*Asian Journal of Medicine and Health*

*19(7): 69-77, 2021; Article no.AJMAH.70172*
*ISSN: 2456-8414*

# Risk Factors Associated with Respiratory Infections in Poultry in Peri-Urban Areas of Dakar and Thies (Senegal)

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/AJMAH/2021/v19i730345
Editor(s):
(1) Prof. Adlina Binti Suleiman, National Defence University of Malaysia, Malaysia.
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Reviewers:
(1) Archana Jain, Nanaji Deshmukh Veterinary Science University, India.
(2) Cristiane Ferreira Prazeres Marchini, Universidade de Franca, Brazil.
(3) Barde Israel Joshua, National Veterinary Research Institute, Nigeria.
Complete Peer review History: http://www.sdiarticle4.com/review-history/70172

***Original Research Article***

***Received 01 May 2021***
***Accepted 06 July 2021***
***Published 09 July 2021***

## ABSTRACT

The objective of this study is identifying the main risk factors for the emergence of respiratory diseases in poultry farms in the Senegalese region of Niayes. It took place in the period from August 2018 to February 2019 in 45 modern poultry farms in the regions of Dakar and Thiès. The analysis of the results of our study showed that the farms are very close to houses and accessible to foreign people in
44.4% and 53.1% of cases respectively. Litter was treated before use in only 24.4% of farms. Respiratory diseases are the most frequent diseases (75.6%) and are found in
80% of broiler farms. The diagnosis of respiratory diseases was made by poultry advisors (75.6%) and was based mainly on memoranda, clinical signs and autopsy. The training of poultry farmers in poultry farming ($p < 0.1$), the proximity of farms to homes ($p < 0.05$), and the accessibility of the farm to outsiders ($p < 0.01$) influence the occurrence of respiratory problems on poultry farms. Similarly, factors such as type of poultry speculation ($p < 0.01$), number of birds ($p < 0.1$), type of buildings ($p < 0.01$), bedding treatment ($p < 0.05$), and watering system ($p < 0.05$) appeared to be

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strongly related to the history of respiratory problems on poultry farms. Recommendations were made to improve environmental conditions and biosecurity measures to reduce the pressure of respiratory infections in poultry farms.

*Keywords: Respiratory diseases; poultry farming; respiratory pathogens; Dakar; Thiès.*

## 1. INTRODUCTION

In order to satisfy the demand for animal proteins of an ever-increasing population in developing countries, several African countries south of the Sahara, notably Senegal, have focused on the breeding of short-cycle species. Among the animal species that can be exploited for this type of breeding, poultry occupies an important place because its breeding requires few means compared to the breeding of other species. Poultry farming is thus a growth sector of undoubted socio-economic importance.

In Senegal, since the ban on imports of chickens and all used poultry equipment in 2005 by the State of Senegal, the modern poultry industry has experienced spectacular growth [1]. However, since 2014, this tremendous expansion of Senegalese poultry farming has been confronted with repeated health crises. The poultry industry is thus subject to numerous sanitary constraints. Indeed, the evolution of production recorded between 2014 and 2015 is below that noted between 2013 and 2014 [2]. The number of units of eggs for consumption is estimated at 571 million in 2015 after a headcount of 631 million units recorded in 2014, a decline of 13.6% [2]. This underperformance (60 million units) is mainly explained by the negative incidence of Marek's disease, which was very prevalent in poultry farms located mainly in the Niayes area. In addition, respiratory diseases have become very common in modern poultry farming in Senegal. In 2017, the emergence of low pathogenic avian influenza type H9N2 was noted in the Dakar and Thies regions [3]. These respiratory pathologies are complex and difficult to combat because of their multifactorial nature, the importance of co-infection and the many factors that promote them. Indeed, in addition to the many pathogens (viruses, bacteria and parasites) associated with these infections, some factors such as climate, hygiene, and poor husbandry conditions favor their appearance, expression and spread in modern poultry farms.

The objective of this survey is to identify the main risk factors for the emergence of respiratory diseases in poultry farms in the Senegalese region of Niayes.

## 2. METHODOLOGY

### 2.1 Location and period of study

The study took place in Senegal, more precisely in the Niayes area, which is favorable to modern poultry farming because of its moderate climate and demography. It is also the area where the majority of poultry farms with a high prevalence of respiratory diseases are located. Data collection was conducted from August 2018 to February 2019 in the regions of Dakar (departments of Pikine and Rufisque) and Thiès (departments of Thiès and Mbour).

### 2.2 Farms

The survey was carried out in 45 broilers (20 broiler farms, 15-layer farms and 10 mixed) and layer farms, most of which were selected with the help of private veterinarians on the basis of the existence of a history or recent onset of respiratory problems (Table 1).

### 2.3 Survey

A questionnaire was administered to owners, poultry farmers, and poultry advisors, in the form of a direct interview and on the basis of observations. It covered identification of the farm and its owner, farm characteristics, sanitary practices, biosecurity measures on the farm, health and medical monitoring of the farm, and pathological history. Consultation of the farmers' follow-up records provided important additional information.

### 2.4 Data Processing

A descriptive analysis was done using computer tools. Indeed, the raw data collected was entered and recorded with the software SPHINX.PLUS. V5, and then exported to Microsoft Office EXCEL 2013 spreadsheet to make the tables and graphs. Then, data processing was performed using Microsoft Office EXCEL spreadsheet and SPSS analysis software. Chi-square test was used to test the null hypothesis of no relationship between risk factors and history of respiratory pathology in farms.

**Table 1. Distribution of farms surveyed by zone**

| Regions | Departmen's | Boroughs/towns rural communities | Number of farms Respondents | Total |
|---|---|---|---|---|
| | Pikine | Keur Massar | 9 | |
| | | Thivouane Peulh | 1 | |
| | | Niakoul Rab | 5 | |
| Dakar | | Sangalkam | 9 | |
| | Rufisaue | | | |
| | | North Rufisque | 1 | 30 |
| | | diamniadio | 3 | |
| | | Wayembam | 2 | |
| | | Pout | 5 | |
| | Thies | Km50 | 6 | |
| Thies | | | | |
| | | Keur Moussa | 2 | 15 |
| | Mbour | Mbour | 2 | |
| | | Total | | 45 |

## 3. RESULTS

### 3.1 Characteristics of the Farms Surveyed

In our study, 71.1% of the farms surveyed were smaller than five hectares. 82.2% of the farms were fenced and had a poultry advisor (71.1%). Poultry advisors are 64.4% veterinary doctors. The latter usually visit the farms when they are asked to do so in case of problems (42.2%). More than half of the farms surveyed did not have a follow-up register (53.3%).

Our study looked at the three different types of livestock. Twenty broiler farms (44.4%), 15-layer farms (33.3%) and ten mixed farms (22.2%) were surveyed. Based on the number of birds, we grouped the farms into "small" (less than one hundred birds) and "medium" (more than one hundred birds): "Small size" (less than 1000 birds) (33.3%), "Medium size" (1000-5000 birds) (40%) and "Large size" (over 5000 birds) (33.3%). This categorization showed a predominance of small (40%) and medium (50%) broiler farms, but a predominance of large (44.4%) and medium (44.4%) layer farms. On the farms surveyed, the majority of poultry is raised on the ground (91.1%) (Figure 18). The majority of laying hen farms use the white Leghorn strain (82.7%). Laying hens are raised from the chick stage on 79.3% of farms. Broiler farms use the Cobb 500 strain for 93.1% of their broiler flocks, with an average of five flocks per year per building. In our study, 66.7% of the farms had California-type buildings (open, screened on both sides) and 73.3% of them were well oriented. The poultry watering system is manual and automatic in 62.2% and 37.8% of the farms respectively.

### 3.2 Sanitary Practices and Biosecurity Measures in the Farms

- **Hygiene and sanitary vacuum**

  The surroundings of the barns are dirty in 60% of the farms. All farmers claim to carry out a disinfection and a sanitary vacuum of the buildings after each batch. The products most used for cleaning and disinfection are, in order of importance: bleach (97.7%) and detergents (liquid soaps, powder, Omo) (71.1%).

- **Water for drinking sources**

  In our study, we found that water for drinking came from a borehole, from the Senegalese Water Company (SDE) or from a well on 44.4%, 31.1% and 24.4% of the farms investigated respectively. No water analysis was done and only 6.6% of the farms treated the well or borehole water before use.

- **Litter and Manure Management**

  The bedding used is varied (wood chips, rice bran or peanut shells) and is treated with a disinfectant such as potassium peroxymonosulfate, sodium dodecylbenzenesulfonate, sulfamic acid (Virkon®) or potassium sulphate and persulphate, sulfamic acid malic acid dodecyl benzenesulfonate (Virunet®) by spraying before use on only 24.4% of farms. The bedding is in poor condition (Figs. 1a and b) on 64.4% of farms and damp in places on 40% of farms. The frequency of its renewal varies according

to the species: renewed in general at the end of the flock for broiler farms (68.9%) but on the other hand in layer farms, every two months in 45% of farms, or when it is wet and in poor condition in 55% of farms.

Manure is sold mostly to farmers, but some farmers use it on the farm for agriculture without any treatment or store it not far from the buildings and farms (Figs. 2 and 3).

- **Movement management**

  53.1% of the farms surveyed are easily accessible to foreigners (visitors and buyers) without any regulation. None of the farms visited have a rotoluve at the entrance. Only one farm out of 45 has footbaths at the entrance to the farm buildings. The presence of an assigned poultry keeper per building was noted in 75.7% of the farms, but group work was often observed.

- **Management of carcasses**

  The discharge of corpses is done in the majority of farms by burial (68.9%) and in 35.6% of cases the corpses are abandoned in the open air next to the buildings.

**Fig. 1a. Poor bedding condition**

**Fig. 1b. Poor bedding condition**

**Fig. 2. Manure storage on the farm**

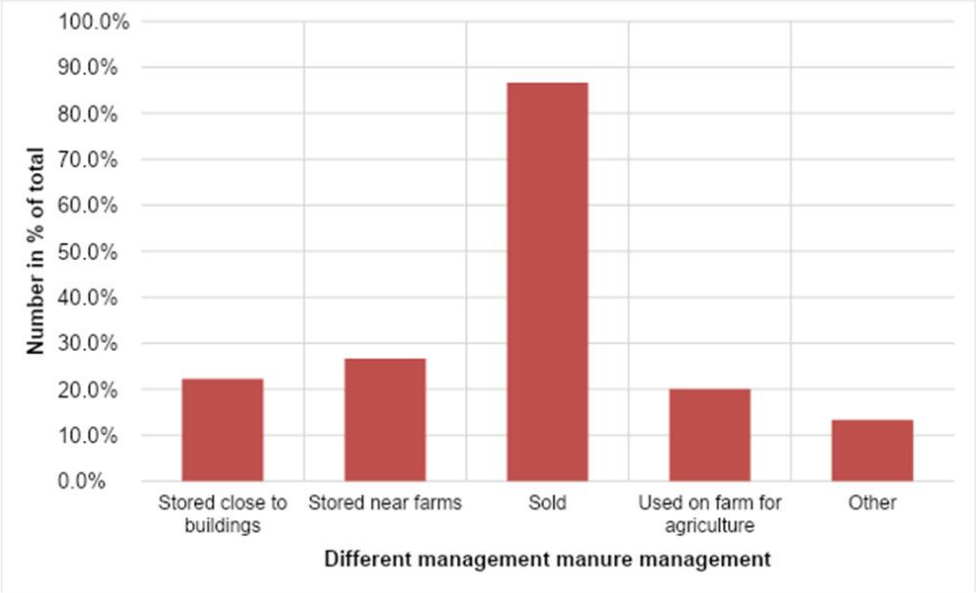


**Fig. 3. Different manure management practices on the poultry farms visited**

- **Management of environmental factors**

  Only 11.1% of farms measure temperature and humidity in the buildings during production.

## 3.3 Prophylaxis and Pathological history

### 3.3.1 Medical prophylaxis program

95.6% of farms reported having a prophylaxis program provided by the poultry advisor or chick supplier in 64.4% and 28.9% of cases, respectively, and reported vaccinating against LPAI, BI, Newcastle disease and infectious coryza in laying hens. Farmers reported implementing vaccination programs (Fig. 4), however, 24.4% of vaccine failures were noted to be related to either the vaccines used, the method of administration or immunosuppression. No serological tests were performed to monitor vaccine uptake.

### 3.3.2 Pathological history and symptomatology

80% of the respondents confirmed the high prevalence of respiratory problems in broiler farms and 82.2% of them occurred during the cold dry season (November to February). The symptoms observed during these diseases are most often: dyspnea, sneezing, anorexia, growth retardation, egg-laying losses and mortality. The lesions are sinusitis, tracheitis, and congestive pneumonia.

- **Diagnosis and treatment**

The poultry advisor and the owner made diagnosis in 75.6% and 28.1% of farms respectively. It is mainly based on the memorabilia, clinical signs, necropsy and rarely on laboratory analysis. The management of respiratory infections is mainly based on the use of antibiotics in 94.1% of farms, followed by the use of essential oils in 26.5%. Vitamins and hepato-protectors are also used. The most used antibiotic molecules are in order of importance: enrofloxacin (40%), colistin (40%), tylosin (32.5%), amoxicillin (17.5%) and trimethoprim (17.5%). These molecules are often found in synergistic association such as:

Quinocol® (Enrofloxacin and colistin), Tylodox® (Tylosin and doxycycline). The waiting period after treatment with antibiotics is only respected in 90% of the farms surveyed.

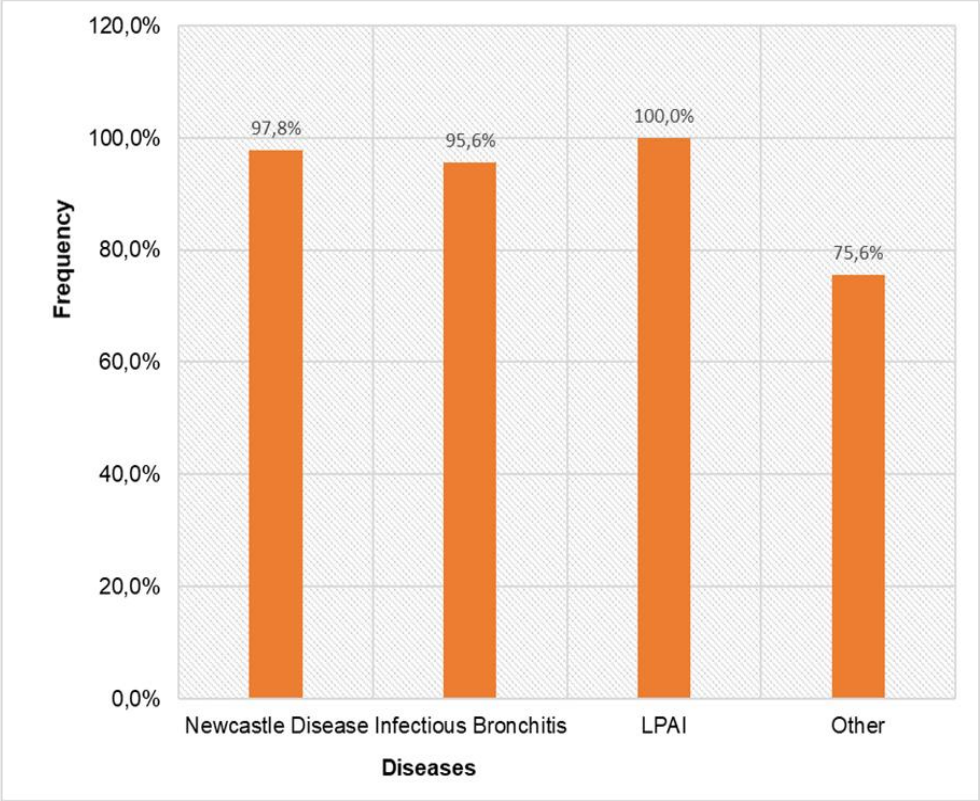


**Fig. 4. Frequency of vaccination of poultry flocks against respiratory diseases in the farms visited**

## 3.4 Risk factors for the Development of Respiratory Diseases Identified

### 3.4.1 External factors to the farm

There was a significant relationship between some factors external to the poultry farm and history of respiratory problems. Indeed, the training of poultry farmers in poultry farming ($p < 0.1$), the proximity of farms to homes ($p < 0.05$), and the accessibility of the farm to outsiders ($p < 0.01$) influence the occurrence of respiratory problems on poultry farms. In other words, there is a significant association between the occurrence of respiratory pathologies in poultry farms and the presence of unqualified poultry workers, their proximity to dwellings, and their accessibility to strangers.

### 3.4.2 Internal factors or related to the conduct of the farm

Some factors within the farm are responsible for respiratory problems: the type of speculation ($p < 0.01$), the number of birds ($p < 0.1$), the type of buildings ($p < 0.01$), the litter ($p < 0.05$) and the watering system ($p < 0.05$) appeared to be strongly related to the history of respiratory problems on poultry farms. In other words, respiratory problems were more frequent in broiler farms, those with small numbers of birds, those that did not treat litter and those that used manual watering systems.

## 4. DISCUSSION

## 4.1 Sanitary Practices and Biosecurity Measures

All farms surveyed reported disinfecting their buildings before installing new animals, and the majority (97.7%) used bleach as a disinfectant. These results are slightly higher than those (82.2%) already obtained in Senegal by Oulon [4]. Hence the importance of disinfection in the reduction of germs in the barn [5] to limit transmission to subsequent flocks [6]. However, the quality of disinfection will depend on

compliance with standards and conditions of use of disinfectants. Bleach is widely used because of its bactericidal, virucidal and fungicidal properties, its availability on the market in Senegal and its relatively low cost.

The vast majority of farmers do not treat the litter before use, which corroborates the work of Soro [7] in poultry farms in Senegal. They ignore the importance of a quality litter in the comfort and welfare of the animals and the role of its treatment in the reduction of the microbism of the farm. Indeed, litter can serve as a reservoir and vector for a large number of pathogens such as: Herpesvirus, Birnavirus, *E. coli, Aspergillus fumigatus* [8,9,10,11,12], which can originate from the soil, the litter itself, germs carried by chicks, drinking water, the building, feed, humans, insects, rodents, ...

Poor manure and carcass management was noted in 49.2% and 35.6% of poultry farms respectively. These results are similar to those obtained by N'guessan [13] in Côte d'Ivoire where manure and carcasses are stored near buildings in 34.5% and 43.5% of cases respectively. These practices are contrary to good husbandry practices cited by FAO [14], and constitute potential risks of contamination of poultry [15] by wind and inanimate vectors.

The majority of poultry farms (53.1%) are accessible to foreigners without any regulation. The same observation (46%) was made by Oulon [4]. These farmers are unaware of the role of pathogen vectors that visitors and buyers ("Banabanas" who pass from farm to farm) can play in the transmission of infections. Indeed, humans have been considered a potential source of transmission of pathogens such as *E. coli,* mycoplasma and salmonella [16,17].

## 4.2 Prophylaxis and History of Respiratory Diseases

95.6% of the poultry farms surveyed claimed to have a prophylaxis program to control diseases. However, no evidence of the existence of this program was given (similar finding 97% [18]. The need for rigorous application of sanitary and medical prophylaxis measures is necessary, given the intensification of production, which increases the risks of transmission of contagious diseases [19].

The frequency of respiratory diseases is high in the dry season, as noted by Kouma in Côte d'Ivoire [20]. Similarly, Khalen Wouembe [21] noted the recurrence of respiratory diseases such as infectious bronchitis, mycoplasmosis, infectious coryza and Newcastle disease in modern poultry farms of laying hens in the western region of Cameroon. This high frequency could be due to vaccine failures, poor sanitary management of poultry farms and poor biosecurity practices.

The treatment of respiratory infections in the poultry farms surveyed relies mostly on the use of antibiotics without respecting the withdrawal period. These same findings were already made by Pare [18]. The lack of respect of the withdrawal period constitutes a danger for the health of the consumer [22]. This could be related to the lack of information, training and awareness on the risks related to the presence of antibiotic residues in poultry products (broiler meat and table eggs). One of the reasons could also be the marketing system based on the "Bana-banas" intermediaries who go around the farms and buy progressively.

## 4.3 Factors Influencing the Occurrence of Respiratory Pathologies

### 4.3.1 External factors

There is a causal relationship between the training of poultry farmers, the proximity of farms to homes, the accessibility to strangers, and the history of respiratory disease on the poultry farms investigated. Indeed, some researchers have shown a link between the requirement for visitors to wear coveralls and boots and the incidence of avian mycoplasmosis in North Carolina, USA [19]. Humans (visitors, buyers, neighbors, technicians, veterinarians) can be a source of pathogens [16,17], for poultry. Similarly, training of poultry farmers is important for better application of hygiene and biosecurity rules [23]. Farms close to homes are more prone to infection because they are more exposed to household waste, household pests, and crowding.

### 4.3.2 Internal or farm management factors

There is an interrelationship between some variables such as type of speculation, small stocking, type of building, watering system, litter treatment and history of respiratory diseases in modern poultry farms. The relationship between small-scale farms, meat speculation and the occurrence of respiratory diseases is thought to be due to their low level of biosecurity [24]. Indeed, BROU et al., [25] had

shown that the main causes of the occurrence of chronic respiratory diseases in broiler farms were related to poor and mediocre sanitary prophylaxis conditions as the holiday season approaches (a period of high demand for chickens), broiler farmers rush to start up the birds without respecting biosecurity standards, thus increasing the risk of respiratory disease.

Dynamic closed houses were significantly less affected by the occurrence of respiratory diseases. This could be explained by the high level of biosecurity in these farms [24]. Litter treatment in poultry farms significantly influenced the occurrence of respiratory diseases, as litter is a potential source of germs [9,10,12].

## 5. CONCLUSION

This study identified and demonstrated the important role of risk factors in the occurrence of respiratory infections in farms with a history or recent onset of respiratory problems. In view of the results obtained, it is strongly recommended to train poultry farmers and especially poultry managers in good hygiene and biosecurity practices in order to limit the pressure of infection and reduce respiratory infections in modern farms. It is therefore important to regulate the access of foreigners to the farms, to treat the litter before its use in the farms, to know and make good use of disinfectants, to promote the automatic watering system in modern poultry farms and to train the different poultry actors in good hygiene practices in order to avoid the anarchic use of antibiotics. The reinforcement of sanitary prophylaxis measures is necessary in the meat industry and especially in small-scale poultry farms, which constitute a significant risk of contamination for large-scale farms.

## CONSENT

It is no applicable.

## ETHICAL APPROAL

It is no applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*http://www.sdiarticle4.com/review-history/70172*