

A Survey on Risks of Malaria Infection among Different Populations in the Yuanjiang River Basin

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Abstract

In order to understand the risks of malaria infection among populations at different altitudes in the Yuanjiang River Basin, a cross-sectional survey of malaria prevalence was performed with parasitological and serological methods. The data were analyzed by stratification. The results of IFAT indicated: a) taking permanent residence in the foothills (<1,200 m) as the reference, the risk ratios (RR) were 4.5 (95%CI: 3.4-5.8), 8.4 (95%CI: 6.4-10.9) and 6.3 (95%CI: 4.9-8.1), respectively, for mobile populations in different areas; b) for residents living at the altitudes 1,200-1,600 m and >1,600 m, taking the age group of younger than 15 years old as the reference, the RR was 2.8 (95%CI: 2.4-3.8) for the labor age group who were 15-60 years old. Analysis of parasite rates showed that, compared with permanent residents in the foothills, the RR was 20.6 (95%CI: 4.8-89.6) for one- or two-day workers who had no shelters and stayed outdoors overnight. It is concluded that malaria transmission is still serious and primarily occurs in the foothill zone, and that staying overnight in the field and lack of personal protective measures are risk factors of malaria infection in the region.

Keywords: malaria, Yuanjiang River Basin, cross-sectional survey, risk ratio

Introduction

The Yuanjiang River originates in south-central Yunnan and flows into the South China Sea at Haiphong in Vietnam (called the Red River). The altitude range is from 76.4 m to 3,165.8 m in the area of China. From the foothills (<1,200 m) to the hilltops, there are tropical, subtropical and temperate zones. About 3.1 million people live in 10 counties (including two border counties) or municipalities along the river within China. In the 1950s, cases in these areas only accounted for 9.1% of the total cases

in Yunnan. However, in 1994, cases for the area as a proportion of total cases in Yunnan, increased to 45.4%. From 1993 to 1995, the reported annual parasite incidence (API) in Yuanjiang County was ranked as the highest in all of the counties in China [1]. The objective of the survey was to compare exposure to malaria at different altitudes (<1,200 m, 1,200-1,600 m, and >1,600 m). In addition, a further objective was to compare, within each of the three altitude zones, people who were permanent residents and those who were mobile populations. The survey was carried out in November, near the end of the farming season, when most of the immigrant laborers were at home.

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Materials and methods

Sampling

Yuanjiang County and Yuanyang County were selected for investigation. Villages in these two counties were first sorted into three zones according to their altitudes and then randomly selected from each zone. More than 70% of the people were required to be surveyed in each selected village. About half of the surveyed people were from Yuanjiang and the other half from Yuanyang.

Investigation

A door-to-door survey was performed by trained village health workers (VHW) and staff from community hospitals, county anti-epidemic stations and the Yunnan Institution of Malaria Control (YIMC). A thick blood slide was prepared and a serum sample was collected from each subject. Meanwhile, the subjects were interviewed and asked to fill out a questionnaire.

Detection

Giemsa-stained thick blood slides were examined for parasites in the laboratories. Serum samples were detected using the indirect immunofluorescent antibody test (IFAT) [1].

Analysis

The risk ratios and their 95% confidence intervals (CI) were calculated by using the Epi Info 6 software package for parasite rate and IFAT positive (final titer 1:20) rates [1-2]. The

geometric mean reciprocal titer (GMRT) was also calculated.

Results

Before stratification, the parasite rates and IFAT rates were similar among residents in three altitude zones (Table 1). However, after stratification, both parasite and IFAT positive rates of the mobile populations were significantly higher than those of the permanent residents in each altitude (Table 2).

In this area, most families who live at the altitudes 1,200-1,600 m and >1600 m have their fields in the foothills. During the farming season, laborer members of a family usually stay overnight in their simple field shacks. None of the subjects interviewed used bed nets in the shacks and 82% (890/1,085) of them slept outside their shacks on very hot nights. However, the prevalence in residents aged 15-60 years was significantly higher than that of younger children (<15 years) and older people (>60 years) (Table 3).

The prevalence was similar between male and female residents of higher zones (>1,200 m). However, a significant difference in prevalence was found between male and female residents in the foothills (Table 4). This was because 86.3% (373/432) of the temporary residents were male. They usually worked as temporary workers. They lived in different settings; some lived in the houses or the field shacks of their landlords; some one- or two-day workers slept

Table 1 The prevalence at different zones.

Zone (altitude)	Sample size	Parasite				IFAT positive	
		SPR (%)	RR (95%CI)	SFR (%)	%	GMRT	RR (95%CI)
<1,200 m	1,087	1.9	1	0.3	42.9	29.4	1
1,200- 1,600 m	1,277	2.1	1.1 (0.6-1.9)	0.3	48.9	33.7	1.2 (1.1-1.3)
>1,600 m	1,139	2.6	1.3 (0.8-3.3)	0.3	53.2	32.8	1.2 (1.1-1.4)
Total	3,493	2.2		0.3		48.3	33.3

SPR = slide positive rate; RR = risk ratio; SFR = slide falciparum rate; 95%CI = 95% confidence interval

Table 2 The prevalence in different populations.

Cohort	Sample size	Parasite			IFAT positive		
		SPR (%)	RR (95%CI)	SFR (%)	%	GMRT	RR (95%CI)
< 1,200 m							
Permanent	655	0.3	1	0.2	28.4	27.4	1
Mobile*	432	4.4	14.4 (3.4-61.5)	0.2	63.9	30.9	4.5 (3.4-5.9)
1,200-1,600 m							
Permanent	763	0.5	1.7 (0.3-9.3)	0	30.1	30.4	1.1 (0.9-1.4)
Mobile**	514	4.5	14.0 (3.3-59.2)	0.8	76.8	32.6	8.4 (6.4-10.9)
> 1,600 m							
Permanent	567	0.3	1.2 (0.2-8.2)	0	34.5	30.4	1.3 (1.1-1.7)
Mobile**	571	4.7	14.8 (3.5-61.9)	0.6	71.5	40.9	6.3 (4.9-8.1)

* Temporary residents from other areas; ** Residents who seasonally left their homes at high altitudes to farm in the foothills.

Table 3 The prevalence of three age groups of residents in the higher zones (>1,200 m).

Age (years)	Sample size	Parasite		%	IFAT positive	
		SPR (%)	RR (95%CI)		GMRT	RR (95%CI)
< 15	638	0.3	1	24.6	25.4	1
15-60	1339	3.8	12.2 (2.9-49.8)	68.0	37.7	2.8 (2.4-3.2)
> 60	439	0.7	2.2 (0.4-12.9)	36.7	30.4	1.5 (1.2-1.8)

Table 4 The prevalence in categories of residents by sex.

Population	Sample size	Parasite		IFAT Positive		
		SPR (%)	RR (95%CI)	%	GMRT	RR (95%CI)
< 1,200 m						
Female	355	0.3	1	21.9	33.6	1
Male	732	2.8	9.7 (1.3-71.9)	52.5	40.1	2.4 (1.9-2.9)
> 1,200 m						
Female	1182	2.0	1	50.1	33.9	1
Male	1234	2.6	1.3 (0.8-2.2)	51.6	34.4	1.1 (0.9-1.2)

in the streets of towns at night and waited for the landlords who needed temporary labor every morning. The parasite and IFAT positive rates among the one- or two-day workers were 6.3%

(15/238) and 86.1% (205/238), respectively; the risk ratios were 20.6 (95%CI: 4.8-89.6) and 3.0 (95%CI: 2.7-3.5), respectively, when compared with permanent residents.

Discussion

According to the views of medical geography, malaria prevalence becomes lower with increasing altitude [3]. It seems unreasonable that the parasite rates and IFAT rates were similar among residents in different altitude zones. The reason was that no significant difference existed among permanent residents at different altitudes (<1,200 m, 1,200-1,600 m, and >1,600 m). This showed that malaria has been successfully controlled among permanent residents. However, the prior parasitological survey indicated that compared with the permanent residents, the odd ratio of mobile populations who had ever worked in the foothills was 2.81 in Yuanyang County [4]. In this investigation, the higher prevalence among the mobile populations indicated that malaria transmission is still serious and primarily occurs in the foothill zones.

In higher zones (1,200-1,600 m, and >1,600 m), in spite of the similarity in prevalence between male and female residents, the prevalence in residents aged 15-60 years was significantly higher than that of younger children (<15 years) and older people (>60 years). This may be because the older people usually looked after the children at home. This indicated that the labor forces contracted malaria in their foothill fields. The level of antibody among children is usually a sensitive indicator for malaria transmission [2]. The very low IFAT positive rate among children was strong evidence for lower malaria transmission at high altitudes.

In the highest areas (>1,600 m), the majority of immigrants were male; this led to a significant difference in malaria prevalence between male and female residents. This showed that malaria control among mobile populations is still a challenge.

The specially high parasite rate and IFAT positive rate among one- or two-day workers indicated that staying overnight in foothill fields and the lack of personal protective measures were risk factors for malaria infection.

The results of the survey indicated that the IFAT positive rates were much higher than the

parasite rates. This may have resulted from lasting immunity after infection and treatment, because quick symptom-releasing anti-malarial drugs (e.g. artemether and artesunate) can be bought everywhere and inappropriate self-treatment is common [5-6]. Therefore, IFAT positive rates may be more useful than parasite rates for indicating exposure to malaria in this setting.

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