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Contents lists available at ScienceDirect

Asian Pacific Journal of Tropical Medicine

journal homepage: http://ees.elsevier.com/apjtm

Original research http://dx.doi.org/10.1016/j.apjtm.2017.08.004

Epidemiological analysis of 133 malaria cases in Shanxian county, Shandong Province, China

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ARTICLE INFO

Article history:
Received 10 Jun 2017
Received in revised form 12 Jul 2017
Accepted 21 Jul 2017
Available online 24 Aug 2017

Keywords:
Malaria
Epidemiological changes
Shanxian county
Shandong province

ABSTRACT

Objective: To conduct an analysis of the epidemiological changes in malaria that have occurred in Shanxian county from 2002 to 2016.

Methods: A retrospective study was conducted and data were collected from web-based reporting system to explore the epidemiological characteristics in Shanxian county from 2002 to 2016. All individual case information was obtained from village malaria servicers organized by the local Shandong Institute of Parasitic Diseases.

Results: A total of 133 cases were identified as malaria in Shanxian county during this period, including 124 indigenous cases (93.2%) and 9 imported cases (6.8%). The 124 indigenous malaria cases were infected with *Plasmodium vivax (P. vivax)*, whereas 7 of the 9 confirmed imported cases were infected with *Plasmodium falciparum (P. falciparum)*, 1 was infected with *Plasmodium ovale* (*P. ovale*) and 1 patient was infected with *P. falciparum* mixed with *P. vivax*. The total number of malaria cases included 86 males (64.7%) and 47 females (35.3%). Age of the patients ranged from 1 to 83 years, although most (64.7%) infections occurred in the 21-to 60-year-old age group. Remarkably, 117 of the total malaria cases (98.0%) were reported from 2006 to 2011. The epidemic season was from June to October, with the peak occurring yearly from July to September. The most common occupation of the infected patients was farmer. In total, 58.1% of the cases occurred in 3 townships, namely, Fugang, Huanggang and Caozhuang.

Conclusions: In Shanxian county, the local malaria incidence experienced an emerge-peak-control-eliminate status. However, due to the numbers of migrant labourers returning from Africa, imported cases were continuous and presented an increasing annual trend, which became a non-negligible and a significant impediment for malaria elimination. Therefore, the need to eliminate instances of malaria reintroduction to receptive malaria-free areas should drive strategies to align with the epidemiological changes.

1. Introduction

Malaria is one of the most important parasitic diseases and is widely endemic in tropical, subtropical, and temperate regions [1]. Updated estimates have indicated that 212 million cases occurred globally in 2015, leading to 429 000 deaths, most of which were in children under 5 years of age in Africa [2]. Although great success has been achieved since the launch of the national malaria control programme in 1955, malaria remains a serious public health problem in China [3], where *Plasmodium vivax* and *Plasmodium falciparum* have historically been present at high frequencies [4]. Shandong Province underwent two large malaria outbreaks during the

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Peer review under responsibility of Hainan Medical University.

Foundation project: This study was supported by the National Natural Science Foundation of China (Grant No. 81471985 and 81672059), the Innovation Project of Shandong Academy of Medical Sciences, and Natural Science Foundation of Shandong Province, China (Grant No. ZR2015YL023 and ZR2015YL032).

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1960s and 1970s with more than 6 million and 4 million annual cases, respectively [5].

Shanxian county lies in the southwest of Shandong Province at the border of Jiangsu, Henan and Anhui provinces between 115°48′–116°24′ east longitude and 34°34′–34°56′ north latitude. The sixth census in 2010 showed that Shanxian county had a population of 1.06 million people. The total area is 1 650 km^2 and belongs to the Yellow River alluvial plain of the north temperate zone. According to the local meteorological department website, the annual mean temperature and rainfall of this country are 13.9 °C and 737.1 mm, respectively. In the 1970s, Shanxian County was considered a high incidence area of *P. vivax* malaria via its single vector [*Anopheles sinensis (A. sinensis)*]. This county was subsequently incorporated into the south Shandong malaria integrated prevention and control area and contributed to a powerful epidemic rebound through an established surveillance system, improved environment and vector control. Since 1988, the area has achieved the standard of almost completely eliminating malaria, and no malaria cases have been reported. Few cases emerged after 2002. However, the morbidity has increased substantially each year since 2005. The numbers of cases detected in the continuous 4 years between 2007 and 2010 were greater than 20, and the proportion of indigenous cases that accounted for all cases in Shandong province increased yearly during this period. Therefore, the malaria prevention and control efforts in Shanxian county are vital to determining whether Shandong province can achieve the goal of eliminating malaria in 2018. The objective of this study was to characterize the malaria situation and development trends in Shanxian county from 2002 to 2016, which was a very important transition period from the control to elimination phases in Shanxian county, and to provide scientific insights for the improvement of regional control strategies and acceleration of the elimination goal in Shandong Province.

2. Material and methods

2.1. Study setting

Shanxian county is located in a warm temperate zone with a semi-humid continental monsoon climate. Rainfall is concentrated mostly in the summer when the southeast monsoons carry rainwater into the county. Many rivers present in Shanxian county belong to the ancient Yellow River canal and include the Fuxin River and Dongyu River, which are drainage clearance rivers. Rural economics is drought crop oriented, and planting fast-growing poplar is prevalent as a means to increase incomes in the villages and their surroundings.

2.2. Data collection

A retrospective study was conducted to explore the changing characteristics of endemic malaria in Shanxian county from 2002 to 2016. Daily disease surveillance data were obtained from the web-based reporting system (WBRS). The parameters included the type of disease, diagnostic approach and reporting institution. Other parameters were collected for individual cases by village malaria servicers (VMS) who were organized by the Shandong Institute of Parasitic Diseases, including age, gender, occupation, residential address, and recent travel/time spent outdoors history.

2.3. Diagnostic approach

Clinically diagnosed cases were defined as a patient with malaria-like symptoms but no parasites detected in the blood examination. Laboratory-confirmed cases were those defined by the use of any laboratory test, including polymerase chain reaction (PCR), rapid diagnostic tests (RDTs), and microscopy examination [6,7].

2.4. Case definition

Imported malaria must meet all of the following criteria: (1) the patient was given a malaria diagnosis; (2) the patient had a travel history to malaria-endemic areas outside of China during malaria transmission season; and (3) the onset time was less than 1 month after returning to China during the local transmission season. This definition is based on the reasonable latent period for all Plasmodium species reported in China [6]. Indigenous malaria was defined as any case infected within the province where the case was diagnosed [8].

2.5. Statistical analysis

A descriptive analysis was performed using the Microsoft Excel and SAS software (SAS Institute Inc., Version 9.2, Cary, NC, USA).

2.6. Ethical approval

Ethical approval for this study was obtained from the Ethics Committee of the China CDC. Permission was also obtained from the Municipal Government, the Municipal Health Bureau and the CDC in Heze city.

3. Results

3.1. Indigenous and imported case surveillance

From 2002 to 2016, Shanxian county had 133 malaria cases overall, including 124 indigenous cases and 9 imported cases. Most of the indigenous malaria cases occurred during the period from 2006 to 2011 (117 cases accounting for 88.0% of the total cases). Although no malaria cases were found in 2003, indigenous malaria cases began to increase gradually after a one-year silent period until the peak was reached (2006–2011). In 2012, no malaria cases were reported (neither local nor non-local cases). The year 2012 seemed to be a turning point for local and imported cases, because after this time point, no indigenous cases occurred. However, imported cases began to rise. Although one imported case per year was reported in 2011, 2013, 2014 and 2016, 5 cases were reported in 2015 (Figure 1).

3.2. Malaria case types

From 2002 to 2016, 124 *P. vivax* malaria cases were reported, which accounted for 93% of the total cases. Additionally, 7 *P. falciparum* malaria cases accounted for 5% of the total cases, and 1 *Plasmodium ovale* (*P. ovale*) malaria and 1 mixed malaria case both accounted for 1% of the total cases (Table 1). The mixed malaria case was infected with *P. vivax* and *P. falciparum*. Among the total cases, 26 were confirmed by a clinical diagnosis, and 107 were confirmed by a laboratory diagnosis (Table 1).