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Short Communication

Putative human and avian risk factors for avian influenza virus infections in backyard poultry in Egypt

Basma M. Sheta [a,b,*], Trevon L. Fuller [b], Brenda Larison [b], Kevin Y. Njabo [b], Ahmed Samy Ahmed [c], Ryan Harrigan [b], Anthony Chasar [b], Soad Abdel Aziz [c], Abdel-Aziz A. Khidr [a], Mohamed M. Elbokl [a], Lotfy Z. Habbak [a], Thomas B. Smith [b]

[a] Zoology Department, Faculty of Science, Damietta Branch, Mansoura University, P.O. Box 819, 34517 New Damietta, Damietta, Egypt
[b] Center for Tropical Research, Institute of the Environment and Sustainability, University of California, Los Angeles, 619 Charles E. Young Dr. East, Los Angeles 90095-1496, CA, USA
[c] National Laboratory for Veterinary Quality Control on Poultry Production (NLQP), Animal Health Research Institute, P.O. Box 264, Nadi El Said Street, Dokki, Giza, Egypt

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ABSTRACT

Highly pathogenic influenza A virus subtype H5N1 causes significant poultry mortality in the six countries where it is endemic and can also infect humans. Egypt has reported the third highest number of poultry outbreaks ($n = 1084$) globally. The objective of this cross-sectional study was to identify putative risk factors for H5N1 infections in backyard poultry in 16 villages in Damietta, El Gharbia, Fayoum, and Menofia governorates from 2010–2012. Cloacal and tracheal swabs and serum samples from domestic ($n = 1242$) and wild birds ($n = 807$) were tested for H5N1 via RT-PCR and hemagglutination inhibition, respectively. We measured poultry rearing practices with questionnaires ($n = 306$ households) and contact rates among domestic and wild bird species with scan sampling. Domestic birds (chickens, ducks, and geese, $n = 51$) in three governorates tested positive for H5N1 by PCR or serology. A regression model identified a significant correlation between H5N1 in poultry and the practice of disposing of dead poultry and poultry feces in the garbage ($F = 15.7$, $p < 0.0001$). In addition, contact between domestic and wild birds was more frequent in villages where we detected H5N1 in backyard flocks ($F = 29.5$, $p < 0.0001$).

1. Introduction

Highly pathogenic avian influenza virus of subtype H5N1 (hereafter "H5N1") remains a major public health challenge in many countries. Egypt, which has reported 173 human cases since 2006 with a 36% fatality rate, has reported third highest number of cases in the world after Indonesia and Vietnam as well as the third highest number of poultry outbreaks ($n = 1084$) after Vietnam and Thailand (OIE, 2013; WHO, 2013). Almost all (93%) H5N1 infections in humans in Egypt are associated with poultry exposure (WHO, 2012). The majority of these cases are in women and children, who are the main caretakers of backyard flocks in rural areas (Kandeel et al., 2010; Wilson and Oushy, 2011). This suggests that poultry rearing methods in rural households are important for the persistence of H5N1 in domestic birds and subsequent spillover to

* Corresponding author at: Center for Tropical Research, Institute of the Environment and Sustainability, University of California, Los Angeles, 619 Charles E. Young Dr. East, Los Angeles 90095-1496, CA, USA.
Tel.: +1 310206 6234; fax: +1 310 825 5446.
E-mail address: basmasheta@ucla.edu (B.M. Sheta).

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humans. In Cambodia, handling and caging backyard poultry were associated with H5N1 infection in humans (Vong et al., 2009). In Thailand, the most significant risk factor for H5N1 in backyard poultry was the occurrence of free-ranging domestic ducks in the flock (Tiensin et al., 2009). In Vietnam, the presence of geese on farms and sharing of scavenging areas with ducks from other farms increased the risk of H5N1 in poultry flocks (Henning et al., 2009). In Indonesia, cropping intensity, elevation, and human population density were significant risk factors for H5N1 in backyard poultry, but unlike Vietnam and Thailand the occurrence of ducks was not a risk factor (Loth et al., 2011). Previous studies of H5N1 in avian hosts in Egypt have analyzed H5N1 prevalence in backyard poultry and wild birds (El-Zoghby et al., 2013), but not their behavioral interactions. To our knowledge, this is the first study of contact between wild birds and poultry. Backyard poultry in rural Egypt typically have direct contact with wild birds because they are allowed to leave the farm household to go outside to feed and swim. In addition to testing domestic birds for H5N1, we sampled wild birds in agricultural fields adjacent to farmers' houses to test for transmission of the virus between wild and domestic birds. Finally, we fielded a questionnaire to attempt to identify possible risk factors for H5N1 at the village level.

2. Materials and methods

2.1. Sampling design

We used a cross-sectional study design, sampling 1242 poultry and 807 wild birds in 16 villages across four governorates in Lower Egypt from 2010 to 2012 (Table 1). We sampled wild birds and asymptomatic and symptomatic poultry. The governorates sampled were selected based on epidemiological and logistical considerations. To increase the likelihood of detecting H5N1, we selected governorates that had reported a human case of H5N1 in the past year. Of these governorates, we sampled those in which staff from the local branch of the General Organization of Veterinary Services, the Egyptian agency responsible for veterinary health, were available to participate in the planning of field campaigns, liaise with farmers, and take part in field work.

The number of villages sampled per governorate was determined by the governorate's land cover types, defined as ecological regions with characteristic vegetation. We sampled one village in every major land cover type, to test whether land cover affected the prevalence of H5N1 in wild birds. Within a land cover type, villages were selected to be at least 30 km apart by road, but blindly with respect to the presence of H5N1. For example, in Damietta governorate, which has three land cover types – saltwater wetlands bordering the Mediterranean, freshwater wetlands bordering Lake Manzala, and farmland in the Nile Delta – we sampled Ezbet Sita village in a saltwater wetland, Enania village in a freshwater wetland, and Sheta village in farmland.

We sampled houses opportunistically inside each village without inquiring in advance about whether the household flock was infected with H5N1. We sampled all individuals of all wild birds species mist netted at each household. Due to logistic constraints, we could not sample all individuals of all domestic species. Instead, we sampled an average of 4 birds per household and an

Table 1
Number of questionnaires, contact rate observation points, cloacal and tracheal swabs, and serum samples collected at the village scale. H5N1 was detected only in poultry and positives are shown in the last two columns.

Village name	Contact rate observation points	Questionnaires	Wild birds sampled (swabs only)	Poultry sampled (swabs and blood)	H5N1 detected in poultry	
					Swabs	Blood
Damietta governorate (June 2011)	60	63	75	102	0	0
Ezbet Sita	20	22	30	37	0	0
Enania	20	15	17	25	0	0
Sheta	20	26	28	40	0	0
El Gharbia governorate (July 2011)	60	61	109	99	0	13
Delgamon	20	20	70	31	0	0
Shubra Tana	20	19	0	32	0	13
Tafhna el Azab	20	22	39	36	0	0
Fayoum governorate (April–June 2010)	60	62	307	491	8	0
AbouNema	15	15	91	75	1[a]	0
Basher Saleh	15	15	42	149	0	0
Fydimin	10	22	105	170	7	0
Zhaina	20	10	69	77	1	0
Menofia governorate (February–March 2012)	114	120	329	550	0	30
Beshtamy	20	20	23	119	0	8
El Hamoul	20	19	104	92	0	0
El Roda	21	19	38	77	0	6
Grace	17	22	46	80	0	6
Manwahla	16	20	75	96	0	10
Shanwan	20	20	43	86	0	0
Total	294	306	807	1242	8	43

[a] Dead chicken, not included in analyses.