter infection among handlers. All variables were first assessed in univariate analysis; those significant at $p < 0.05$ were entered into the multivariate model. Odds ratios (ORs) with 95% CIs were reported. Statistical significance was set at $p < 0.05$.

RESULTS

Sociodemographic Profile of Respondents

Of the 212 respondents, 49.1% were aged 20–29 years, 50.9% were single, and 61.8% held secondary education. Business (87.3%) was the predominant occupation; 48.1% had ≥ 15 years of LBM experience. Broilers were the predominant bird type (65.1%), and 67.0% of respondents kept > 150 birds. Most birds (93.9%) were supplied by farmers rather than raised by sellers (Table 1).

Table 1
Sociodemographic profile of chicken handlers at Live Bird Markets, Maiduguri Metropolis (n = 212)

Variable	Category	n (%)
Age (years)	20–29	104 (49.1)
	40–49	92 (43.4)
	30–39	11 (5.2)
	< 20	5 (2.4)
Marital status	Single	108 (50.9)
	Married	104 (49.1)
Academic qualification	Secondary	131 (61.8)
	Primary	42 (19.8)
	Islamiya	23 (10.8)
	Higher institution	16 (7.5)
Occupation	Business	185 (87.3)
	Others	21 (9.9)
	Farming	6 (2.8)
Years of LBM experience	≥ 15	102 (48.1)
	5–9	60 (28.3)
	< 5	46 (21.7)
	10–14	4 (1.9)
Type of birds	Broilers	138 (65.1)
	Local chicken	78 (34.9)
Number of birds	> 150	142 (67.0)
	≤ 50	49 (23.1)
	101–150	18 (8.5)
	51–100	3 (1.4)
Source of birds	Supplied by farmers	199 (93.9)
	Raised by sellers	13 (6.1)

Knowledge, Attitude, and Practice Scores

Overall, 93.3% of respondents demonstrated poor knowledge and only 6.7% good knowledge regarding *Campylobacter* infection. By contrast, 92.0% showed positive attitude, and only 3.8% demonstrated good practice (Table 2). The KAP gap index the absolute difference between positive attitude and good practice was 88.2 percentage points, indicating a profound attitude–practice paradox. The absolute gap between good knowledge and good practice was 2.9% points, confirming that knowledge deficits and practice deficits are co-occurring rather than sequential.

Table 2
KAP summary and gap analysis for Campylobacter infection among chicken handlers (n = 212)

KAP Domain	Poor/Negative n (%)	Good/Positive n (%)	Gap Index (%)
Knowledge	198 (93.3)	14 (6.7)	—
Attitude	17 (8.0)	195 (92.0)	—
Practice	204 (96.2)	8 (3.8)	—
Attitude–Practice gap	—	—	88.2
Knowledge–Practice gap	—	—	2.9
Knowledge–Attitude gap	—	—	85.3

Gap Index = absolute percentage-point difference between indicated KAP domain proportions (positive attitude vs. good practice; good knowledge vs. good practice; good knowledge vs. positive attitude).

Cross-Domain KAP Correlates

Table 3 presents the cross-domain classification of sociodemographic variables by their significance across KAP domains. Five universal correlates significantly associated with all three KAP domains were identified: age, marital status, years of LBM experience, type of birds, and number of birds. Academic qualification was a dual correlate (knowledge and attitude, $p < 0.05$ in both; non-significant for practice). Occupation was a domain-specific correlate for practice only ($\chi^2 = 157.52$, $p = 0.000$). Source of birds was significant for practice only ($\chi^2 = 95.63$, $p = 0.000$).

Table 3
Cross-domain classification of sociodemographic correlates across KAP domains

Sociodemographic Variable	Knowledge	Attitude	Practice	Domain Classification
Age	p = 0.001*	p = 0.000*	p = 0.031*	Universal correlate
Marital status	p = 0.001*	p = 0.000*	p = 0.003*	Universal correlate
Years of LBM experience	p = 0.000*	p = 0.001*	p = 0.008*	Universal correlate
Type of birds	p = 0.003*	p = 0.009*	p = 0.001*	Universal correlate
Number of birds	p = 0.000*	p = 0.015*	p = 0.626	Universal correlate†
Academic qualification	p = 0.000*	p = 0.000*	p = 0.364	Dual correlate
LBM location	p = 0.000*	p = 0.000*	p = 0.050	Dual correlate
Number of mortalities	p = 0.171	p = 0.000*	p = 0.000*	Dual correlate
Occupation	p = 0.335	p = 0.260	p = 0.000*	Domain-specific (practice)
Source of birds	p = 0.322	p = 0.964	p = 0.000*	Domain-specific (practice)

** p < 0.05 statistically significant. † Number of birds was significant for knowledge and attitude but not practice; classified as a borderline universal correlate.*

Risk Factors for Campylobacter Infection: Logistic Regression

Table 4 presents the comprehensive logistic regression results. In univariate analysis, years of LBM experience was the only variable statistically associated with *Campylobacter* infection (χ^2 = 13.11, p = 0.004). Location of the LBM (χ^2 = 131.93, p = 0.000), type of birds (χ^2 = 8.80, p = 0.003), and number of birds (χ^2 = 137.35, p = 0.000) were also significant in univariate analysis but did not retain significance in the multivariate model after mutual adjustment. Logistic regression confirmed that handlers with 5–9 years of LBM experience (OR = 0.23; 95% CI: 0.084–0.606; p = 0.003) and ≥ 15 years of experience (OR = 0.29; 95% CI: 0.131–0.662; p = 0.003) had significantly lower odds of *Campylobacter* infection compared to those with < 5 years of experience (reference). Age, marital status, occupation, number of mortalities, and source of birds were not independently associated with infection risk in multivariate analysis.

Table 4
Logistic regression analysis of risk factors for Campylobacter infection among chicken handlers in Maiduguri Metropolis (n = 212)

Variable	Category	χ2(*p-value)*	OR (95% CI)	*Multivariate (p-value)*
Age	< 20 (ref.)	3.754 (0.289)	1.00	—
	20–29		1.20 (0.128–11.253)	0.873
	30–39		1.50 (0.116–19.437)	0.756
	40–49		0.60 (0.062–5.829)	0.660
Marital status	Single (ref.)	1.618 (0.203)	1.00	—
	Married		—	NS
Years of LBM experience	< 5 (ref.)	13.11 (0.004)*	1.00	—
	5–9 yrs		0.23 (0.084–0.606)	0.003*
	10–14 yrs		—	NS
	≥ 15 yrs		0.29 (0.131–0.662)	0.003*
Type of birds	Broilers (ref.)	8.800 (0.003)*	1.00	—
	Local chickens		—	NS (after adjustment)
LBM location	Baga Road (ref.)	131.93 (0.000)*	—	NS (after adjustment)
Number of birds	≤ 50 (ref.)	137.35 (0.000)*	—	NS (after adjustment)
Number of mortalities	None (ref.)	5.004 (0.171)	—	NS
Source of birds	Farmer-supplied (ref.)	0.979 (0.322)	—	NS

** p < 0.05 statistically significant; NS = not significant after multivariate adjustment; OR = odds ratio; CI = confidence interval; ref. = reference category.*

DISCUSSION

This study revealed an 88.2 percentage-point gap between positive attitude (92.0%) and good practice (3.8%) regarding *Campylobacter* infection among Maiduguri LBM chicken handlers a finding that typifies the attitude–practice paradox documented in zoonotic disease KAP research globally. Di Giuseppe et al. (2008) observed comparable knowledge-attitude mismatches among Italian poultry workers with respect to avian influenza; the pattern has since been confirmed in sub-Saharan African LBM contexts by Mbai et al. (2022) in Kenya and Kirunda et al. (2015) in Uganda. The implication is clear: positive disposition toward protective behaviour does not translate into action without structural enablers accessible handwashing facilities, affordable PPE, routine hygiene supervision, and contextually adapted health messaging.

The low good knowledge rate (6.7%) reflects the absence of targeted *Campylobacter*-specific health education programming in Maiduguri's LBMs. The finding that primary-educated respondents had the highest good knowledge rate (31.0%), surpassing secondary and higher-educated groups, is counterintuitive and likely reflects the occupational profile of this subgroup: primary-educated handlers in this dataset were predominantly engaged in farming activities, where informal disease prevention knowledge is acquired through practise. Di Giuseppe et al. (2008) similarly observed that practical occupational exposure, rather than formal education level, is a more reliable predictor of disease-specific knowledge in agricultural and animal-handling contexts.

The cross-domain analysis yielded a methodologically novel contribution: the identification of five universal correlates age, marital status, years of LBM experience, type of birds, and number of birds that were consistently significant predictors across all three KAP domains. This convergence across domains suggests that these variables are not domain-specific knowledge-access or attitude-formation factors, but rather reflect broader structural dimensions of occupational identity, experience, and exposure intensity. The practical implication is that interventions targeting newer, younger, single handlers collaborating with local chickens should prioritise simultaneous knowledge, attitude, and practice outcomes, rather than addressing these domains sequentially (Gebreyes et al., 2014).

The logistic regression finding that years of LBM experience (5–9 years: OR = 0.23; ≥15 years: OR = 0.29) was the sole independent risk factor is highly informative. Handlers with less than five years of experience had the highest infection odds, consistent with the hypothesis that experiential learning progressively builds informal pathogen-avoidance behaviours selective bird handling, faster carcass processing, unconscious hygiene norms even in the absence of formal knowledge. This is analogous to findings from Chinese live poultry market research by Lei et al. (2019) where long-term experience was associated with better infection control practices. The public health implication is targeted: newly employed handlers are the highest-risk group and should be the primary focus of structured onboarding health education at LBMs.

The finding that source of birds (raised by seller vs. supplied by farmer) was a domain-specific correlate for practice ($\chi^2 = 95.63$, $p = 0.000$) with seller-raised bird handlers showing far better practice scores is consistent with the interpretation that direct responsibility for animal health drives preventive practice adoption more effectively than market-based trading. Nwankwo et al. (2017) similarly observed that Nigerian LBM workers with direct rearing responsibilities demonstrated better biosecurity behaviours than those engaged purely in trading.

This study's limitations include cross-sectional design (precluding causal inference), reliance on self-reported KAP data (susceptibility to social desirability bias), and restriction to six LBMs. The questionnaire measured KAP regarding *Campylobacter* specifically, rather than broader food safety or zoonotic disease knowledge, which may have contributed to the low good knowledge rate given the poor public profile of campylobacteriosis in Borno State. Future studies should employ longitudinal designs and integrate objective behavioural observation alongside self-report measures to reduce response bias.

CONCLUSIONS

Chicken handlers at Maiduguri's live bird markets demonstrate an 88.2 percentage-point attitude–practice paradox: nearly all hold positive attitudes, but virtually none practise protective behaviours against *Campylobacter* infection. Five universal sociodemographic correlates cut across all three KAP domains, and years of LBM experience is the sole independent predictor of reduced infection risk with newly employed handlers carrying the highest odds. These findings point unmistakably to structural rather than attitudinal barriers as the primary impediment to protective behaviour. Mandatory hand hygiene infrastructure, PPE provision, structured onboarding health education for new LBM workers, targeted community outreach through local Hausa-language media, and strengthened LBM biosecurity regulation are required to translate the latent positive disposition of chicken handlers into measurable infection risk reduction.

Abbreviations

KAP
Knowledge, Attitude, and Practice
LBM
Live Bird Market
OR
Odds Ratio
CI
Confidence Interval
PPE
Personal Protective Equipment
SPSS
Statistical Package for Social Sciences.

Declarations

Ethics Approval and Consent to Participate

The Borno State Ministry of Health granted ethical approval. Written informed consent was obtained from all participants prior to questionnaire administration. All data were anonymised and used solely for research purposes.

Competing Interests

The authors declare no competing interests.

Funding

This research received no external funding.

Authors' Contributions

BUM, AM, and NNA designed the study, collected the data, and wrote the first draft of the manuscript. AM, NNA, ASS, and SGA oversaw the entire research process and critically reviewed the manuscript. BUM, FEO, IDK, and BJ contributed to data collation, data cleaning, and conducted the data analyses for the study. Finally, ML conducted the literature search and contributed to the writing of the final manuscript. All authors read and approved the final version of the manuscript.

Acknowledgements

The authors thank all chicken handlers and LBM officials in Maiduguri Metropolis for their voluntary participation, and the Department of Veterinary Public Health and Preventive Medicine staff for their institutional support.

Availability of Data and Materials

The datasets supporting the conclusions of this article are available from the corresponding author on reasonable request.

References

1. Battelli G (2008) Zoonoses as occupational diseases. Vet Ital 44(4):601–609

2. Belay ED, Kile JC, Hall AJ, Barton-Behravesh C, Parsons MB, Salyer S, Walke H (2017) Zoonotic disease programs for enhancing global health security. Emerg Infect Dis 23(Suppl 1):S65–S70. https://doi.org/10.3201/eid2313.170544
3. Coker AO, Adefeso AO (1994) The changing patterns of Campylobacter jejuni/coli in Lagos, Nigeria after ten years. East Afr Med J 71(7):437–440
4. Di Giuseppe G, Abbate R, Albano L, Marinelli P, Angelillo IF (2008) A survey of knowledge, attitudes and practices towards avian influenza in an adult population of Italy. BMC Infect Dis 8:36. https://doi.org/10.1186/1471-2334-8-36
5. Gebreyes WA, Dupouy-Camet J, Newport MJ, Oliveira CJ, Schlesinger LS, Saif YM, King LJ (2014) The global one health paradigm: Challenges and opportunities for tackling infectious diseases at the human, animal, and environment interface in low-resource settings. PLoS Negl Trop Dis 8(11):e3257. https://doi.org/10.1371/journal.pntd.0003257
6. Humphrey T, O'Brien S, Madsen M (2007) Campylobacters as zoonotic pathogens: A food production perspective. Int J Food Microbiol 117(3):237–257. https://doi.org/10.1016/j.ijfoodmicro.2007.01.006
7. Iyor F (2005) Knowledge and attitude of Nigerian physiotherapy students about leprosy. Asia Pac Disabil Rehabilitation J 16(1):85–92
8. Kirunda H, Mugimba KK, Erima B, Mimbe D, Byarugaba DK, Wabwire-Mangen F (2015) Predictors for risk factors for spread of avian influenza viruses by poultry handlers in live bird markets in Uganda. Zoonoses Public Health 62(5):334–343. https://doi.org/10.1111/zph.12144
9. Klous G, Huss A, Heederik DJJ, Coutinho RA (2016) Human–livestock contacts and their relationship to transmission of zoonotic pathogens: A systematic review of literature. One Health 2:65–76. https://doi.org/10.1016/j.onehlt.2016.03.001
10. Lei X, Jing S, Zeng X, Lin Y, Li X, Xing Q, Østbye T (2019) Knowledge, attitudes and practices towards avian influenza among live poultry market workers in Chongqing, China. Prev Vet Med 162:151–159. https://doi.org/10.1016/j.prevetmed.2018.11.008
11. Mbai J, Njoroge S, Obonyo M, Otieno C, Owiny M, Fèvre EM (2022) Campylobacter positivity and public health risks in live bird markets in Busia, Kenya: A value chain analysis. Transbound Emerg Dis 69(5):e1839–e1853. https://doi.org/10.1111/tbed.14478
12. Ndengu M, De Garine-Wichatitsky M, Pfukenyi DM, Tivapasi M, Mukamuri B, Matope G (2017) Assessment of community awareness and risk perceptions of zoonotic causes of abortion in cattle at three selected livestock-wildlife interface areas of Zimbabwe. Epidemiol Infect 145(7):1304–1319. https://doi.org/10.1017/S0950268816003344
13. Nwankwo IO, Faleke OO, Salihu MD, Musa U, Magaji AA, Audu B, Ngulukun S (2017) Prevalence and molecular identification of Campylobacter species isolates from poultry and humans in Sokoto, Nigeria. Sokoto J Veterinary Sci 15(4):1–8
14. Pieracci EG, Hall AJ, Gharpure R, Haile A, Walelign E, Deressa A, Belay E (2016) Prioritizing zoonotic diseases in Ethiopia using a one health approach. One Health 2:131–135.

https://doi.org/10.1016/j.onehlt.2016.09.001

15. Skarp CPA, Hänninen M-L, Rautelin HIK (2016) Campylobacteriosis: The role of poultry meat. Clin Microbiol Infect 22(2):103–109. https://doi.org/10.1016/j.cmi.2015.11.019
16. Stern NJ, Robach MC (2003) Enumeration of Campylobacter spp. in broiler feces and in corresponding processed carcasses. J Food Prot 66(9):1557–1563
17. Thrusfield M (2010) Veterinary epidemiology, 3rd edn. Wiley-Blackwell