

Air sample contamination with Avian Influenza (A/H5N1 and A/H9N2) in live poultry markets in Dhaka, Bangladesh, and its association with market and stall-level characteristics: an ecological analysis

Sudipta Sarkar¹, Patrick Nguipdop Djomo², Immamul Muntasir¹, Lorcan Carnegie³, Saira Butt³, Anne Conan⁴, Alam Nawsher¹, Tahmina Shirin¹, Mahmudul Hasan⁵, Abdus Samad⁵, Guillaume Fournie³, Mahbubur Rahman¹, Punam Mangtani²

¹Institute of Epidemiology, Disease Control and Research (IEDCR), Bangladesh; ²London School of Hygiene and Tropical Medicine (LSHTM), UK; ³Royal Veterinary College (RVC), UK; ⁴French Agricultural Research Centre for International Development (CIRAD), France; ⁵Bangladesh Livestock Research Institute (BLRI), Bangladesh;

Background

- Live Poultry Markets (LPM) are an important part of society in Bangladesh and settings for high-density population mixing.
- Avian Influenza A viruses (AIV) are enzootic in local poultry, notably H5N1 and H9N2.
- Human infections with AIV have been sporadic, but they have pandemic potential, through reassortment with other strains.
- Although the risk of spill-over from poultry to humans appears mostly associated with close contact with poultry, airborne infection from contaminated aerosols is possible.
- We investigated aerosol contamination with AIV in from LPM in Dhaka, Bangladesh's most populous city, and its association to market characteristics, including hygiene.

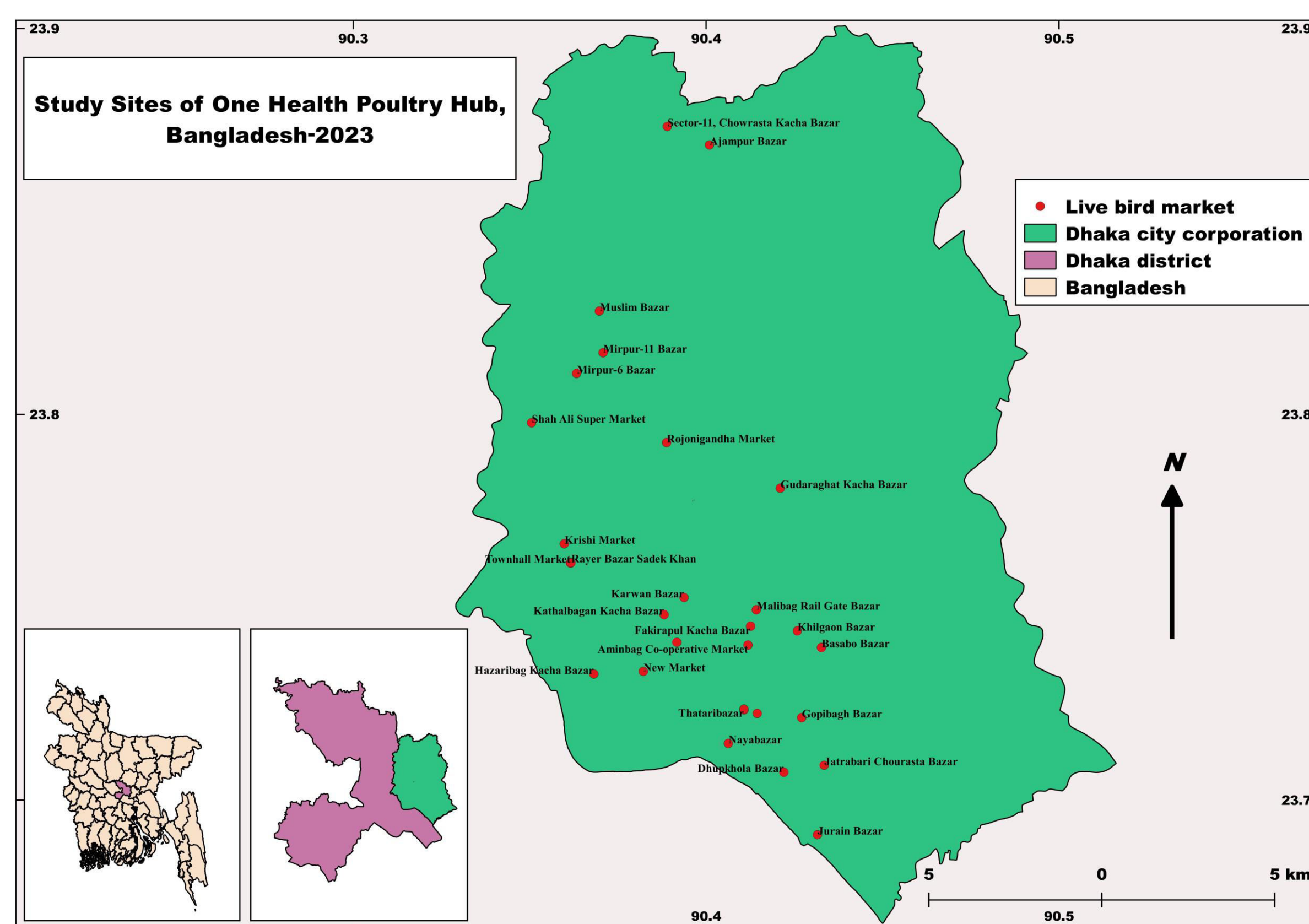
Methods

- This was a cross-sectional study in February / March 2023
- 30 LPMs in Dhaka, Bangladesh, selected with probability proportional to number of poultry trading stalls.
 - Air samples collected using QuickTake[®] impactor air sample pump.
- 9 to 15 poultry stalls selected in each market using simple random sampling (SRS) for observation of marketing practice and hygiene.
- Up to two workers in each poultry stall selected using SRS
 - Nasal and Pharyngeal swabs provided
 - => Air samples and Nasal and Pharyngeal swabs tested for AIV by RT-PCR
 - => Sequencing being done for positive samples
- Prevalence of market AIV positive samples estimated and statistical association investigated using logistic regression with robust standard error.
- Phylogenetic analyses planned to compare sequences of viruses recovered in market air samples and poultry traders.

Air sample collection in the market



Figure 1: Map of Dhaka in Bangladesh with location of participating poultry markets



Example of poultry stall in the market with chicken and ducks

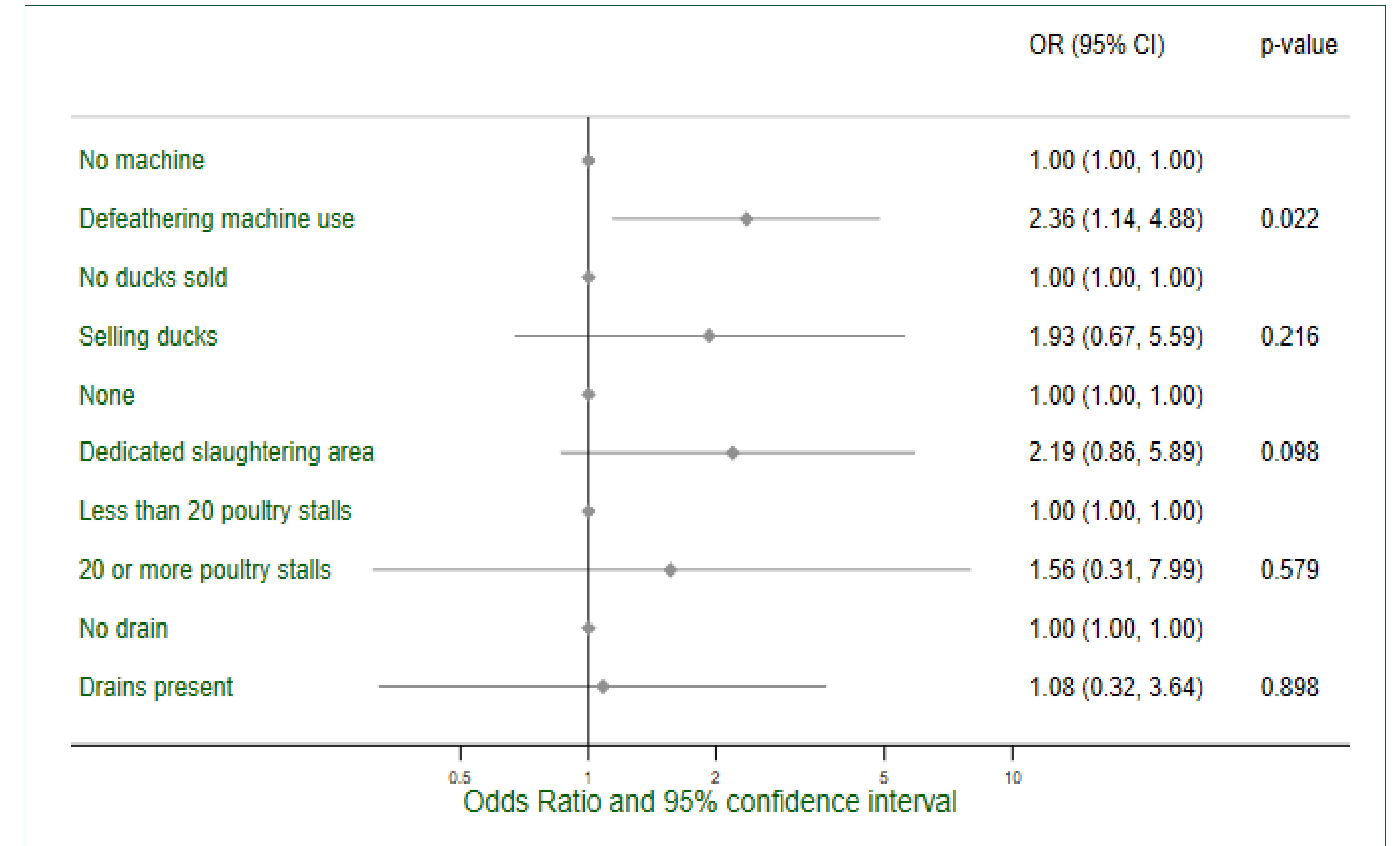
Results

- Overall 383 poultry stalls and 415 poultry workers enrolled in 30 LPMs.
- Air samples positive for AIV in 12 markets (prevalence 40%; 95%CI 23% to 59%)
 - ❖ 2/30 (7%; 95%CI 1% to 22%) LPMs with H5N1 only
 - ❖ 4/30 (13%; 95%CI 4% to 31%) LPMs with H9N2 only
 - ❖ 6/30 (20%; 95%CI 8% to 39%) LPMs with both H5N1 and H9N2
- Two poultry workers with nasal swab positive for H9N2 (all asymptomatic)

Table 1: Characteristics of poultry stalls by market size and overall

Variable	Smaller markets (<20 poultry stalls) (%) (n ₁ =179)	Larger markets (>= 20 poultry stalls) (%) (n ₂ = 204)	Total (%) (n=383)
Selling ducks	31 (17%)	26 (13%)	57 (15%)
Selling birds other than chicken or ducks (geese, pigeon, quail)	7 (4%)	8 (4%)	15 (4%)
Birds kept in cages	176 (98%)	200 (98%)	376 (98%)
Floor cleanliness (Small (vs Large) amount faeces / feathers on floor)	121 (68%)	140 (69%)	261 (68%)
Presence of drains	43 (24%)	32 (16%)	75 (20%)
Any PPE used by workers (facemask, gloves, apron, coverall or closed shoes)	9 (5%)	9 (4%)	18 (5%)
Dedicated slaughter area	96 (54%)	126 (62%)	222 (58%)
Use of defeathering machine	94 (53%)	90 (44%)	184 (48%)
Cover on defeathering machine	88 (94%)*	82 (93%)*	170 (93%)*
Birds boiled before using machine	94 (100%)*	81 (91%)*	175 (96%)*

* Restricted to stalls using a defeathering machine



OR and 95%CI from logistic regression with robust standard error, adjusting for market clustering, and all variables presented in the plot

Figure 2: Forest plot of association between AIV air contamination and stalls/market-level characteristics in Dhaka, Bangladesh

- Sequencing of positive samples (air and nasal / pharyngeal swabs from workers) ongoing
- Phylogenetic analyses will be done to compare air samples to poultry data and market workers.

Conclusions

- ✓ High prevalence of AIV air contamination in Dhaka's live poultry markets, thus potential for airborne exposure and contamination of market users.
- ✓ Some suggestion that presence of ducks and using defeathering machines may contribute respectively to pathogen introduction and aerosolization.
- ✓ Half of the markets with positive air samples have both H5N1 and H9N2, suggesting potential viruses co-circulation in poultry, and further underlining the importance of live poultry markets in facilitating virus reassortment.
- ✓ Further analysis will help to understand the contribution of airborne exposure in LPM and potential contribution to environmental surveillance and risk assessment.

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