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Use of poultry manure in vegetable cultivation and influenza pandemic

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ABSTRACT

Vegetable workers were assessed for the prevalence of physical and psychological ill-health, symptoms associated with avian influenza (AI), as well as, their awareness of AI pandemic threat, using structured questionnaire. Vegetable workers reported significantly higher symptoms of physical ill health than control (P = 0.002). Symptoms associated with flu in humans such as fever, headache, extreme tiredness, cough, sore throat, runny / stuffy nose, muscle ache, nausea, vomiting were highly prevalent among vegetable workers. There was however no significant difference in symptoms of anxiety and depression reported between vegetable workers and control populace. The knowledge of AI risk among vegetable workers was very poor. Unhygienic practices such as application of manure without protective coverings such as nose masks as well as bathing with manure contaminated well water which exposed them to AI risk, were reported among the vegetable workers.

Keywords: Avian influenza, ill-health, organic fertilizer, poultry manure, vegetable cultivation.

INTRODUCTION

Poultry litter is a good source of nutrients and organic matter for growing crops (Marsh *et al.*, 2009). Poultry Manure is made up of faecal droppings, wood shaving (bedding), waste feed and high load of microbes (2 - 4). It is commonly used by vegetable farmers as organic fertilizer (1 - 3). Vegetable contamination by pathogenic microbes is of great health importance in leafy vegetables, especially those consumed raw, as farmers often broadcast their poultry manure over already established crops (2, 3). Human exposure to poultry dust has been associated with various infectious, allergic, respiratory and immunologic diseases (4).

Avian influenza (AI) is a highly contagious viral disease affecting several species of birds used for food (chickens, turkeys, quails, guinea fowl, etc.), pet birds and wild birds (5). The AI viruses are orthomyxoviruses, influenza type A and exhibit high frequency of genetic resortment with resultant antigenic changes in the viral surface glycoproteins. This makes influenza viruses

formidable challenge for control efforts (6). Highly pathogenic AI viruses of the H5N1 subtypes are zoonotic agents that present a continuing threat to animal and human health (7). Avian influenza (H5N1) outbreak was first in Nigeria in the year 2006 (8), since then the disease has been ravaging poultry farms in the country.

Humans can contact AI virus through direct contact with bird faeces and respiratory secretions, droplets and by mechanical transfer through contacts with contaminationated formites (9). Depending on environmental conditions, AI viruses may remain infectious in manure, water, soil and contaminated equipments for at least 35 days and perhaps as long as 3 months in colder climates (9). The serious pandemic threat posed by AI H5N1 intensified the urgency of global pandemic preparedness for influenza H5N1 (10).
The objective of this study is to assess the physical and psychological ill-health of vegetable workers that make use of poultry manure and their awareness of AI pandemic threat.

MATERIALS AND METHODS

The study was carried out in the year 2007 in a vegetable farmland situated in Ojo town in Lagos state, Nigeria. This is a lowland tropical rainforest with a daily temperature of 28 $^{\pm}$ 2^{o}C. The farmland is owned by a cooperative in which members are allotted plots. The vegetables cultivated include those consumed raw (especially for salads) and those used for preparing sauce. Cultivation of vegetables in the farmland is all year round.

The human exposure assessment was conducted via questionnaire. The questionnaire used, which is made of four sections, was adapted from the work of Thu *et al*. (11). Section A contains questions that provided information on socio-demographics, as well as knowledge of pandemic influenza. Section B provided symptoms (18 in number) of physical ill health. Section C is a depression scale made up of 20 questions based on the work of Zung (12). This scale is derived from established research utilizing factor analysis to derive the most common set of underlying characteristics that predict depression in clinical setting (12). Section D, containing 21 questions, is an anxiety scale based on the Beck Anxiety Inventory (13).

A total of 91 vegetable workers participated in the exercise. Similar questionnaire was administered to 100 control subjects that were not vegetable workers and were neither occupationally exposed to organic dust.

The following were used for comparison of frequency of occurrence of symptoms of ill health: -
a) Physical health: never = 0, rarely = 1, occasionally = 2, often = 3, very often = 4;
b) Depression: never = 0, some of the time =1, good part of the time = 2, most of the time = 3;
c) anxiety: not at all = 0, sometimes = 1, frequently = 2, almost constantly = 3, as described by Thu and co-workers (11).
Paired t-test was used to test for significant difference in mean symptoms values between the vegetable workers and the control subjects. Anxiety and depression indices were obtained by totalling the raw scores of the participants and dividing by total possible score (11). Analysis of data was carried out using SPSS 15.0 for Windows Evaluation Version.

RESULT AND DISCUSSION

The vegetable workers' socio-demographic data and knowledge of pandemic AI is summarized in table 1. All the farmers make use of poultry manure in vegetable cultivation, only 5.49% of the farmers do not handle poultry manure by themselves but by their employee. The studied

vegetable workers are constantly exposed to AI risk by: (a) direct contact with poultry manure - 100%; (b) inhalation of manure dust during spreading of poultry manure on vegetable beds due to non-usage of nose mask – 94.51; (c) bathing with water from farm well into which manure from vegetable beds are regularly leached following rainfalls – 83.52%; (d) visiting poultry farms to pack manure – 16.48% and (e) consumption of vegetables especially in raw form – 100% (Table 1).

All the workers believed that they could not contact bird flu from manure with the idea that the disease was limited to birds. Vegetable workers reported significantly higher symptoms of physical ill health than control ($t = 3.675$, $P = 0.002$; Figure 1). Symptoms associated with flu in humans such as fever, headache, extreme tiredness, cough, sore throat, runny / stuffy nose, muscle ache, nausea, vomiting were highly prevalent among vegetable workers. The vegetable workers experienced significantly higher symptoms of psychogenic illness, characterized by weakness, nausea/vomiting, dizziness and fainting/black-out, than the control populace ($t = 13.565$, $P = 0.001$; Table 2). There were no significant differences from control for the symptoms of depression ($t = 0.646$, $P = 0.526$; Figure 2), and anxiety ($t = 1.019$, $P = 0.321$; Figure 3) experienced by the vegetable workers. Their depression and anxiety indices were 0.45 and 0.14; while those of control were 0.46 and 0.12 respectively.

TABLE 1: Socio-demographics of vegetable works and their knowledge of avian flu

Characteristics		Number
Total no interviewed		91
Gender:	Male	71(78.02%)
	Female	20(21.98%)
Age (years)		32.32^{+} 8.46
Years of vegetable cultivation		5.34 ± 3.07
Smoking habit:	Smokers	19 (20.898%)
	Non-smokers	72 (78.12%)
Use of poultry manure in vegetable cultivation		100%
Source of manure:	Purchase from vendors	76(83.52%)
	Direct packing from farms	15 (16.48%)
Direct involvement in application of manure to vegetable		86 (94.51%)
Use of protective materials:		
	Face / nose masks	9 (9.99%)
	Hand gloves	12 (13.19%)
	Boots	25 (27.47)
	Eye protective	0 (0%)
Bathing with farm's well water after work		76 (83.52%)
Awareness of bird flu in Nigeria		89 (97.8%)
Avian flu is a disease of fowls		91 (100%)
I can contact bird flu through poultry manure		0 (0%)
I consume a lot of vegetable		91 (100%)

TABLE 2: Comparing the clusters of symptoms of physical ill health between vegetable workers and control populace

Symptoms cluster	T – value	P – value
i. All symptoms combined	3.675	0.002*
ii. Symptoms of bronchitis and hypereactive airways	1.238	0.238
iii. Cluster 2: Symptoms of mucous membrane irritation	1.738	0.224
iv. Cluster 3: Symptoms of psychogenic illness	13.565	0.001*
v. Cluster 4: Symptoms of chronic sinusitis	1.571	0.361
vi. Cluster 5: Others	1.339	0.272

* *Significant*

Cluster 1: *Cough, sputum, shortness of breadth, tightness in chest, wheezing*
Cluster 2: *Running nose, scratchy throat burning/watering eyes*
Cluster 3: *Weakness, nausea/vomiting, dizziness, fainting/blackout*
Cluster 4: *Headache, plugged/irritating ears.*
Cluster 5: *Fever, muscle ache/pain, skin rash, hearing problem.*

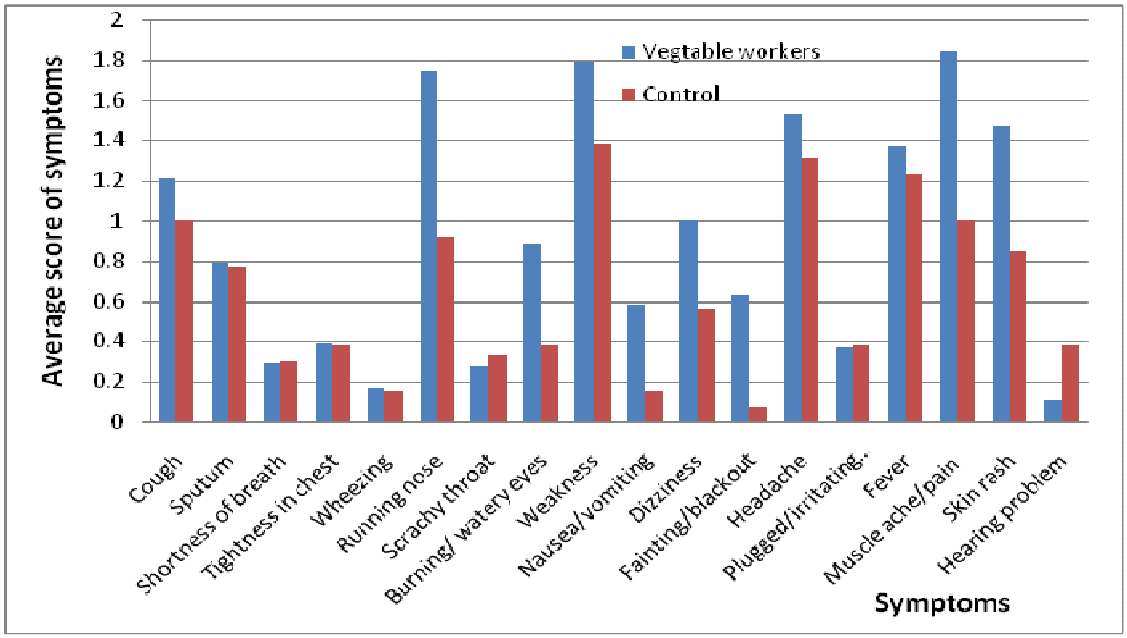

Figure 1: A comparison of frequency of symptoms of physical ill health of farmers using poultry manure in cultivation of vegetables with control sbjects (Paired *t* test: t = 3.675, P = 0.002)

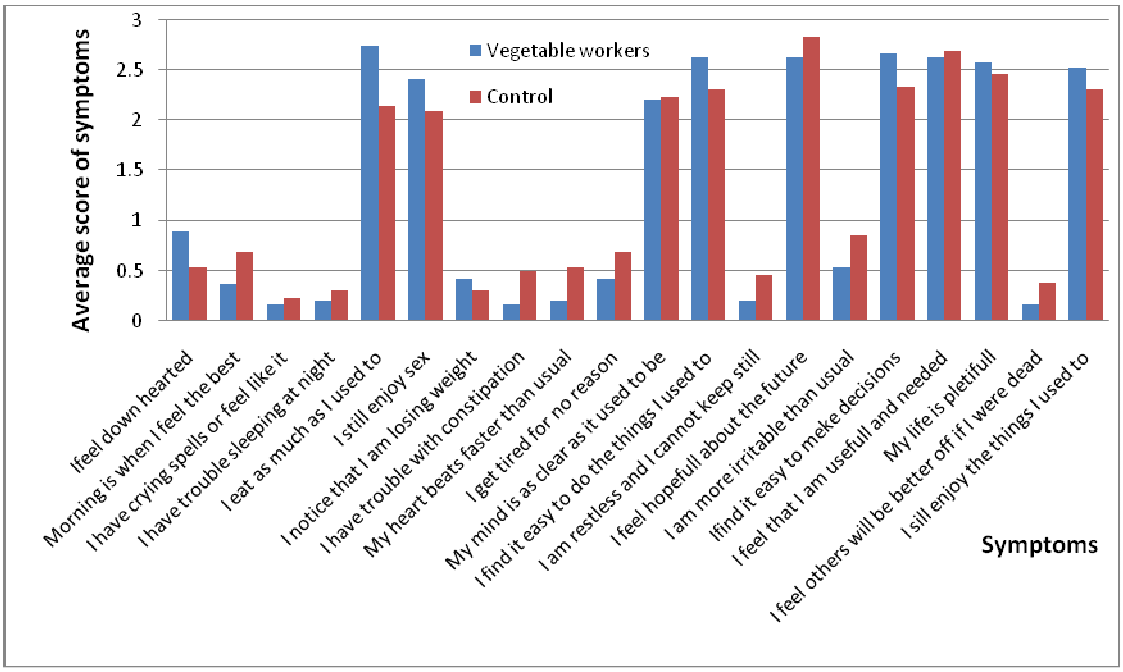

Figure 2: A comparison of depression symptoms experienced by farmers utilizing poultry manure in vegetable cultivation (Paired *t* test: t = 0.646, P = 0.526)

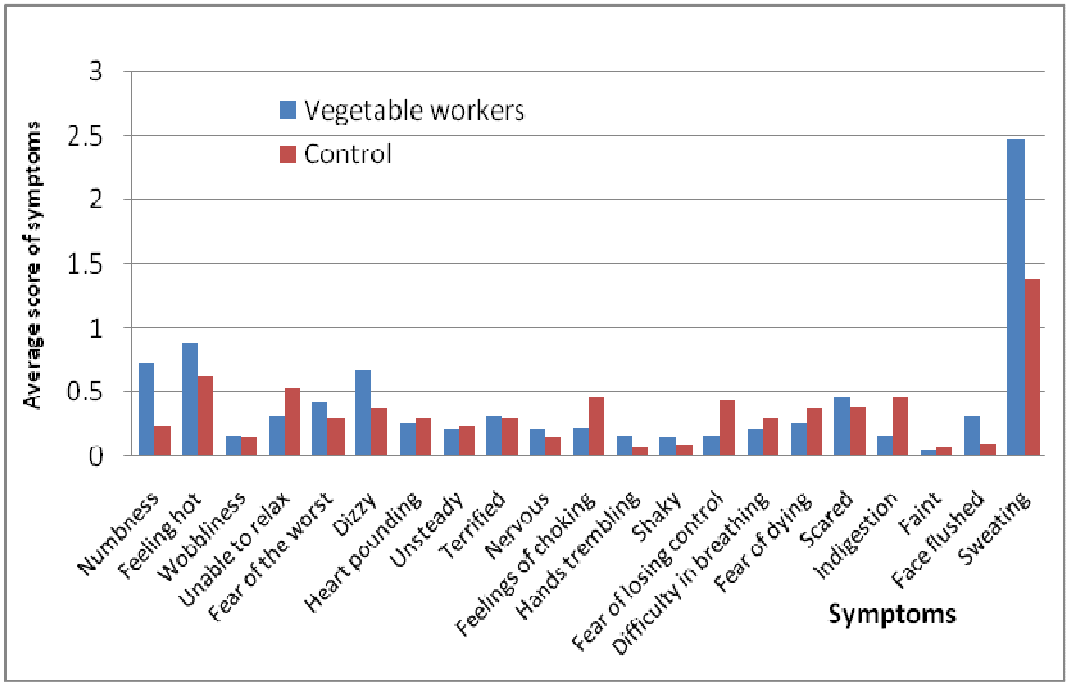

Figure 3: A comparison of frequency of anxiety symptoms experienced by farmer utilizing poultry manure in vegetable cultivation with control subjects (Paired *t* test: t = 1.019, P = 0.321)

The significantly higher frequency of symptoms of physical ill health reported by vegetable workers than control is an indication that the vegetable workers are occupational at risk to hazardous /infectious agents in poultry manure. The depression and anxiety indices of vegetable workers were similar to that of control, signifying that occupational exposure to poultry dust at the level of spreading manure on vegetable beds, has no effect on the psychological health. Zung's clinically admitted population of depressed patients had depression index of 0.74 and his control or "normal" population had an index of 0.33 (11, 12). With the depression index of 0.45,

the vegetable workers are not depressed. Also with an anxiety index value 0.14, the vegetable workers did not experience anxiety. Thu and co-workers (11) reported an index of 0.11 for both control and case study and the two groups were considered normal. Steer and co-workers (13) obtained an index score of 0.29 in a population of 250 clinically admitted patients categorized as "moderately anxious". This implies that health crises associated with the use of poultry manure in vegetable cultivation is commonly that of physical ill health.

Symptoms associated with flu in humans include fever, headache, extreme tiredness, cough, sore throat, runny / stuffy nose, muscle ache, nausea, vomiting among others (6,14). All these symptoms of physical ill-health and others reported in this study were prevalent among both vegetable workers and the control subjects, but with higher frequency of occurrence in the former. These symptoms of ill health have been found to be associated with human exposure to organic dust (4,10). There could be a misinterpretation of clinical symptoms presented by allergic/inflammatory response to dust inhalation especially among atopic individuals to be AI associated human flu and *vice versa.* Early recognition of an infection and rapid initiation of precautions are the most important strategies for controlling of infections, especially severe respiratory diseases (15). A balanced approach is for clinicians not only to look for suggestive clinical features but to routinely seek epidemiological clues suggestive of AI exposure. The key epidemiological risk factors in AI include: (a) exposure to poultry faecal material, (b) exposure to live birds, (c) exposure to sick birds and (d) faecal contaminated material (9).

Based on epidemiological risk factors, vegetable workers could be occupationally exposed to AI during spreading of dry manure on vegetable via inhalation, if manure is brought from AI infected poultry farms. Vegetable cultivated with AI contaminated poultry manure could be of public health risk especially for vegetables that are consumed raw such as those used for salads (e.g. *Lactuca sativa* – lettuce; *Brassica olracea* cabbage) and those used for sauce and medicinal purposes. (e.g. *Teliferia occidentalis, Vanonia amagdalina*). Earlier studies from the same cohort revealed that the vegetable from the farms were contaminated with such bacteria as *Escherichia coli*, *Salmonella typhimurium*, *Shigella* species, *Clostridium perfringens*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Enterococcus faecalis* (3). Vegetables could carry AI viruses if they are cultivated with AI contaminated manure.

The knowledge of bird to human transmission of AI based on epidemiological consideration of vegetable cultivation is highly important because past studies on food markets have been restricted to exposure to live birds. When vegetables are to be consumed raw, they should be washed properly with vinegar (5 % acetic acid) (3,16) or chlorinated water, as AI viruses cannot survive such media. The studied vegetable workers showed that they lacked the perception of the high occupational risk of contacting AI *via* poultry manure. Bathing with well water into which poultry manure is commonly leached by majority of these workers (83.5%), could expose them to influenza risk.

CONCLUSION

Vegetable workers need to be informed that they are occupational at risk and can as well aid the spread of AI to the human populace via contaminated vegetables. Also there is need for environmental laws in all countries, especially where bird flu is enzootic, mandating vegetable workers to use protective clothing, hand gloves, nose masks and eye goggles during application of poultry manure. In addition the vegetable workers should liaise with local veterinary officers to as certain that the poultry farms from which they are obtain their manure are free from avian influenza.

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