



Prevalence of dengue viral and malaria parasitic co-infections in an epidemic district, Angul of Odisha, India: An eco-epidemiological and cross-sectional study for the prospective aspects of public health

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Received 16 September 2015; received in revised form 26 October 2015; accepted 27 October 2015

KEYWORDS

Dengue;
Malaria;
Co-infection;
Surveillance;
Odisha

Summary The co-existence of dengue and malaria infection in an individual and the primary and secondary dengue infection during co-infection were assessed. Over 1 year, 1980 blood samples were collected from suspected cases of dengue fever and analyzed by rapid diagnostic test (RDT), enzyme-linked immunosorbent assay (ELISA) and polymerase chain reaction (PCR) methods to detect dengue infection. RDT and microscopic methods were used to detect malaria. Of the 1980 samples, only 22 (3.0%) cases were identified as dengue–malaria co-infection cases, out of which 13 were male and 9 were female. The highest number of confirmed cases were found during the hot and humid months of September and October (7 cases, 31.8%) and within the over 15 years age group. Of the cases of co-infection, dengue primary infection (21 cases, 95.5%) was significantly more common than dengue secondary infection (1 case, 4.5%) among all of the age groups. There were 12 cases of *Plasmodium falciparum* and 10 cases of *Plasmodium vivax* infection among malarial cases. A high prevalence of concurrence of dengue and malaria infection was recorded in

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this ecosystem. In light of the severity of co-infection and overlapping symptoms, a multidimensional diagnostic approach is suggested.

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Introduction

In the tropics, infections from the dengue virus (DENV) and the protozoan malaria parasite (*Plasmodium* spp.) are transmitted by *Aedes* and *Anopheles* mosquitoes, respectively. Both dengue viral infection and malaria parasitic infection can cause acute febrile illness, can cause quite similar symptoms and signs and may not be clinically distinguishable. However, malaria can be chronic and dengue cannot, and therefore, it is important to differentiate between the two conditions; while there is no vaccine or specific treatment for dengue, malaria is treatable, but any delay in treatment may result in increased morbidity and even mortality. In recent years, both dengue and malaria fever have become leading causes of morbidity and mortality in tropical and subtropical areas throughout the world [1], and approximately two-fifths of the world population lives in areas that are at risk for dengue [2–4]. Both dengue and malaria fevers are endemic in Odisha state. Malarial parasitic infection has long been documented in the state, while DENV infection was first documented in 1998. Several epidemics due to DENV precipitated after 2005, causing an increase in the case fatality rate (CFR = total mortality X100/total positive cases of dengue) [5]. For example, in 2011, 33 deaths occurred among a total of 1846 detected dengue cases in Odisha, with the epicenter at the Talcher coalmine area of Angul district; the maximum number of dengue positive cases (33.7%), with a CFR of 66.7%, had been reported in the Angul district [5].

Infections from dengue virus (DENV) and malaria parasite (MP) are exasperating enough individually. However, the contemporaneous presence of both infections in an individual is the most dire situation [5,6]. According to WHO guidelines, dengue viral and malaria parasitic co-infection in an individual is regarded as a 'severe malaria' case [7]. In the rural, semi-urban and urban areas of Angul district, both vectors, i.e., *Aedes* and *Anopheles*, are present throughout the year [5]; therefore, the occurrence of malaria–dengue co-infection in an individual cannot be ruled out. There are numerous scientific reports on investigations of dengue fever (DF) and dengue hemorrhagic fever (DHF) from various parts of the Indian subcontinent [8–13]. However,

systematic studies on dengue and the monitoring of dengue–malaria co-infection has yet not been attempted, either in epidemics or in sporadic dengue outbreaks in Odisha, despite the fact that both infections are quite common. Other than documenting the prevalence/epidemiological trends of the diseases in databases, there is no systematic study [5].

Therefore, the aim of the present study was to investigate suspected dengue fever cases to determine the presence of dengue and malaria co-infection, as well as the prevalence of co-infection among common demographic factors to assess the spectrum of co-infection. Primary and secondary dengue infections during co-infection were assessed. This paper presents a comprehensive surveillance report on the co-infection of dengue viral and malaria parasitic infection among febrile cases in the Angul district of Odisha.

Materials and methods

Study area

With an area of 6232 sq. km, the Angul district is centrally located in the state of Odisha (20°31'N and 21°40'N latitude and 84°15'E and 85°23'E longitude). As per the 2011 census, the total population of the Angul district is 1,271,703 (654,898 males and 616,805 females). With a brief winter, the climate of the district is sub-tropical, with temperatures ranging from 6 to 47°C (Fig. 1).

Clinical specimens

Dengue and malaria infections share similar symptomatology. From January to December 2013, dengue suspected fever cases were collected using passive case detection (PCD) from the study area of Angul district, Odisha, in accordance with the observation of non-specific constitutional symptoms. The following criteria were considered for the selection of DF cases in three phases – febrile, critical and recovery: (a) high fever, (b) headache, (c) retro-orbital pain, (d) nausea/vomiting, (e) myalgia (muscle pain), (f) generalized skin rashes,

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