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Risk factors for Newcastle disease in broiler farms in Israel

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A R T I C L E I N F O

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A B S T R A C T

Following a large outbreak of Newcastle disease (ND) in Israel, a cross-sectional study was conducted in the broilers sector. The aim of the study was to find geographical and farm related risk factors for ND. Information was available on 96% of the broiler farms in Israel. Of these, farms diagnosed with ND in the years 2010–2012 were compared with the other farms. Risk factors for ND were analyzed, using Generalized Estimating Equation models. Six variables were found to be associated with the risk for ND outbreak: a distance of less than 300 m from another farm (OR = 1.77, 95% CI 1.07–2.93), a distance of less than 6000 m from a national border (OR = 2.00, 95% CI 1.22–3.30), farm location in the Ha'amakim district (OR = 2.46, 95% CI 1.32–4.61), village type: a Moshav (village) vs. Kibbutz (Cooperative village) (OR = 1.96, 95% CI 1.04–3.70), and carcass disposal in an uncovered bin (OR = 1.96, 95% CI 1.18–3.26). A distance of less than 800 m from an inter-city road was found to be a protective factor (OR = 0.60, 95% CI 0.37–0.98). The results of this study provide information that may be used to improve surveillance and control of ND.

1. Introduction

Newcastle Disease (ND) is an important viral disease of domestic poultry and wild birds, characterized by gastrointestinal, respiratory and neurological signs. ND affects poultry worldwide. The disease causes economic losses due to mortality, morbidity, growth retardation and drop in egg production, as well as performance losses associated with post-vaccination reactions. Significant losses are caused by international trade restrictions on poultry products applied to countries which are infected by ND (Cornax et al., 2012). Due to its significance many efforts and resources are invested in prevention and control of ND (Miller et al., 2015).

The cause of ND is the Newcastle disease virus (NDV), an RNA virus from the family Paramyxoviridae. Clinical signs caused by NDV infections of poultry range from in-apparent to rapidly fatal disease, depending upon the pathotype of the virus involved and the host condition and its immune status. NDV strains are classified into highly virulent (velogenic), intermediate (mesogenic) or low virulent (lentogenic) based on pathogenicity tests or the amino acid composition in the cleavage site of the viral fusion protein. Lentogenic strains are widely used as live vaccines. Hence the OIE definition of ND outbreak is infection of birds with mesogenic or velogenic strains of NDV (OIE, 2012).

The first outbreak of Newcastle in Israel was recorded in 1937 (before the State of Israel was established) and since then Israel has been intermittently infected by the virus (Neriah, 2001). Constant improvement in breeding methods and biosecurity, as well as implementation of control measures such as mandatory vaccination, declaration of infected areas, and culling of infected flocks, failed to prevent the occurrence of outbreaks of the disease, which still causes significant economic losses in Israel.

During the last three decades, five epidemics of ND occurred in Israel. These epidemics were usually characterized by a sharp accumulation of outbreaks, occurring in many farms, followed by a gradual decrease in the number of outbreaks during the following years (Fig. 1). Similar to other areas of the world, the epidemics are usually seasonal (Antipas et al., 2012; Awan et al., 1994), and in Israel occur mostly during the winter months. In this study we analyzed a major epidemic which peaked in 2011–2012. During the years 2010–2012, ND was diagnosed in Israel in 393 flocks. Of these, 53% were diagnosed in broiler flocks, 26% in commercial table egg layer flocks and the remaining in turkey flocks (6%), breeding flocks (4%) and backyard flocks and wild birds (11%). During the study period (2010–2012), the monthly flock incidence in the broiler sector ranged from 0 to 12.2% and the cumulative yearly flock incidence was 0.28%, 5.92% and 2.48% in 2010, 2011 and 2012 respectively. The average age at diagnosis was 32 days (Wiseman, 2015).

All commercial poultry flocks in Israel are vaccinated against NDV according to a defined program using a combination of live and inactivated vaccines. The vaccination protocol for broilers during the

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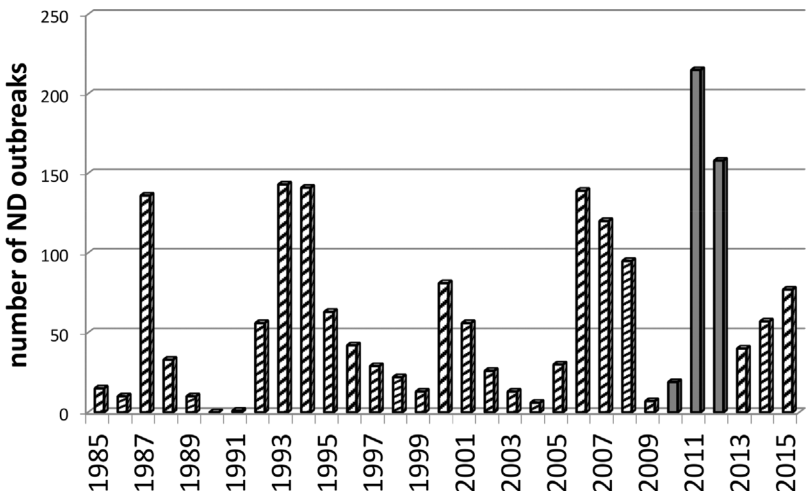

Fig. 1. Number of reported flocks diagnosed with ND in Israel by year 1985–2015. Columns with solid fill represent the study period 2010–2012.

years of the study included a live vaccine by spray on the day of hatch, inactivated vaccine by subcutaneous injection at 10–12 days of age, and another live vaccine by aerosol at 17–21 days of age (Gallili and Ben-Nathan, 1998; Israel Veterinary Services and Animal Health, 2014). An additional live vaccine was administered at the age of 10–12 days in several farms. In Israel, even though it is mandatory to vaccinate backyard and petting zoo poultry against NDV, vaccine coverage in this sector is low.

The surveillance measures for ND in Israel includes active and passive surveillance. All movement of poultry between farms is conditional on a flock's minimal anti-NDV antibody titer (tested by HI-hemagglutination inhibition). Breeding flocks are routinely tested by HI-NDV every two months. Broiler farms are tested by HI-NDV once a year in order to monitor the implementation and the performance quality of the vaccinations program against ND. The passive surveillance includes reports from producer and field veterinarians when ND is suspected, and reports from the poultry health laboratories on positive tests (mainly real time reverse transcriptase PCR and virology).

There are only a few studies aimed at assessing risk factors for ND in developed countries. A survey that was conducted in Australia following several ND outbreaks (East et al., 2006), found geographic location and a distance of less than 0.5 km to the nearest-neighbor poultry farm, as statistically significant risk factors for positive serology to NDV. In other production sectors (layers and breeders) increased risk was associated with location, ownership, distance to the nearest-neighbor poultry farm, increasing age, and the presence of wild birds on the farm. A far greater number of studies were performed in developing countries where poultry production is based on small backyard flocks. Some of the risk factors are different in developing countries and developed countries and some are common. The following risk factors were found in Ethiopia: reduced frequency of removing poultry litter, receiving or buying replacement birds as opposed to hatching at the farm itself, flock size, and using an open water source for the poultry drinking water. The use of a grain supplement was found as a protective factor (Chaka et al., 2013). Additional risk factors were found in rural African poultry production systems and included seasonality, poor physical condition of the birds, concurrent disease, breed (local breeds are more resistant), high percentage of young birds in a flock, poultry sheltering, environmental pollution, poultry transport and commerce and the use of poultry litter for field fertilization. Poultry vaccination was found as a protective factor (Antipas et al., 2012; Miguel et al., 2013).

This is the first study aiming to identify and analyze risk factors for ND in broiler flocks in Israel. This study focused on geographical and farm variables. Recently, we showed that herd immunity is a significant protective factor for the risk of ND outbreak (Wiseman and Berman, 2017). We chose to conduct the study on the broiler sector because half of the ND cases during the years 2010–2012 were diagnosed in this sector and because of the higher reliability of data generated from this poultry sector. The Israeli broiler sector is advanced, introducing modern husbandry practices as they become available. In 2013, 43% of the farms were part of integrated operations. 45% of houses were tunnel ventilated. All farms were all-in-all out with an average of 3.0 houses per farm. The average farm housed 65,000 chicks per flock (Wiseman, 2015).

2. Materials and methods

2.1. Study design

A cross-sectional study was designed to compare all the broiler farms diagnosed with ND during 2010–2012 with all the remaining broiler farms.

2.2. Sources of information

In order to avoid information and memory biases, we analyzed only variables for which data existed in available databases. Four sources of information were used in this study.

1 Data on in-farm variables were collected from the results of a broiler farms survey of the Israel Veterinary Services and Animal Health. In 2012, the veterinary services conducted a survey in all broiler farms prior to the implementation of poultry farms and houses business licensing regulations on August 2013 (Israel Ministry of Agriculture and Rural Development, 1981). In the survey, inspectors visited the broiler farms and filled out a questionnaire according to the business licensing regulations demands. This study used only the questionnaires filled out in the first visit to a farm as part of the survey during 2012.
2 Data on diagnosed ND cases were collected from the database of the Poultry Health Laboratories of Israel Egg and Poultry Board (Berman and Samberg, 1991). This database records veterinary data on all commercial flocks.
3 Geographical data were collected from the Israel Ministry of Agriculture GIS database. This database includes geographical data (longitude and latitude) of each farm, district maps, village type and location of the farm relative to the village.
4 GIS layers of roads and borders in Israel available in the Hebrew University GIS unit were used to assign distance of each poultry farm from main roads and borders.