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ORIGINAL ARTICLE

Comparing Seasonal Pattern of Laboratory Confirmed Cases of Pertussis with Clinically Suspected Cases

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Abstract
Objectives: During recent decades, there has been limited attention on the seasonal pattern of pertussis within a high vaccine coverage population. This study aimed to compare the seasonal patterns of clinical suspected pertussis cases with those of laboratory confirmed cases in Iran.
Methods: The current study was conducted using time series methods. Time variables included months and seasons during 2011—2013. The effects of seasons and months on the incidence of pertussis were estimated using analysis of variance or Kruskal—Wallis.
Results: The maximum average incidence of clinically confirmed pertussis was 23.3 in July ($p = 0.04$), but the maximum incidence of clinical suspected pertussis was 115.7 in May ($p = 0.6$). The maximum seasonal incidences of confirmed and clinical pertussis cases were reported in summer (average: 12, $p = 0.004$), and winter (average: 108.1; $p = 0.4$), respectively.
Conclusion: The present study showed that the seasonal pattern of laboratory confirmed pertussis cases is highly definite and different from the pattern of clinical suspected cases.

1. Introduction

Pertussis is an acute communicable respiratory infection and a vaccine preventable disease which is one of the main public health concerns. This infection is caused by *Bordetella pertussis* and causes chronic cough in children, adults, and older people [1—3]. Pertussis is a common infection in both children and adults, and is transmitted through respiratory droplets [2]. Parents and other family members are the main sources of infection for neonates. Newborns may also be accidentally infected by asymptomatic adults [4].

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Pertussis is a mild to moderate disease among teenagers and adolescents, with rare serious complications, although, these age groups are considered as the main reservoirs within the community and the major factor of transmission particularly to the infants [5]. By contrast, the degree of severity, rate of hospitalization, pneumonia, apnea, epilepsy, encephalopathy, and death are more common among neonates in comparison with the other age groups. This infection is diagnosed by microbial culture or polymerase chain reaction (PCR) of nasopharyngeal swab samples, as well as serum anti-Bordetella antibody titration. Early detection and treatment during primary stages can shorten the clinical and transmission phase of the disease [6].

At the beginning of the 20^{th} century and before the widespread implementation of vaccination programs, pertussis epidemics occurred every 2–3 years [7]. After introducing vaccines in 1950, remarkable reductions were observed in the incidence of the disease. In countries with high vaccination coverage, an outbreak of pertussis has occurred every 3–4 years [8]. Iran is a country with high vaccine coverage. The pertussis vaccination during the last decades has been increased so that the coverage for 1991, 1992, and 2010 was reported as of 87%, 95%, and 99%, respectively [6].

Seasonality is a general phenomenon among infectious diseases, but its mechanism has not been completely detected [9]. The main focuses in the seasonal pattern of respiratory pathogens are survival of the pathogen outside the host, host behavior, and its degree of immunization [10].

Many studies investigating the seasonal patterns of infectious diseases have reported that the incidences of most respiratory infections are changing seasonally. As a matter of fact, season may play a critical role in the mechanism of transmission and survival of the infectious agent by providing an optimal environment and host [11–13]. The seasonal pattern of pertussis has been reported in a study by Greeff et al [7] during a low vaccine coverage period of time. The maximum incidence of pertussis was observed in the USA in August [11]. That was the case for all age groups except for people aged 13–18 in August in the Netherlands [7].

Understanding the seasonal pattern of pertussis can help us to predict future health problems, plan effective public health programs, determine goals and strategies, and finally, use the available resources more effectively [12]. In addition, seasonality signals the time of disease rising, and thus leads to an appropriate decision being made for the future [14,15].

The above mentioned facts indicate that only limited investigations have been performed about the seasonal pattern of pertussis within a high vaccine coverage population, while study of the seasonal pattern of pertussis can reveal important modes of disease transmission and introduce a viewpoint for potential effects of vaccination strategies in the future. According to the role of the detection of seasonality in the awareness of the dynamics of infectious diseases, and particularly promotion in the management of a pertussis surveillance system, this study aims to compare the seasonal patterns of the laboratory confirmed and clinical suspected cases of pertussis in Iran.

2. Materials and methods

In this longitudinal time series approached study, we used pertussis surveillance system data provided from the Iranian Center for Diseases Control. Based on ethical considerations, names of all cases were deleted from the dataset. These data included all notified pertussis cases, laboratory confirmed cases, and clinically diagnosed cases. Nasopharyngeal swabs were taken from all notified pertussis cases and transferred to the national reference laboratory (Pasteur Institute) during 72 hours using the Bordetella-specific (Bordet-Gengou) transport environment to be confirmed by laboratory-based diagnostic methods. Isolation of samples was done using the gold standard method of microbial culture or PCR. Each patient with related clinical signs [a cough illness of $\geq$2 weeks duration and one of the following classical symptoms: (1) paroxysmal coughing; (2) inspiratory whooping; or (3) posttussive vomiting] and symptoms without laboratory confirmation was considered as a clinical suspected case [2,16]. A confirmed case was introduced as each clinical case whose diagnosis been laboratory confirmed [2].

This study was conducted from 2011 to 2013 including 36 monthly time points. A time variable was defined as each of the months and seasons of 2011–2013. To measure the cumulative occurrence of monthly cases, daily incident cases in each month were summed. Moreover, seasonal patterns of the total notified cases, confirmed cases, and clinical cases of different months were compared according to different age groups (<2 months, 2–11 months, 1–5 years, 6–10 years, >10 years). Seasons were defined as spring (April–June), summer (July–September), autumn (October–December), and winter (January–March).

We received all required data from the Iranian Ministry of Health and Medical Education within Excel spreadsheets and transferred them into SPSS 20 (SPSS Inc., Chicago IL) software after refining. The effects of season and month on the occurrence of notified, confirmed, and clinical cases were estimated using analysis of variance (when normality assumption was met) or Kruskal–Wallis (when normality assumption did not meet) tests. When these tests were statistically significant, LSD *post hoc* test was used to compare the results between different subgroups. A p value <0.05 was considered statistically significant.