EVALUATION OF A MALARIA CONTROL PROJECT IN DPR KOREA, 2001-2003

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Abstract. This cross-sectional study aimed to evaluate a malaria control project implemented from 2001 to 2003. The evaluation indicators included assessing malaria prevalence, people's knowledge, awareness, and preventive behavior regarding malaria. First, a review of clinical records in the study areas was used to measure malaria prevalence. Second, a cross-sectional study was done, and 1,007 people aged ≥15 years who lived in Saenal Ri (rural area) Sichon County, South Hwanghae Province and Hwangju Up (urban area), North Hwanghae Province, were randomly sampled and interviewed. The prevalence of malaria, from review of clinical records, declined from 20.5 cases per 1,000 population in 2001 to 4.9 cases per 1,000 population in 2003. Of the 245 malaria cases, 1.6% had three, and 13.9% had two, experiences of malaria infection. Survey data showed that the prevalence of malaria was 2.7 cases per 1,000 population. About 75.6% (31/41) were in the age group 30-49 years. Overall outcome evaluation showed that the targets had been achieved: prevalence (2.7 *vs* 9 per 1,000 population), people's good knowledge of malaria (97.5 *vs* 90.0%), awareness (93.8 *vs* 85.0%), and preventive behavior (84.7 *vs* 80.0%). However, some aspects of the individual target indicators still needed improvement, *ie* people's knowledge of malaria symptoms and mosquito-source elimination behavior. The malaria control project appeared to be effective in reducing malaria prevalence and improving people's knowledge, awareness and preventive behavior about malaria in the studied areas.

INTRODUCTION

Malaria is a life-threatening parasitic disease transmitted by *Anopheles* mosquitoes. Four kinds of malaria parasites can infect humans, *Plasmodium falciparum, P. vivax, P. ovale,* and *P. malariae* (WHO, 2000). The World Health Organization (WHO) reported that about 100 countries or territories in the world were considered malaria-endemic areas. The incidence of malaria worldwide is estimated at 300–500 million clinical cases each year, with about 90% of these occurring in Africa, south of the Sahara, and mostly caused by *P. falciparum*. Approximately 2.48 million malaria cases are reported annually from South-Asia. Of these, 1.06 million (42.7%) are *P. falciparum* cases. *P. falciparum* is associated with malaria outbreaks and malaria-related mortality, and the parasite has acquired resistance to standard anti-malarial drugs (WHO, 2001). The main burden of *P. vivax* malaria (56%) occurs in Southeast Asia. Globally, there is a pattern of co-endemicity with *P. falciparum* in the tropics, and an increasing proportion of *P. vivax* occurs in the higher latitudes, with *P. vivax* alone occurring in northern and central China, the Korean peninsula, and areas such as the Caucasus (WHO/SEARO, 2002).

In DPR Korea, malaria was eradicated in the 1970s, but re-emerged as a serious problem in 1997. In 1998, 2,100 *P. vivax* malaria were detected in some areas of Kangwon Province, South Hwanghae Province and Kaesong City, in the south of the country. The shortage of anti-malarial drugs and imperfect preparedness for treating and managing malaria cases resulted in rapid transmission of malaria, increasing from around 100,000 cases in 1999 to 300,000 cases in 2001. Most of the cases have been clinically diagnosed, those diagnosed by laboratory test were 36.8%. The relapse rate among malaria cases in 2000 was about 7.9 % (MOPH Korea,

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2001a; Phu, 2002).

Since 1999, the Ministry of Public Health, DPR Korea has developed a national malaria control project in co-operation with the WHO, to reduce the burden of malaria (Kondrachine, 2000). In 2000, national malaria treatment guidelines were developed and distributed to health facilities. In 2001, support from the WHO made it possible to carry out most proposed activities in the year 2000 action plan. This included distribution of 40,000 treated bed-nets for families, insecticide, and microscopes for health laboratories in counties with anti-epidemic stations and hospitals. About 70 participants were trained in malaria microscopy. The anti-malarial drugs, chloroquine and primaquine, were provided for 200,000 cases. Health education materials regarding malaria prevention and control were distributed to people in malaria-epidemic areas to improve the people's knowledge, awareness and practice related to malaria prevention. Key persons responsible for the malaria control project in provinces, cities and counties were trained in vector control, and baseline surveillance for monitoring and evaluation of the malaria control project (WHO, 1999; MOPH Korea, 2001b).

While the variety of malaria found in the DPR Korea has a relatively low fatality rate, patients suffer from high fever and chills. Agricultural workers are most at risk. WHO officials in Pyongyang estimated that sickness from malaria accounted for one million lost working days in 2001 (Gluck, 2002). The Seanal Ri (rural) and Hwangju Up (urban) are areas of paddy fields or flat terrain and low hills located in the south and central zones of the country, and are some of the worst affected areas, involved with the national malaria control project since 1999. This study aimed to evaluate the effectiveness of the current malaria control project's implementation between 2001 and 2003. The outcome evaluation indicators included assessing malaria prevalence, people's knowledge, awareness, and preventive behavior related to malaria.

MATERIALS AND METHODS

DPR Korea is geographically divided into 9 provinces, 3 major municipalities, 212 counties, and further sub-divided into smaller administrative units, *ie* Ri (rural) and Dong (urban) areas. Saenal Ri is a rural area with 1,010 households and a population of 4,714; the majority are farmers. Hwangju Up is a small city with 1,012 households and a population of 3,759. The capital of Hwangju County is located in the central zone of the country, about 100 km from Pyongyang.

This study was part of the malaria control project evaluation in North and South Hwanghae Province, DPR Korea. First, the clinical records of Ri clinics and the resident registration system in the study areas from 2001 to 2003 were reviewed to identify the prevalence of malarial episodes. Second, a cross-sectional study was done; a total of 1,007 eligible population, 460 people from Hwangju Up, North Hwanghae Province and 547 people in Saenal Ri, South Hwanghae Province, were recruited by systematic random sampling (Fig 1). We estimated the sample size using the single proportion formula, with 95% confidence interval. Sample size calculation was based on 1% of DPR Korea malaria prevalence (WHO, 2001). Precision was set at 0.062%. The respondents were interviewed with structured questionnaires during February 2004. Inclusion criteria were people aged ≥15 years who had lived in the study areas for at least 12 months prior to conducting the survey. Severe patients or persons in the household who could not communicate verbally were excluded.

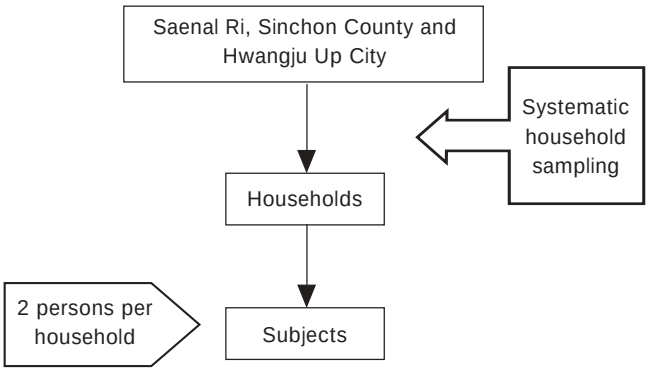

Fig 1–Flow diagram of sampling method.

The study protocol was reviewed and approved by the Ethics Committee for Human Research, Faculty of Public Health, Mahidol University. Written consent was gained from all participating respondents before data collection.

Instruments

The survey instrument was a four-part questionnaire. The first part comprised closed-ended questions about the respondent's general characteristics and malaria history. The second part comprised 29 items for knowledge of malaria. Dichotomous measurement was used by answering 'Yes' or 'No'. The Cronbach's alpha coefficient was 0.82. The third part was awareness of malaria, divided into awareness of susceptibility, severity, and the benefits of malaria prevention. Altogether, 7 items with a 3-point Likert scale were rated as 3=agree, 2=uncertain, and 1=disagree. Reverse scores were given for negative items. The Cronbach's alpha coefficient was 0.80. The fourth part dealt with preventive behavior, composed of 7 items regarding personal preventive behavior and acceptance of malaria-preventive methods. It was rated on a 3-point Likert scale, with 2=always, 1=sometimes, and 0=never. The Cronbach's alpha coefficient was 0.79. A total score of ≥60% was classified into the 'good/high' group while a total score of <60% was classified into the 'need for improvement' group, according to the set of indicators.

Statistical analysis

General characteristics and studied variables were described by percentage, mean, and standard deviation.

RESULTS

Prevalence of malaria episodes from review of clinical records

Table 1 shows that the total prevalence of malaria episodes from review of clinical records in Saenal Ri and Hwangju Up provinces decreased rapidly from 20.5 cases per 1,000 population in 2001 to 4.9 cases per 1,000 population in 2003. The trends of malaria prevalence in both rural and urban areas also declined, but the prevalence in the rural area was higher than the urban area, especially in the year 2003 (8.3 *vs* 0.8 cases per 1,000 population) (Fig 2). Of the 245 malaria cases, 1.6% had three, and 13.9% had two, experiences of malaria infection. The recurrent episodes were reported only from the rural area (Table 2).

Cross-sectional survey

General characteristics of respondents. Of the 1,007 respondents, 54.3% resided in the rural area, and 56.2% were females. Ages ranged from 15 to 89 years, with a mean age of 42.7(±15.1) years; 33.0% were in the age group 30-39 years and 23.9% in the age group 40-49 years. Eighty-seven percent had a secondary level of education; 40.1% were farmers. An identical proportion of respondents (26.6%) were workers and house-wives/students/others.

Malaria prevalence from the survey. Survey data showed that the prevalence of malaria was 2.7 cases per 1,000 population. About 76% (31/41) of these were in the age group 30-49 years and 12.2% (5/41) in the age group 50-59 years. Only 9.8% (4/41) were in the age group 15-29 years.

Evaluation of the malaria control project

The evaluation of the malaria control project was conducted by comparing the outcomes from the survey in 2003 with the target indicators. Overall, all outcome evaluation indicators of the malaria control project exceeded the targets set: prevalence (2.7 *vs* 9 cases per 1,000

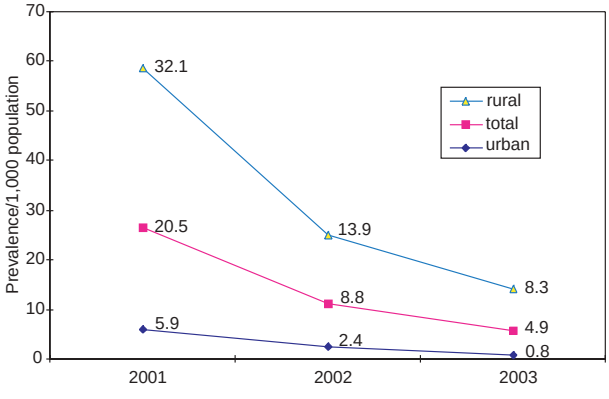

Fig 2–Trends of malaria episode prevalence in Saenal Ri (rural area) and Hwangju Up (urban area), 2001-2003.

population), people's good knowledge of malaria (97.5 *vs* 90.0%), awareness (93.8 *vs* 85.0%) and preventive behavior (84.7 *vs* 80.0%) as shown in Table 3. Upon further analysis for individual aspects, some aspects of individual outcome indicators did not achieve the target set, *ie*, people's knowledge of malaria symptoms (71.9 *vs* 90%) and mosquito source-elimination behaviors (75 *vs* 80%), as shown in Tables 3 and 4. Over 90% of respondents reported that they always used a mosquito net while sleeping and smoked mugwort (herbal plant) to control malaria. Less than 1% said that they always used repellents to prevent malaria. About 68.2% reported that they always eliminated stagnant water to prevent malaria (Table 5).

DISCUSSION

After launching the malaria control project in 2000, the prevalence of malaria decreased rapidly from 20.5 cases per 1,000 population in 2001 to 4.9 cases per 1,000 in 2003. However, the prevalence of malaria in 2001, from the review of the clinical records, was higher than the country level (20.5 *vs* 14.0 cases per 1,000

Table 1
Prevalence of malaria episodes in Saenal Ri and Hwangju Up, 2001-2003.

Year	Saenal Ri (Rural)			Hwangju Up (Urban)			Total	
	Population (mid-year)	Case[a]	Prevalence /1,000 pop	Population (mid-year)	Case[a]	Prevalence /1,000 pop	Case[a]	Prevalence /1,000 pop
2001	4,647	149	32.1	3,696	22	5.9	171	20.5
2002	4,677	65	13.9	3,726	9	2.4	74	8.8
2003	4,714	39	8.3	3,759	3	0.8	42	4.9

[a]Number of episodes

Table 2
Malaria episodes in Saenal Ri and Hwangju Up, 2001-2003.

No. of episodes	Saenal Ri (Rural)		Hwangju Up (Urban)		Total cases	
	n = 211	%	n = 34	%	N = 245	%
One	173	31.3	34	7.4	207	84.5
Two	34	6.2	0	0.0	34	13.9
Three	4	0.7	0	0.0	4	1.6

Table 3
Evaluation of malaria control project in Saenal Ri and Hwanhju Up Provinces, 2001-2003.

Indicator	Baseline (2001)	Target (2003)	Actual (2003)	Remark
Prevalence (/1,000 population)	14	9	2.7[a]	above
Knowledge (%)	40	90	97.5	above
Awareness (%)	20	85	93.8	above
Preventive behavior (%)	35	80	84.7	above

[a]From survey data

population (Tables 1, 3). One possible explanation is that the study sites were malaria-epidemic areas, resulting in a higher malaria prevalence compared to the whole country. The malaria prevalence from the present survey was less than that from review of Ri clinics and the resident registration system clinical records (2.7 *vs* 4.9 cases per 1,000 population) in 2003. This might be due to the present survey involving a smaller sample size, which might have caused a sampling error.

Table 4
Knowledge, awareness and preventive behavior related to malaria among 1007 respondents in the study area.

Variable	Good/ High[a]	Need for improvement
Overall knowledge of malaria	92.5	2.5
Transmission	99.8	0.2
Prevention	99.3	0.7
Symptoms	71.9	28.1
Overall awareness of malaria	93.8	6.2
Susceptibility	98.7	1.3
Severity	91.1	8.9
Benefit of prevention	90.9	9.1
Overall malaria-preventive behavior	84.7	15.3
Prevent mosquito bite	98.0	2.0
Eliminate mosquito source	75.1	24.9

[a] Good/High = ≥60% of total scores

It was observed that malaria prevalence also decreased in both rural and urban areas during the study period. However, the prevalence in the rural area was about 5.4-10 times higher than the urban area (Table 1). This was possibly because rural areas are usually surrounded by rice fields, which are recognized mosquito-breeding places. In addition, the majority of people in rural areas are farmers. Their daily lives involve a higher risk of exposure to mosquitoes, especially at night when *Anopheles* mosquitoes, which transmit malaria, are active and biting.

Thirty-eight persons in the rural areas were infected with malaria >2 times and 4 persons had been infected with malaria more than 3 times, since 2001 (Table 2). The majority of these supposed malaria-relapse cases were farmers in the age group 30-49 years. Two possible reasons to explain this are: 1) the malaria patients were not completely treated with primaquine or did not comply with the treatment regimen; 2) their daily lives exposed them to mosquito breeding places, without good malaria prevention (Kondrachine, 2000).

The baseline indicators in 2001 for knowledge (40%), awareness (20%), and preventive behavior of malaria (35%) were quite low. No malaria case was found in the previous thirty years, until 1997. Therefore, malaria was not a health problem for the country. In addition, health education and training programs did not focus on malaria, which resulted in a low knowledge, awareness and preventive behavior concerning

Table 5
Malaria-preventive behaviors among populations in Saenal Ri and Hwangju provinces, by item (n=1,007).

Item	Always	Sometimes	Never
Prevent mosquito bite			
Use mosquito net while sleeping	94.9	4.7	0.4
Smoke mugwort (herbal plant) to control malaria	90.5	9.2	0.3
Wear long-sleeved shirt when going out at night	31.5	25.9	42.6
Use repellents to prevent malaria	0.1	0.4	99.5
Eliminate mosquito source			
Spray insecticide to control mosquitoes	3.1	10.1	86.8
Eliminate stagnant water to prevent malaria	68.2	30.5	1.3

malaria among the people; health personnel also did not receive updated training in malaria. However, after implementing the malaria control project in 1999, malaria prevalence immediately declined, while the people's knowledge, awareness and preventive behaviors regarding malaria increased rapidly.

The proportions of people with good knowledge, awareness and preventive behavior regarding malaria in 2003 were quite high, since the cut-off was set at ≥60% of the total scores for each individual indicator. It was defined according to the implementing project. The results of the present study show that people's overall knowledge of malaria was above the target in 2003 (97.5 *vs* 90%). Only knowledge regarding malaria symptoms was lower than the target (71.9 *vs* 90%). Probably, the knowledge of symptoms depended directly on a personal experience of contacting malaria and the health education materials in the study area.

The assessment of malaria-preventive behavior was divided into two groups: behavior to prevent mosquito bite and behavior to eliminate mosquito sources. The overall malaria-preventive behavior of the people was also above the target indicators (84.7 *vs* 80%), except for some items, *ie*, only 0.1% of people reported always using mosquito repellent, as such materials were scarce in the surveyed areas. Only 3.1% reported always spraying insecticide; possible reasons for this may be lack of insecticide provision, which was not available for domestic use, and the support from national or international non-governmental organizations did not satisfy the need.

Nevertheless, the people practiced some items of malaria-preventive behavior very well. For example, 94.9% of people always used a mosquito net while sleeping, and 90.5% always used mugwort (herbal plant) smoke to prevent bites. The reason was that the malaria control project implemented such preventive behaviors in the community.

The limitations of this study included: 1) a self-reported questionnaire without long-term observation. Some people may overstate actual malaria-preventive behavior; 2) we could not assess the exact level of baseline indicators for this community before implementing the malaria control project. It might be underestimated as data collection was clinic-based; 3) only four outcome evaluation indicators were included in this study. No indicators assessed early diagnosis and treatment, compliance with anti-malarial drugs, or community participation in vector control, and; 4) the modest sample size represented only the study areas.

In conclusion, the malaria control project had achieved all target indicators included in this study. The intervention should be continued to improve the knowledge, awareness and preventive behaviors against malaria in the community, with particular attention to knowledge of malaria symptoms and preventive behavior. Training materials need to cover all aspects of malaria, in terms of transmission, symptoms, and possible malaria-prevention methods. The program should involve health-behavioral scientists to develop and modify the IEC materials. The community health workers should be reoriented about health education in light of the revised content matter. Attention should be given to applying various health-education approaches, not only through community group education but also combined with visual materials and other approaches. National TV and radio networks can be utilized to accomplish this. Malaria control intervention needs to pay particular attention to the people in rural areas aged 30-49 years, since they were found to be a high-risk group. It is particularly important that personal protective materials, such as repellents, be made available for people aged 30-49, whose activities are mainly outdoors, and for farmers who mainly work outside. The malaria control project should support efforts to identify feasible production of repellents using locally available resources, to ensure the sustainability of malaria control activities.

In order to ensure that every aspect of the project is progressing towards its goal, indicators must be identified for each project planning stage. Accordingly, project implementation should be periodically monitored against the indicators in the plan, and if found to be unsatisfactory, necessary steps should be taken during the project implementation phase itself, to en-

sure thorough achievement of the objectives. The responsible authority for monitoring and evaluation and the frequency of evaluation procedures should be specified in the plan itself.

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