Original Article

Epidemic characteristics, high-risk cities and space-time clusters of human brucellosis in Jiangsu Province of China, 2006–2016—human brucellosis in Jiangsu Province of China

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Background: Brucellosis, which is a zoonosis, is able to gravely infringe public health. This research work aims at presetting the epidemic of human brucellosis in Jiangsu from the year of 2006 to the year 2016, in addition to providing the proof of avoiding from brucellosis in endemic regions.

Methods: A total of 410 diagnosed scenarios of human brucellosis patients were chosen on the bases of the data gathered by Chinese National Notifiable Infectious Disease Reporting System between the year of 2006 and the year of 2016 in Jiangsu province. The use of geographic information system was made for the identification of cities at elevated threat of the ailment. Space-Time Scan Statistic was put to application for detecting the space-time clusters of human brucellosis.

Results: The reported occurrence rate exhibited a dramatic rise from 0.067/1,000,000 in the year 2006 to 1.793/1,000,000 in the year 2016, showing an average annual rise of 15.7%. Moreover, 4.88% cases were diagnosed in 2016, exhibiting a sharp rise in the quantity of cases this year. The percentage of the impacted urban areas rose from 0.08% in the year 2006 to 100% in the year 2016. Cities prone to high risk dissipated from the north and the south, followed by to the centre of Jiangsu Province that appeared to be appropriate for livestock cultivation. As revealed by concentration distribution frameworks, seasonality of human brucellosis, having elevated occurrence in late spring, the entire summer as well as a seasonal apex in April to June. In the latest 11 years, aggravation has been encountered in Jiangsu province's human brucellosis epidemic, together with elevated-risk regions having concentrations in northern Jiangsu regions. Space-time clusters were existent, in addition to some constantly situated ultimately.

Conclusions: A significant increase in epidemic of human brucellosis among the elevated risk groups of Jiangsu province was observed from 2006 to 2016, whereby mounted deterrence together with control steps is an emergency requirement.

Keywords: Human brucellosis; epidemiology; Jiangsu province

Introduction

Brucellosis, a zoonosis resulted by Brucella species, is capable of graveling harming human health (1-3). The ailment exerts impact on the people of all age groups as well as both genders (4). The key means of infectivity are the polluted tiny ruminants and cattle (5). For the majority of the brucellosis cases, the responsibility lies with the people that get engaged in breeding, grazing, and slaughtering of the animals, whereby pathogenic infectivity takes place through direct or indirect interaction with the contaminated livestock or their products (6). The key signs of the patients that were characterized by Brucella, counted ton feebleness, lassitude, fever, as well as disability. Owing to the fact that the duration the illness can encompass from numbers of years to several, it can been regarded as a crucial public health risk to the population, leading more above 500,000 fresh cases every year (7). In the majority of developed nations, effective control on brucellosis had been exercised or even eradicated. Nevertheless, human brucellosis has emerged as an endemic transmittable illness in the developing nations (8-10).

Past research works have revealed that human brucellosis had been existent until the mid-1980s in China, with a following steady downfall subsequent to that era (11). Nonetheless, the illness reappeared substantially and exhibited fast progression subsequent to 1990s in this country, particularly at the start of the 21st century (12). Earlier, the human Brucellosis infection has been related to the animal surroundings, profession, host concentration, socioeconomic level, travel and immigration (13-17). China possesses a huge array of ecological, environmental and economic sites across the country. Provided the warning boosts in the human cases, it appears to be quintessential to comprehend what is likely to be underlying the appearance. Additionally, owing to the fact that human brucellosis possesses a robust work-association, people involved in agricultural cultivation or breeding, grazing, slaughtering, processing as well as sales of livestock are considered to be highly prone groups regarding human brucellosis inspection (1,6,12).

In this research work, we brought forth the occurrence rate among these high risk groups, together with showing the human brucellosis epidemic Jiangsu province from the year 2006 to the year 2016. That is why, the observation have critical importance to the avoidance as well as controlling of human brucellosis in endemic regions.

Methods

Data collection and management

All of the data associated with human brucellosis was derived from the Chinese National Notifiable Infectious Disease Reporting Information System (NIDRIS). In addition, the basic population data stemmed from the Bureau of Statistics. The research involved questionnaire survey, in addition to serological testing. Every scholar of the survey took part in a professional training course prior to the research.
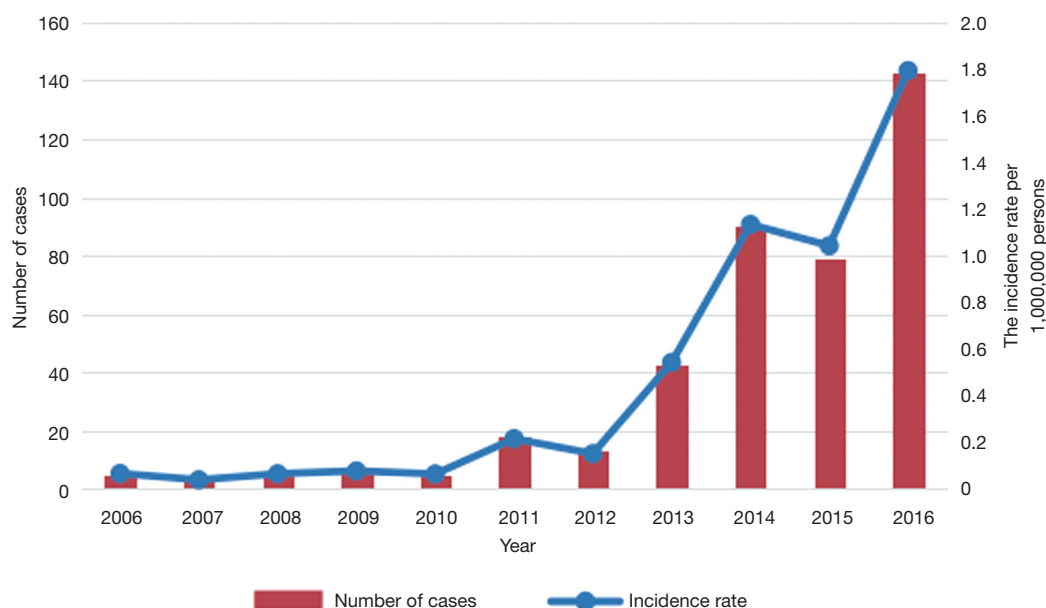
Serological testing

Collection of 5 ML of venous blood was made in respect of each participant. Centrifugation of the venous blood was performed for a period of 5 min at the rate of 3,000 rounds per min, followed by keeping the disintegrated serum frozen in the cool boxes, which was moved to the domestic Disease Control and Prevention Centre (CDC) in respect of serological testing. Subsequently, the blood specimen tests were conducted using serum agglutination test (SAT). Antibody Titers ≥1:100++ were given positive consideration. Every serological testing in CDCs was subjected to stern quality control of formerly trained qualified supervisors. In addition, the reagents utilized for testing purposes were delivered by Chinese Centre for Disease Control and Prevention (CCDC).

Diagnostic of brucellosis

Diagnosis of new brucellosis cases was performed in accordance with the "2007 Diagnostic Criteria of Brucellosis (WS268-2007)" of Chinese Ministry of Health whereby every fresh case in this research work was verified for not possessing past history of Brucellosis. The inclusion criteria for the cases are as follows:

(I)   Made a contact with Brucella formerly or residing endemic regions;
(II)   Prevalence of medical sings, for instance high fever, myalgia, and arthralgia of the large joints;
(III) Positive serological testing result. Serological testings count on the standard plate agglutination test (PAT) and/or rose Bengal plate test (RBPT) and/or SAT, or bacterial isolation. We made use of SAT, in this research work, for serological testing.

Figure 1 Annual reported cases and CUI of human brucellosis in Jiangsu Province, 2006–2016. CUI, cumulative incidence.

Data analysis

Analyses of the data were carried out using IBM SPSS software, Version 19.0 (IBM Corp, Armonk, NY, USA), whereas plotting of the spatial distribution maps was conducted with the use of ArcGIS Release 10.2 (Esri, Redlands, CA, USA). Applications of the methodologies on spatial thematic mapping, spatial autocorrelation analysis, spatial clustering analysis, and temporal clustering analysis were made for describing the temporal as well as spatial allocation on human brucellosis cases.

Results

Temporal trend and seasonality

The lowest measured cumulative incidence (CUI) of human brucellosis in Jiangsu Province from the year 2006 to the year 2016 amounted to be 0.04/1,000,000 in the year 2007 having 3 cases of the illness. Other than a little downfall in the quantity of the cases and CUI in the year 2015, Jiangsu's epidemic tendency of human brucellosis has exhibited a sharp rise from the year 2006 to the year 2016, showing an average per annum rise in CUI of 15%. In the year 2016, the occurrence rate of human brucellosis all across the province made it to 1.793/1,000,000 with 143 reported cases, which was the topmost record all through 2006–2016 in Jiangsu (*Figure 1*). There has been observed a seasonality
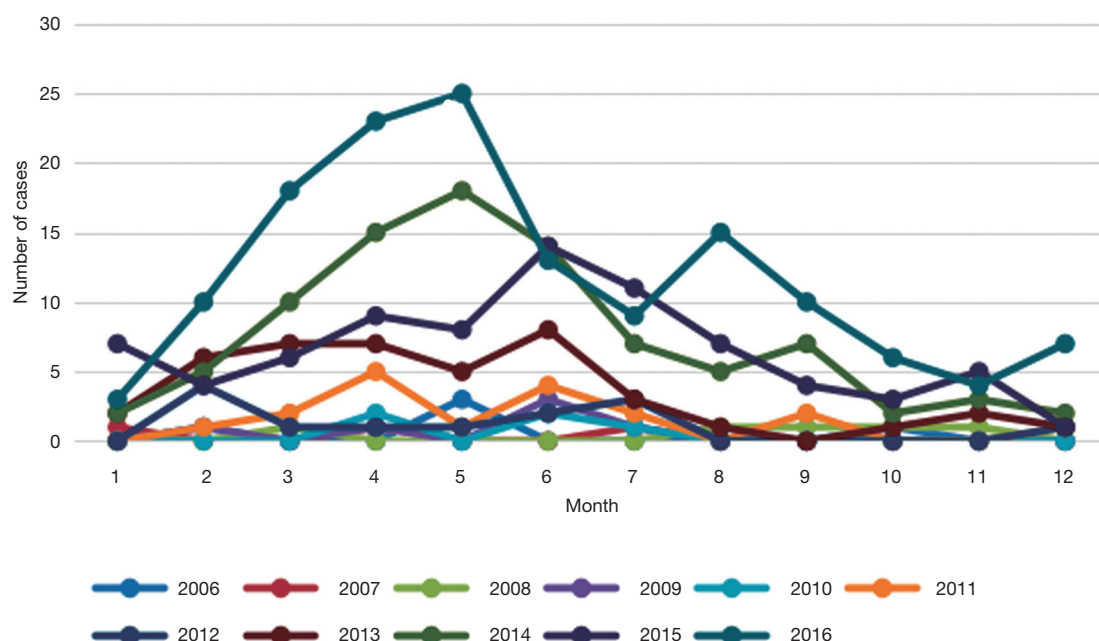
of human brucellosis in Jiangsu Province, showing elevated occurrence in the late spring, the entire summer season as well as a seasonal top in April to June (*Figure 2*). In accordance with the concentration distribution formula, M =0.370804058.
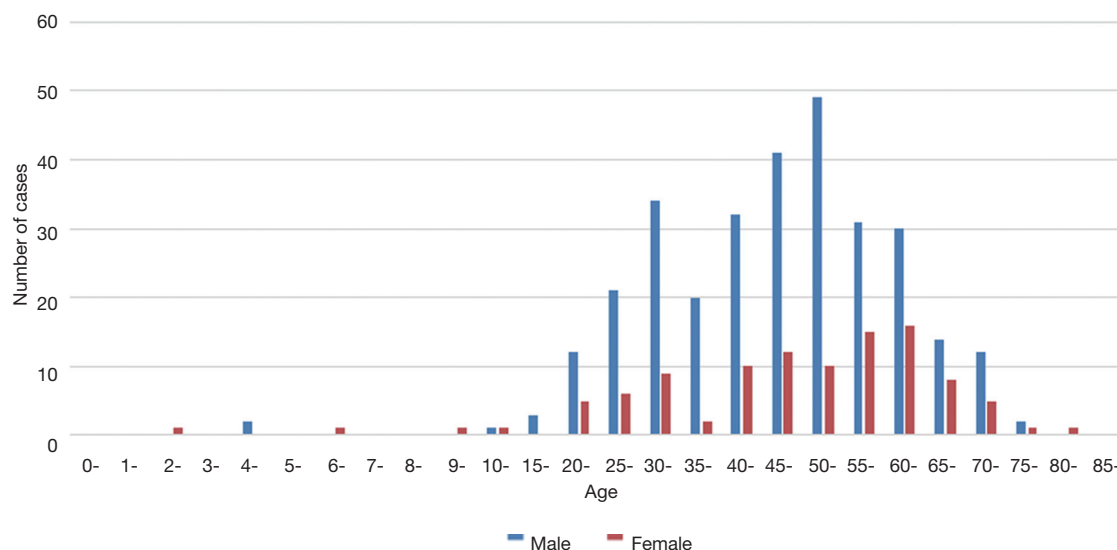
Socio-demographic characteristics

All through the research duration, the median age series of all of the human brucellosis patients in Jiangsu Province amounted to be 45–49. Despite the fact that all of the population, irrespective of age, is evenly vulnerable to the illness, yet most of the patients were in the age range between 25 and 64 years, having a percentage of as much as 82.4%. Children (≤14 year-old) percentage was 1.7% of cases whereas the elderly (≥65 year-old) had 10.5 percentage. The number of male (n=306) patients was extensively higher as compared with female counterpart (n=104) in Jiangsu Province, suggesting a gender ratio of 2.9:1 (*Figure 3*).

Geographic distribution

The cities of Xuzhou (having 190 cases) as well as Lianyungang (having 62 cases) possessed the most collected cases out of all of the 13 cities all through the duration, which account for 61.5% of the aggregate cases [410] prevailing in the province. These two regions are situated

Figure 2 Monthly reported cases of human brucellosis in Jiangsu Province, 2006–2016.
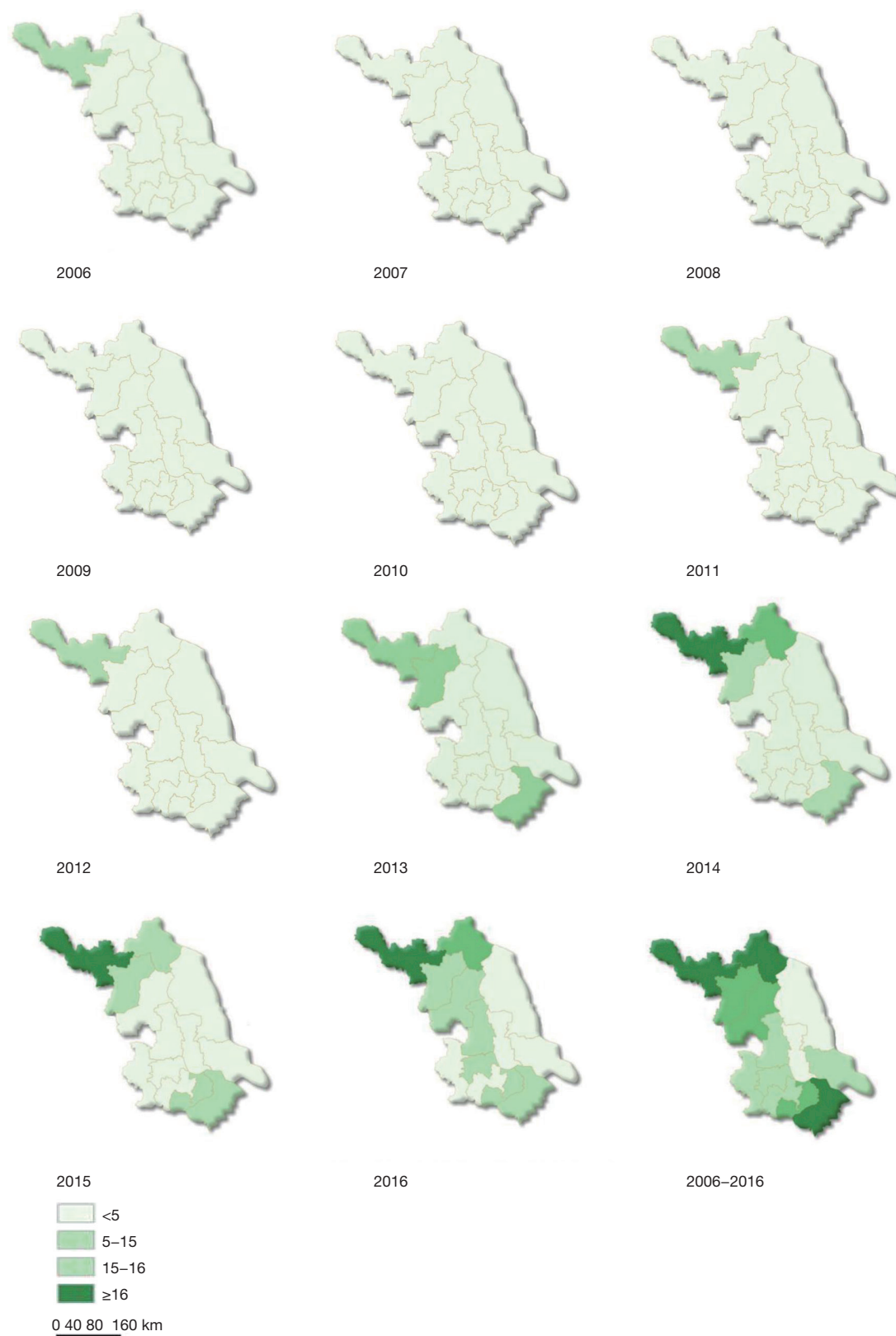

Figure 3 Human brucellosis incidence over gender and age group in mainland China.

in the north Jiangsu, having boundary with the Shandong province, suggesting higher number of brucellosis cases. Reports of human brucellosis cases were received among 1 out of 13 cities in Jiangsu Province in the year 2006. In addition, in all of 13 counties, the same was observed in the y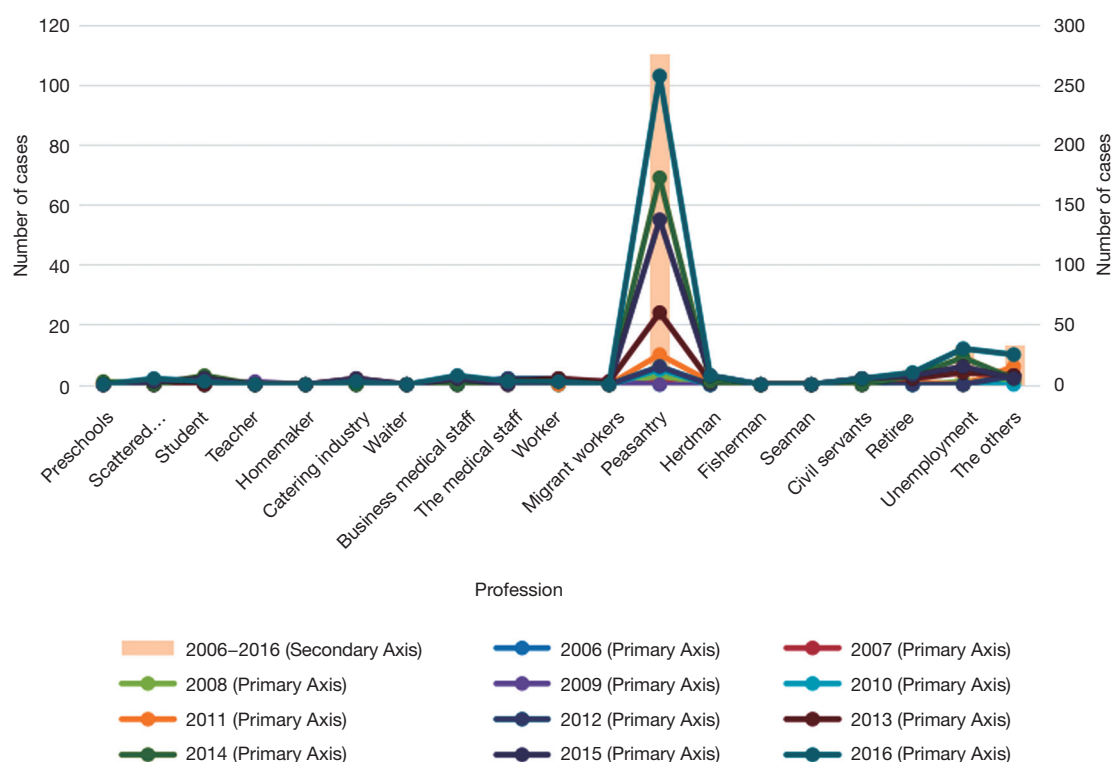ear 2016. Cities with elevated risk extend from the north and south thereafter to the centre of Jiangsu Province that was appropriate in respect of livestock cultivation (*Figure 4*).

Occupational distribution

The occupational distribution of brucellosis cases the

Figure 4 Brucellosis cases distribution of human brucellosis in Jiangsu Province, based on city polygons (2006–2016).

Figure 5 Distribution map of proportion of human cases over occupation (2006–2016).

occupational distribution was primarily peasants, showing 276 cases, which accounted for 67.32% of the aggregate number of cases. On the second place are the jobless as well as retired people that account for 8.29% and 7.80%, correspondingly. Both students and children, collectively accounted for 2.43% (*Figure 5*).

Discussion

Human brucellosis is termed as an ailment having an extensive array of medical signs, suggesting numbers of diagnostic hardships owing to the fact that its symptoms share similarities with those of various other illnesses (4). The significance of this ailment is not constrained to physical intricacies. Moreover, it is termed as being among the most considerable challenges for economic development in numerous, that have economic development and employment both still dependent on the livestock and the agriculture (18). The illness is considered to be a key public health concern globally, in addition to being among the most socioeconomic issues in several developing countries, in particular, in the Mediterranean basin, north and east

Africa, the Middle East, the Arabian Peninsula, the Indian subcontinent as well as areas of South America and central Asia (2,8-10,19,20).

In this research work, extraction of NIDRIS data was made for describing the epidemic attributes of human brucellosis in Jiangsu Province. Right from the start of the 21st century, human brucellosis has been recurring in China whereby the number of human brucellosis cases made it to a historically top position in the ear 2009 (2). On the bases of the findings of this research work, the epidemic of human brucellosis in Jiangsu Province has been experiencing the rising trend from the year 2006 to the year 2016, suggesting a quickly rising occurrence as well as infected prefectures. This tendency shows consistency with the profile of the entire nation (2,21,22), for instance the Shanxi (11) as well as Shandong Province (23).This tendency is likely to be ascribed to the rapid growth of husbandry recently, in particular, goat and sheep breeding in the countryside China (24,25). Above 90% of human brucellosis cases in the country receive infection from the contact with the sick sheep and goats (26,27). Unluckily, they barely put on personal safeguarding tolls, for instance gloves, aprons, or

masks (28). These kind of breeding approaches together with behaviour customs have easy positions to give rise to exposure and infectivity on having direct interaction with the contaminated livestock.

The epidemic season in Jiangsu Province encompasses late spring and the summer season, which is in line with that of the reset of the country (11,23,27). This duration has consistency with the lambing season that is likely to result into more numbers of opportunities of getting exposed to Brucella. Kicking off the campaigns to make the public aware prior to the start of epidemic period is likely to have great impact for the prevention of the risk group from the infectivity, in addition to prompting them for seeking in-time cure on getting infection. Majority of the brucellosis patients involves adolescent and middle-aged men that act as the major revenue producers in the countryside families, in addition to being the foundation of the labour force (29). Furthermore, we also discovered that 74.59% of all of the reported cases took place in men that possessed a substantially greater occurrence in comparison with their female counterparts in all of the age groups (P<0.05) that showed consistency with the remaining country. There is a need to conduct more studies for clarifying the illness load of human brucellosis in China for the purpose of mobilizing greater means for combating this illness. One health methodology is both the best and the essential for containing this overlooked zoonosis that require immediate collaboration from health and agriculture fields. It requires being stated that inhibiting animal illness is the preliminary measure for controlling the human brucellosis. The Quarantine-Slaughter-Immunization strategy had been observed with evidences for being efficient in the latest century that is still carried out while requiring introduction of more numbers of means as well as efforts in China (26).

Analyses of the disease maps at the township degree all through the research duration had revealed the fact the cities of Xuzhou (with 190 cases) and Lianyungang (with 62 cases) possessed the most numbers of gathered cases out of all of thirteen cities all through the duration, which accounted for 61.5% of the aggregate cases [410] in the province. Both of these two regions are situated in the north Jiangsu, neighbouring the Shandong province, having higher number of brucellosis cases. A spread of human brucellosis cases was observed from the north and the south, thereafter, to the centre of Jiangsu Province that exhibited a quickly growing tendency. An extensively fast growth tendency in the two cases of growth rate and disease infection area is observed regarding Brucella. Nevertheless, neither the Centres for Disease Control and Prevention nor the National Health and Family Planning Commission had awarded much needed consideration to this problem for the latent reason that there are fewer cases, together with diminished risky exposures, in addition patients' farming-induced working approach. All of these elements are capable of potentially breeding a risky flashpoint.

A cluster is a representation of a potential eruption (30,31). Accordingly, we are required to take into consideration the significance to include human brucellosis in the ailment list of the National Infectious Disease Alerting and Warning System in China. Despite the fact that human brucellosis indicates seasonality as regards the occurrence, yet it appears that the clusters were capable of occurring at any time, which reveals that either the transmission channel or the influencing population of the clusters is likely to be varied. We are required to direct more amount of consideration to the potential eruptions, which are likely to be resulted by polluted milk as well as associated products that are likely to be involved in all of the population, implicating the elder, the children and the women instead of constraining to the professional cohorts that usually receive infection from getting contacted with sick animals (7).

This research work contains numbers of constraints. The data utilized were gathered from passive public health observation. The data quality is likely to receive the influence of the major measures in observation, which include reporting methodology, accessibility of health facilities as well as clinical diagnostics, in addition to underreporting, wholeness as well as precision of data over the years. In particular, human brucellosis's signs as well as symptoms are typically abnormal that might result into an incorrect diagnosis, in addition to underreporting for this illness.

Conclusions

From the year 2006 to the year 2016, the occurrence of human brucellosis in Jiangsu Province of China has experienced not only growth but also expansion to more regions. Human brucellosis cases have extended from the north and south, thereafter, to the centre of Jiangsu Province that exhibited a quickly growing tendency. Space-time clusters were existent and some were gradually situated eventually. There is a need to devote more amounts of means for the enhancement of control efforts in high-risk prefectures, in addition to decentralizing to the township

level for the purpose of facilitating immediate treatment in epidemic areas, for instance Jiangsu Province. Furthermore, there is a need to conduct more numbers of studies for the purpose of detecting the triggering forces supporting the rising tendency of this ailment.

Acknowledgments

Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/jphe.2017.11.05). BZ serves as an Editor-in-Chief of *Journal of Public Health and Emergency* from Jan 2017 to Dec 2022. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Institutional ethical approval and individual informed consent were waived.

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