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Case report

A lost world disease: Copra itch outbreak caused by *Tyrophagus longior* mite

Prakit Sarathep*, Worayot Phonkaew

Ministry of Public Health, Phang Nga Provincial Public Health Office, Phang Nga Province, Thailand

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ABSTRACT

An outbreak investigation of copra itch revealed a cluster of six suspected cases with skin dermatitis, with 11–32 years of age, belonging to a single family, between June and July 2016 in Phang Nga province, Southern Thailand. Epidemiologic investigation of these suspected cases revealed five probable cases developing multiple discrete erythematous papules with intense pruritus on the body rather than the extremities and one confirmed case whose skin was infested with domestic mite, *Tyrophagus longior* (Gervais) (Ascari: Ascaridae). This mite was also found in unused coir mattresses outside their bedrooms. Household infestation with *T. longior* mites rendered these family members to become more susceptible to expose indoor biting of *T. longior* adult mites that were adapted well to the domestic environments with poor hygienic conditions. Human exposure to mite bites was more likely to be a direct contact than an indirect contact. Findings from this copra itch outbreak investigation provided understanding of natural disease of copra itch and factors that favored the outbreak, and could guide diagnosis for physicians, surveillance and response for surveillance and rapid response teams (SRRTs), and prevention and control for entomologists and public health personnel.

Introduction

Mite infestations are a nuisance and mite bites can pose a medical problem to humans [1]. Bitten by the mites, individuals may suffer from skin irritations or pruritic dermatoses characterized by pruritus, lesions, rash, and inflammation. The pruritic dermatoses manifest as a pruritic itchy papular rash or multiple erythematous papules accompanied by intense pruritus, and they are not well recognized by patients or physicians. The biting mites include scabies mites (*Sarcoptes scabiei* var. hominis) [2], dust mites (*Dermatophagoides pteronyssinus* and *D. farinae*) [3,4], chiggers (*Leptotrombidium* sp. and *Ascoschoengastia* sp.) [5], avian mites (*Dermanyssus gallinae*, *Ornithonyssus sylviarum*, and *O. bursa*) [6,7], tropical rat mites (*Ornithonyssus bacoti*) [7,8], straw itch mites (*Pyemotes tritici*) [9,10], and storage mites (*Lepidoglyphus destructor*, *Glycyphagus domesticus*, *Acarus siro*, *Tyrophagus putrescentiae*, and *T. longior*) [10–13].

On 5 July 2016, the Department of Disease Control (DDC), Ministry of Public Health, Thailand received messages about 6 cases bitten by insects from a patient in Phang Nga province by information hotline service, and then notified to the Communicable Disease Control Section (CDCS), Phang Nga Provincial Public Health Office (PPHO). All were subsequently identified suspected cases of copra Itch [14–16] belonging to a single family and resided in village no. 3 as the affected village of Thai Mueang subdistrict, Thai Mueang district, Phang Nga province. Between 5 and 25 July 2016, the outbreak investigations [17] were conducted by the Provincial Surveillance Rapid Response Team (SRRT) of the PPHO, in collaboration with the SRRT of Thai Mueang District Public Health Office (TDHO) and the Vector Borne Disease Control Center (VBDC) 11.1 Phang Nga.

Methods

Case finding

Casefinding of suspected Copra Itch was carried out by the narrative review of the past and current situations in Thailand along the literature review. Both passive and active case findings were then used in the study.

Passive case finding

We employed data from hospital-based notifiable disease surveillance system (NDSS) authorized by the Ministry of Public Health, Thailand. Since reported cases were from Thai Mueang district, Phang Nga province and some of them accessed to Phang Nga hospital, all medical records of the notifiable diseases regarding skin irritations or pruritic dermatitoses maintained by the Thai Mueang Chaipat and Phang Nga hospitals were retrieved from the NDSS using an ICD-10–based classification system. Those records included typhus fever due to *Rickettsia tsutsugamushi* (A75.3), copra Itch (B88.0), infections of

* Corresponding author at: Ministry of Public Health, Phang Nga Provincial Public Health Office, Phang Nga Province, 82000, Thailand.
E-mail addresses: p.sarathep@gmail.com (P. Sarathep), kaow55@hotmail.com (W. Phonkaew).

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the skin and subcutaneous tissue (L00 – L08), dermatitis and eczema (L20 – L30), urticaria (L50), rash and other nonspecific skin eruption (R21), and insect bite (W57).

Theoretically, the occurrence of copra Itch relies on human-mite interaction and natural disease of copra Itch. Due to the lack of information of life cycle of mite that causes copra Itch, we utilized the information of life cycle of house dust mites. We hypothesized the longest period of human exposure to dust mite biting from one generation of mites' life cycle, which can take about 3.5 months, i.e., 14 days from egg to adult plus 3 months of life span of adult female [18]. To yield reliable results of case finding, two generations were applied to review all notified cases that met the classifications of those mentioned notifiable diseases over a period of past 7 months (from 1 January to 25 July 2016).

Active case finding

We explored the existence of any patients experiencing skin irritations or pruritic dermatoses that resided in households of the affected village. All experienced patients were asked whether or not they resided in the affected village of Thai Mueang subdistrict, Thai Mueang district, Phang Nga province. Three categories of copra itch were defined as follows:

Suspected case was classified as any patient who experienced pruritic dermatitis accompanied by the inflammation of skin and was exposed to mite bites through contact with coconut fibers or coir mattresses between 1 January and 25 July 2016.

Probable case was classified as any suspected case that was epidemiologically linked with the source of mite infestations and the susceptibility and exposure to mite bites.

Confirmed case was classified as any probable case whose skin was infested with biting mite of *Tyrophagus longior* according to microscopic examination.

Subsequently, all suspected cases that gave informed consents were interviewed using questions regarding demographics, clinical presentations, history of exposure, and daily activities. The information was collected by face-to-face interviewing by the epidemiologist as member of the SRRT.

Finally, all these cases were both physically examined for the skin lesions by dermatologist and microscopically examined for the presence of biting mite on skin by entomologist. Only one confirmed case and two probable cases with severe clinical manifestations were treated by dermatologist with antimicrobial and supportive drugs including doxycycline 100 mg × 2 tablets 5 days, gamma benzene hexachloride (0.1%), hydroxyzine 10 mg, cetirizine 10 mg, 3% vioform in 0.02% triamcinilone acetonide cream 5 g, tar shampoo. All three cases with treatment and three cases without treatment were followed up 2 weeks and all recovered.

Household environmental and entomological surveys

Household environmental and entomological surveys were done at the houses of all probable and confirmed cases to investigate the source of mite infestation. Environmental checklist and entomological survey form were designed and used by the entomologist as member of the SRRT. Also, neighboring houses within a radius of 20 m distant from the house of any probable or confirmed case were surveyed.

House dust samples which included the dust, particles, and fibers were also collected from possible dust mite habitats inside the house of any probable or confirmed case such as coir mattresses, furnitures, and floors in bedrooms, bathroom, kitchen, and living room by using electric dust collector with mite trap according to the methods described elsewhere [19,20]. All dust samples were microscopically analyzed to determine the number of dust mites and other domestic mites and to identify the species by the entomological expert at the VBDC 11.1 Phang Nga.

After environmental and entomological surveys and dust sample collection, space spraying by using deltamethrin as effective insecticide was used to control vectors indoors and outdoors.

Laboratory investigation

The individual venous blood specimens of all suspected cases were collected and examined to analyze complete blood count, and to diagnose the rickettsial infections, both scrub typhus (*Orientia tsutsugamushi*) and murine typhus (*Rickettsia typhi*) [21]. Polymerase chain reaction (PCR) specific for 16S rRNA gene of bacteria was done at the Neuroscience Centre for Research and Development, Chulalongkorn University, Bangkok, Thailand. Immuno-fluorescent assay (IFA) specific for antibodies against *Orientia tsutsugamushi* and *Rickettsia typhi* was done at the Medical Science Research Institute, Department of Medical Science, Ministry of Public Health, Nonthaburi, Thailand.

Results

Case finding and investigation

A total of 276 dermatitis cases from the hospital-based NDSS was found by passive case finding survey. They included 119 cases living in Thai Mueang subdistict and 157 cases living outside Thai Mueang subdistict. Of the 119 patients in Thai Mueang subdistict, there were only 19 indigenous cases inhabiting in the affected village, whereas the rest residing outside. Of these 276 dermatitis cases, none met the criteria of suspected case so they were excluded from further case investigations.

For active case finding survey, a total of 6 cases met the criteria of suspected case definition, and they were clustered within a single family. Further case investigations were carried out to proof the epidemiological linkages between the source of mite infestations and the susceptibility and exposure to mite bites.

All these 6 suspected cases reported the onset of signs and symptoms that were likely to be exposed to mite bites, and subsequently, they developed primary skin lesions between 25 June and 4 July 2016 (Table 1). Results of clinical examinations of all 6 suspected cases showed that 6 cases (100%) developed erythematous papules and intense pruritus, 3 cases (50%) developed myalgia and feverish, and one case (16.7%) developed difficult breathing and fatigue (Table 2). The locations and frequencies of multiple discrete erythematous papules of 6 suspected cases were shown in Fig. 1A and typical skin lesions of erythematous papules in case nos 1 and 3 were shown in Fig. 1B. Of the 6 suspected cases that were physically examined for mite infestation on skin, only one case was found to be infested with the *Tyrophagus longior* mite. This mite was recovered from the erythematous papule of case no. 1 (Fig. 2).

Household environmental and entomological surveys

Household environmental survey demonstrated that all 6 suspected cases were epidemiologically linked with the source of mite infestations in domestic environments of the house where human exposures to bites of *T. longior* mites possibly occurred. Their house was single-floor concrete semi-detached and had two houses sharing the wall. Meanwhile, there was no existence of the source of the infestation of *T. longior* mites present in neighboring houses within a radius of 20 m of the infested house (Fig. 3). Entomological survey agreed with findings of environmental survey in that mites infested in domestic environments. Only dust sample collected from the unused coir or coconut mattresses close to shallow well was found to contain *T. longior* adult mites (Table 3). The dust samples collected from coir mattresses in bedroom nos 1 and 2 were found to have bedbugs (*Cimex* sp.) and dust mites (*Dermatophagoides* sp.), whereas this sample was not found in kitchen room.

Table 1
Recognition of the onset of signs and symptoms by 6 suspected cases.

Case	Demographics	Recognition of the onset of signs and symptoms			Contact site and source of exposure
		Day of the exposure	Day of the onset	Signs and Symptoms	
Case 1	31-year-old female housewife as index case	22 Jun 2016	25 Jun 2016	Multiple erythematous papules, accompanied by intense pruritus, myalgia, feverish, fatigue, and difficult breathing	Head and some parts of body exposed to unused rat nests, coconut fibers, dusts during cleaning the ceiling of bathroom located within bedroom
Case 2	32-year-old male farmer as index case	22 Jun 2016	30 Jun 2016	Same as case no. 1 (female index case) except for difficult breathing	Same as above
Case 3	28-year-old male worker as a husband	Unknown	2 Jul 2016	Same as female index case except for myalgia, and difficult breathing	Unknown
Case 4	14-year-old schoolgirl as a daughter	Unknown	3 Jul 2016	Same as female index case except for myalgia, feverish, and difficult breathing	Unknown
Case 5	23-year-old male house construction as a son-in-law	Unknown	3 Jul 2016	Same as female index case except for myalgia, feverish, and difficult breathing	Unknown
Case 6	11-year-old schoolboy as a son	Unknown	4 Jul 2016	Same as female index case except for feverish and difficult breathing	Unknown

Cases 1 and 2 recognized as index cases.

Table 2
Frequencies of clinical manifestations ranked by order.

Sign and symptom	N	%
Erythematous papule	6	100
Intense pruritus	6	100
Myalgia	3	50.0
Feverish	3	50.0
Difficult breathing/feeling suffocated	1	16.7
Fatigue	1	16.7

Laboratory investigation

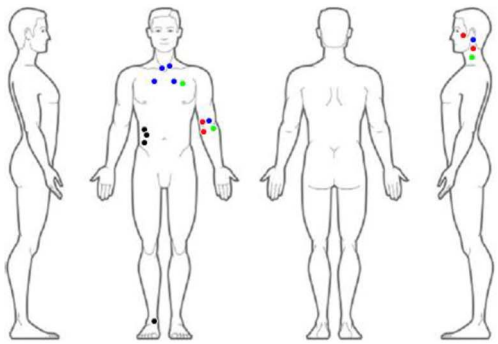
Hematologic examination results of 5 suspected cases (one lost to follow-up) showed some certain types of diseases associated with the abnormality of blood cells (Table 4). Both case nos 3 and 5 seemed to have leukocytosis (an increase in the number of leukocytes in blood). Both case nos. 1 and 5 were noted to have anemia (deficiency in hemoglobin). Case no. 4 was noted to have thrombocytopenia (decrease in the number of blood platelets). For diagnosis of rickettsial infections and other bacterial infections, none were positive with the *Rickettsia* locus-specific PCR or the 16S rRNA-based PCR.

Discussion

This outbreak investigation of first-ever 6 suspected cases with copra itch in Thailand revealed that all cases clustered within a single family and had primary skin lesions associated with bites of *T. longior* mites. Five suspected cases became probable cases because they were epidemiologically linked with the source of mite infestations and the susceptibility and exposure to mite bites. Only one was confirmed case because her skin was infested with biting mite of *T. longior* according to microscopic examination. These findings emphasized the clinical and epidemiological implications and imperative SRRTs for effective diagnosis and surveillance for copra itch as rare medical problem.

Upon clinical examination, human infestation with *T. longior* mites present in these susceptible family members caused itchy skin lesions of multiple erythematous papules and clinically marked pruritic dermatitis. Both male and female patients had these primary skin lesions on the body rather than on the extremities. Case no 1 who had multiple erythematous papules accompanied by intensely pruritic dermatitis (Fig. 1A and B) was more likely to be highly susceptible to bites of *T. longior* mites than other susceptible cases including another index case (case no 2). Similar to other susceptible cases, such clinical presentations in this index case might not be associated with eosinophilia in copra Itch [14–16]. With regard to bites of *T. longior* mites, multiple discrete erythematous papules were noted to be typical reactions of skin inflammations occurring within a week.

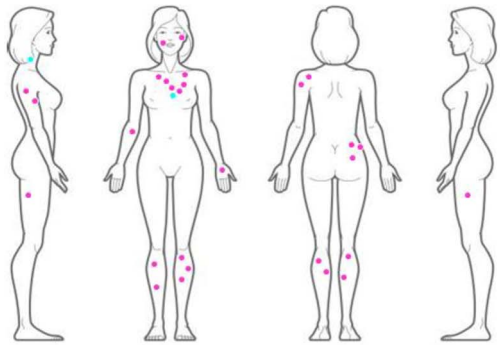
By contrast, reactions of skin inflammations caused by *Cimex* bed bugs [22] are often more acute maculopapular rash in susceptible patients, and in some cases, subacute and chronic reactions develop several weeks after numerous bites. Erythematous papules appeared after the red and itchy skin. The distribution of erythematous papules was more likely to be localized or concentrated on a certain area of the body and extremity than being generalized. The presence of inflammation was more likely to be acute than subacute or chronic in those susceptible cases. The acute reactions may be the possible sensitization due likely to the salivary proteins as that of *Cimex* bed bugs [22]. However, the infestation of *Cimex* bed bugs was also found in coir mattresses. We could not rule out the possibility that the skin dermatitis present in some patients (especially in case nos 3 and 4) may be caused by the infestation with blood-sucking *Cimex* that fed on these patients' skins. It was likely that *T. longior* mites that infested on the patients' skins commonly caused multiple pruritic erythematous papules through their numerous bites. More likely, it may burrow on human skins because it was found on an erythematous papule present in case no 1 (Fig. 2).



A

Locations and frequencies of erythematous papules of 4 male cases

Location	Frequencies of erythematous papules			
	Case 2	Case 3	Case 5	Case 6
Body	0	2	3	1
Neck	1	2	0	1
Face	1	1	0	0
Arms	2	1	0	1
Angles	0	0	1	0



Locations and frequencies of erythematous papules of 2 female cases

Location	Frequencies of erythematous papules	
	Case 1	Case 4
Body	9	1
Neck	0	1
Face	2	0
Arms	4	0
Hands	1	0
Legs	10	0

B

Erythematous papules on the chest (red arrows) of case no 1

Erythematous papule with central punctum at neck (red arrow) of case no 3

Fig. 1. Erythematous papules in 6 Copra Itch cases. A) Locations and frequencies of multiple discrete erythematous papules present in 4 male cases and 2 female cases. B) Typical skin lesions of erythematous papules in case nos 1 and 3.

The infestation with *T. longior* mites in domestic environments is important for the public health implications. Clearly, the findings of individual case investigations of copra itch outbreak were associated with skin dermatitis, whereas it was unlikely to be associated with common source of outbreak. Poor domestic environments rendered family members to become more susceptible to expose indoors biting of *T. longior* mites. The spread of *T. longior* mites is limited to particular environment because neighboring houses within a radius of 20 m of the infested house were not infested with *T. longior* mites.

Before the outbreak of copra itch occurred, there were other tenants who stayed at the house of 6 suspected cases between September and December 2015. They occupied this house to produce a large number of peeled coconuts for selling. During the stay, numerous coconut shells were abandoned around the house. Meanwhile reviews of medical records did not match any cases with those notifable diseases. Between January and March 2016, the house was abandoned until two index cases (case nos 1 and 2) and other family members moved into in April 2016. All family members shared rooms, spaces, and facilities as shown in Fig. 3. This might be a reason why copra itch outbreak was relatively associated with skin dermatitis since confirmed case was infested with *T. longior* mites. Evidently, both confirmed and probable cases (case nos 1 and 2) with skin dermatitis caused by mite biting were due to direct contact with dust, coconut fibers, and rat nest. However, there was no evidence that other cases (case nos 3–6) with skin dermatitis had a

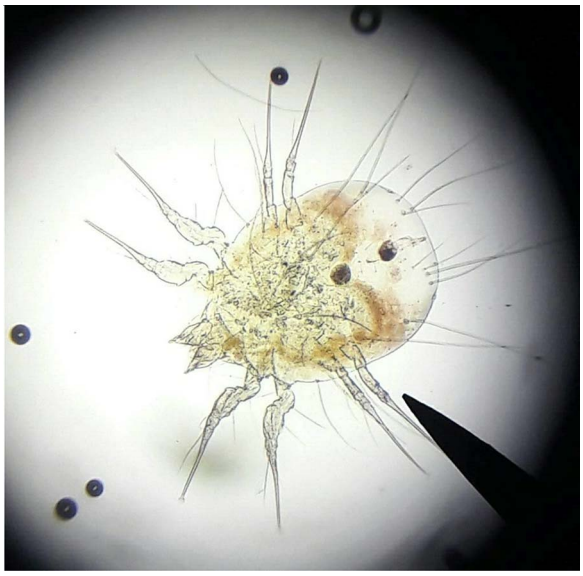


Fig. 2. The adult female of *Tyrophagus longior* mite recovered from the erythematous papule of case no. 1.

direct contact with mites.

Conclusion

The first outbreak investigation of copra itch disclosed a cluster of six suspected cases with skin dermatitis belonging to a single family, between June and July 2016 in Phang Nga province, Southern Thailand. This outbreak investigation concluded that five probable cases developed multiple discrete erythematous papules with intense pruritus on the body rather than the extremities and one confirmed case whose skin was infested with *T. longior* mite. Their skin dermatitis was related neither to rickettsial infections and other bacterial infections nor to eosinophilia. This mite was adapted well to the domestic environments with poor hygienic conditions because it was also found in unused coir mattresses outside their bedrooms. Household infestation with *T. longior* mites was the source that these family members were exposed to indoors biting of *T. longior* adult mites. Human exposure to mite bites was more likely to be direct contact than indirect contact. Thus, this study provided the proof that *T. longior* mites cause a medical problem to humans and it is required for further study.

Table 3
Entomological survey for dust mites and other domestic mites in dust samples.[a]

Site	Infestation of dust mites and other domestic mites
Living room	Not found
Bedroom 1	
Floor	Not found
Coir mattress	Adults of bedbugs and dust mites were found
Bedroom 2	
Floor	Not found
Coir mattress	Adults of bedbugs and dust mites were found
Bathroom	Not found
Shallow well	
Unused coir mattresses	Dust mites and storage mites (*T. longior*) were found
Kitchen room	
Floor	Not found
Coir mattress	Not found

[a] Each sample per site (totally 9 samples) collected from the 6 suspected cases' house in the village no 3 of Thai Mueang subdistrict, Thai Mueang district, Phang Nga province.

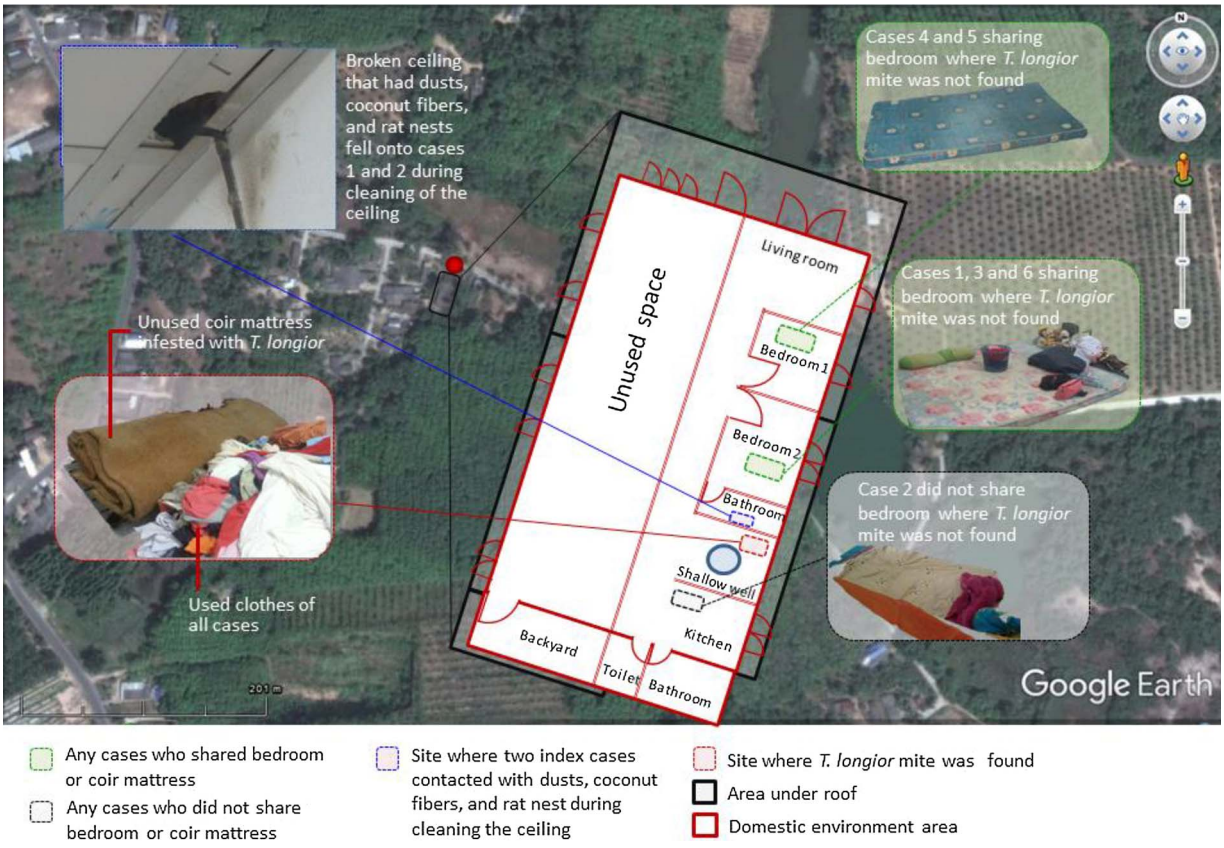


Fig. 3. Compartments and environment of the *T. longior* mite-infested house where georeferenced on the Google Earth map. Some compartments and daily life of 6 suspected cases evidently rendered two index cases (nos 1 and 2) to expose dusts, coconut fibers and rat nests located in bathroom as the source of mite infestations.

Table 4
Hematologic examinations among 5 suspected cases.

Blood counts	Normal blood values	Female		Male		
		Case 1[a]	Case 4	Case 2[a]	Case 3	Case 5
Hematocrit (%)	37.7–53.7	35.3	43.0	46.0	46.7	35.0
Hemoglobin (gm%)	12.2–18.1	11.5	14.3	16.4	16.5	11.0
Erythrocytes (RBC) (x 10^6 cells per mm^3)	4.0 – 6.1	5.6	4.7	6.1	6.6	5.2
Leukocytes (total WBC) (x 10^3 cells per mm^3)	4.6–10.2 (100%)	5.7	5.7	7.6	10.7	10.2
Lymphocytes	10–50%	30	30	30	41[b]	45
Neutrophils	37–80%	64	65	63	52	51
Eosinophils	0–7%	6	4	5	4	3
Basophils	0–3%	0	0	0	0	0
Monocytes	0–12%	0	1	2	3	1
Platelets (x 10^3 cells per mm^3)	200–500	346	201	300	315	362

Mean or range (or in parentheses) of normal blood values are shown.
[a] Patients who were index cases.
[b] Only the case whose atypical lymphocytes (of 1%) were counted.

Conflict of interest statement

The authors declared that there was no conflict of interest in this study.

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