

SFG rickettsiae and *R. typhi* have been observed, but a lack of cross-reactions has also been observed (9). It has been noted (10) that when cross-reactions were observed between *R. felis* and both *R. conorii* and *R. typhi*, the infection was probably related to *R. felis*. When cross-reactions were observed between *R. felis* and only *R. typhi*, the causative agent was most probably of the typhus group.

R. felis infections occur globally and are linked to the worldwide distribution of vectors, but the occurrence is relatively rare when compared with the high frequency of *R. felis* infections related to flea infestation. Human infections remain poorly characterized and are apparently underappreciated, possibly because of the lack of specific signs and symptoms. Further characterization of the interactions between *R. felis* and fleas could elucidate the particular epidemiology and pathology of flea-borne spotted fever.

This work was supported by the French Centre National de la Recherche Scientifique.

**Aurélie Renvoisé,
Antoine-Yves Joliot,
and Didier Raoult**

Author affiliations: Université de la Méditerranée, Marseille, France (A. Renvoisé, D. Raoult); and Centre Hospitalier de Salon de Provence, Salon-de-Provence, France (A.-Y. Joliot)

DOI: 10.3201/eid1507.090029

References

1. Rolain JM, Gouriet F, Brouqui P, Larrey D, Janbon F, Vene S, et al. Concomitant or consecutive infection with *Coxiella burnetii* and tickborne diseases. *Clin Infect Dis*. 2005;40:82–8. DOI: 10.1086/426440
2. La Scola B, Raoult D. Laboratory diagnosis of rickettsioses: current approaches to diagnosis of old and new rickettsial diseases. *J Clin Microbiol*. 1997;35:2715–27.
3. Schriefer ME, Sacci JB Jr, Dumler JS, Bullen MG, Azad AF. Identification of a novel rickettsial infection in a patient diagnosed with murine typhus. *J Clin Microbiol*. 1994;32:949–54.
4. La Scola B, Meconi S, Fenollar F, Rolain JM, Roux V, Raoult D. Emended description of *Rickettsia felis* (Bouyer et al. 2001), a temperature-dependent cultured bacterium. *Int J Syst Evol Microbiol*. 2002;52:2035–41. DOI: 10.1099/ijs.0.02070-0
5. Mehrej V, El Karkouri K, Raoult D. Whole genome-based phylogenetic analysis of rickettsiae. *Clin Microbiol Infect*. 2009. In press.
6. Pérez-Osorio CE, Zavala-Velázquez JE, Arias León JJ, Zavala-Castro JE. *Rickettsia felis* as emergent global threat for humans. *Emerg Infect Dis*. 2008;14:1019–23. DOI: 10.3201/eid1407.071656
7. Reif KE, Stout RW, Henry GC, Foil LD, Macaluso KR. Prevalence and infection load dynamics of *Rickettsia felis* in actively feeding cat fleas. *PLoS One*. 2008;3:e2805. DOI: 10.1371/journal.pone.0002805
8. Henry KM, Jiang J, Rozmajzl PJ, Azad AF, Macaluso KR, Richards AL. Development of quantitative real-time PCR assays to detect *Rickettsia typhi* and *Rickettsia felis*, the causative agents of murine typhus and flea-borne spotted fever. *Mol Cell Probes*. 2007;21:17–23. DOI: 10.1016/j.mcp.2006.06.002
9. Pérez-Arellano JL, Fenollar F, Angel-Moreno A, Bolaños M, Hernández M, Santana E, et al. Human *Rickettsia felis* infection, Canary Islands, Spain. *Emerg Infect Dis*. 2005;11:1961–4.
10. Znazen A, Rolain JM, Hammami A, Jemaa MB, Raoult D. *Rickettsia felis* infection, Tunisia. *Emerg Infect Dis*. 2006;12:138–40.

Address for correspondence: Didier Raoult, Unité des Rickettsies, CNRS-IRD UMR 6236-198, Université de la Méditerranée, Faculté de Médecine, 27 blvd Jean Moulin, 13385 Marseille CEDEX 5, France; email: didier.raoult@gmail.com

Rapid Increase of Scrub Typhus, South Korea, 2001–2006

To the Editor: Scrub typhus, or tsutsugamushi disease, is a febrile illness caused by the rickettsial bacteria *Orientia tsutsugamushi*. Scrub typhus is endemic to a geographically distinct region, the so-called tsutsugamushi triangle, which includes Japan, Taiwan, China, and South Korea (1,2). Scrub typhus is a public health issue in Asia, where 1 billion persons may be at risk for the disease (3). In South Korea, scrub typhus is the most common rickettsial disease, and public health authorities are concerned about its increased incidence.

Scrub typhus has been a reportable disease in South Korea since 1994. Physicians who diagnose suspected or confirmed cases must report these cases to their local health bureau and the Korea Centers for Disease Control and Prevention (KCDC) through the National Notifiable Disease Surveillance System (NNDSS). For a patient's illness to meet the case definition for scrub typhus, the clinical signs (acute febrile illness and skin eschar) must be present or there must be laboratory confirmation (4-fold rise in antibody titer, antigen detected in blood, or genetic material detected by PCR).

We analyzed NNDSS data confirmed by KCDC and classified all reported cases into 2 groups according to residential area. Cases with rural administrative address codes “eup” or “myun” were defined as rural cases, whereas cases with a city administrative address code of “dong” were defined as urban cases. All case-patients were classified by occupation as farmer or nonfarmer; all agricultural, fishery, and forest workers from rural areas were defined as farmers.

In total, 23,929 cases, including 16,199 (67.7%) serologically con-



firmed cases, were reported between 2001 and 2006, of which 35.5% were male patients and 64.5% female patients. The greatest number of cases was in the age group 50–69 years, in both male (47.2%) and females (51.7%) patients; however, there were 167 boys (2.0%) and 119 girls (0.8%) <10 years of age. The number of cases peaked in 2005, with 2,331 and 4,449 cases in male and female patients, respectively. In 2006, a total of 6,480 cases (2,364 and 4,116 in males and females patients), which is 2.5× the number reported in 2001, were reported. The autumn epidemic period was from October through November; 96.2% of all cases were reported during this period (Figure). The proportion of cases identified in farmers decreased from 2001 (44.4%) to 2006 (36.4%); the number of cases in nonfarmers reached 4,121 (63.6%) in 2006. The number and proportion of patients living in urban areas increased from 1,059 (40.2%) in 2001 to 3,230 (49.9%) in 2006. This trend was observed in both farmers and nonfarmers. The number of cases among farmers living in urban areas increased from 150 (12.8%) to 443 (18.8%), while the corresponding number of cases in nonfarmers went from 909 (62.0%) to 2,787 (67.6%). In addition, we identified different features of scrub typhus epidemicity, compared with those reported in previous studies (4–7). Many of the values reported in this study (64.5% of cases in female patients, 59.5% in nonfarmers, and 96.2% occurring in autumn) are higher than the values reported previously in Japan (4), Taiwan (5), and China (6). The higher incidence in female workers may be associated with conventional South Korean working behavior. Female workers typically work in a squatting position, with bare hands, and usually in dry fields, whereas male workers tend to work in a standing position, with tools, and in rice fields. Therefore, female workers are more likely to be exposed to infected mites.

Previously, farmers were considered a high-risk group, but our results imply that the same or even more attention should be given to nonfarmers. *Leptotrombidium pallidum*, a common mite in Korea, first appears in September. Its population then peaks in October and November and to a lesser degree in April and May (7). In autumn, especially around Chusok (Korean Thanksgiving), nonfarmers and urban residents also take part in agricultural activities, such as the chestnut harvest, mowing around graves, and assisting their farmer relatives. A sharp peak in the number of cases occurred during October–November, which is inconsistent with a previous report on vector density showing a secondary peak during April–May (7). This finding suggests that many cases are misreported, especially in spring. Unfortunately, there are still no reports on the comprehensiveness of the scrub typhus surveillance system in South Korea. We cannot exclude other modes of exposure such as golf, climbing, and other outdoor leisure activities. A 5-day work week was introduced in 2004, and, as a result, more leisure time has been available to urban residents. In addition, improved surveillance and diagnostic methods as well

as changes in atmospheric temperature (8) may have contributed to the increase.

We report the rapid increase of scrub typhus and the proportion of infected persons living in urban areas in South Korea. This information will be used to establish strategies for prevention, surveillance, and management in South Korea and in other countries where scrub typhus is endemic.

Sun-Seog Kweon, Jin-Su Choi, Hyun-Sul Lim, Jang-Rak Kim, Keon-Yeop Kim, So-Yeon Ryu, Hyo-Soon Yoo, and Ok Park

Author affiliations: Chonnam National University Hwasun Hospital, Hwasun, South Korea (S.-S. Kweon); Chonnam National University College of Medicine, Gwangju, South Korea (J.-S. Choi); Dongguk University College of Medicine, Gyeongju, South Korea (H.-S. Lim); Gyeongsang National University School of Medicine, Jinju, South Korea (J.-R. Kim); Kyungpook National University School of Medicine, Daegu, South Korea (K.-Y. Kim); Chosun University College of Medicine, Gwangju (S.-Y. Ryu); and Korea Centers for Disease Control and Prevention, Seoul, South Korea (H.-S. Yoo, O. Park)

DOI: 10.3201/eid1507.080399

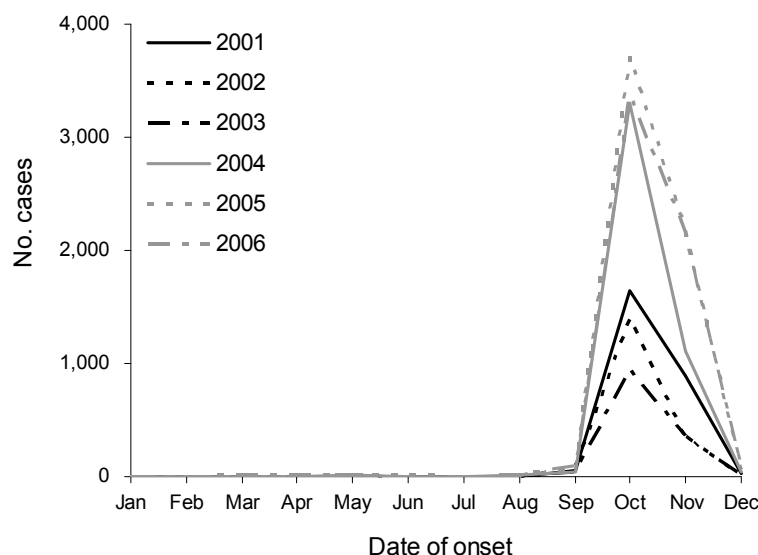


Figure. Monthly occurrence of scrub typhus cases in South Korea, 2001–2006. A color version of this figure is available online (www.cdc.gov/EID/content/15/7/1127-F.htm).

References

1. Chang WH. Current status of tsutsugamushi disease in Korea. *J Korean Med Sci.* 1995;10:227–38.
2. Cook GC, Warrell DA, Bryceson AD. Royal Society of Tropical Medicine and Hygiene meeting at Manson House, London, 17 October 1996. Debate: tropical medicine as a formal discipline is dead and should be buried. *Trans R Soc Trop Med Hyg.* 1997;91:372–4, discussion 374–5. DOI: 10.1016/S0035-9203(97)90244-3
3. Watt G, Parola P. Scrub typhus and tropical rickettsioses. *Curr Opin Infect Dis.* 2003;16:429–36. DOI:10.1097/00001432-200310000-00009
4. Ogawa M, Hagiwara T, Kishimoto T, Shiga S, Yoshida Y, Furuya Y, et al. Scrub typhus in Japan: epidemiology and clinical features of cases reported in 1998. *Am J Trop Med Hyg.* 2002;67:162–5.
5. Lee YS, Wang PH, Tseng SJ, Ko CF, Teng HJ. Epidemiology of scrub typhus in eastern Taiwan, 2000–2004. *Jpn J Infect Dis.* 2006;59:235–8.
6. Cao M, Guo H, Tang T, Wang C, Li X, Pan X, et al. Spring scrub typhus, People's Republic of China. *Emerg Infect Dis.* 2006;12:1463–5.
7. Seong SY, Choi MS, Kim IS. *Orientia tsutsugamushi* infection: overview and immune responses. *Microbes Infect.* 2001;3:11–21. DOI: 10.1016/S1286-4579(00)01352-6
8. Okada N. Tsutsugamushi disease found in the northern districts of Awaji Island—epidemiological study of the outbreak season temperature [in Japanese]. *Kansenshogaku Zasshi.* 2003;77:60–7.

Address for correspondence: Jin-Su Choi, Department of Preventive Medicine, Chonnam National University College of Medicine, 5 Hakhong, Donggu, Gwangju, South Korea; email: jschoix@chonnam.ac.kr

Letters

Letters commenting on recent articles as well as letters reporting cases, outbreaks, or original research are welcome. Letters commenting on articles should contain no more than 300 words and 5 references; they are more likely to be published if submitted within 4 weeks of the original article's publication. Letters reporting cases, outbreaks, or original research should contain no more than 800 words and 10 references. They may have 1 Figure or Table and should not be divided into sections. All letters should contain material not previously published and include a word count.

Fatal Algaemia in Patient with Chronic Lymphocytic Leukemia

To the Editor: *Prototheca* species are achlorophyllous lower algae, ubiquitous in nature, which can cause human infections, particularly in immunocompromised patients (1). Human protothecosis is mostly caused by *P. wickerhamii* and *P. zopfii*. Although such infections are infrequent, they can manifest themselves clinically as cutaneous lesions, olecranon bursitis, and, even more rarely, as disseminated or systemic infections (1). These infections occur in severely immunocompromised patients, such as persons with AIDS, or patients undergoing extensive treatment, such as cancer treatment or organ transplantation (1–4). We describe a fatal case of *P. wickerhamii* algaemia in a patient with chronic lymphocytic leukemia.

In July 2007, a 79-year-old man, who had been monitored since 1993 for stage C chronic lymphocytic leukemia (5), was hospitalized July 13–20 for a depressive syndrome with fever, asthenia, and weight loss (3 kg over 2 months). Blood and urinary cultures on admission were sterile. The patient was hospitalized again on July 30 for fever (39°C), anorexia, and diarrhea, with ≈7 stools per day. He had lost 10 kg in 2 weeks. Blood cultures for bacteria (in BD Bactec Plus Aerobic/F and BD Bactec Lytic Anaerobic/F vials; Becton Dickinson, Le Pont de Claix, France) and fungi (BD Bactec Mycosis IC/F; Becton Dickinson) and stool cultures for bacteria were negative. Blood cultures were incubated in a Bactec 9240 instrument (Becton Dickinson). *Aspergillus fumigatus* was found in a bronchoalveolar lavage specimen, but no *Aspergillus* galactomannan antigen was detected in blood.

The patient was treated with piperacillin-tazobactam, ciprofloxacin, acyclovir, voriconazole, and lop-

eramide. Voriconazole (400 mg/day) was used from day 17 to day 27. On day 21, *Cryptosporidium parvum* was detected on parasitologic stool examination. Symptoms persisted on day 26, with strong asthenia and deterioration of general state. At that time, the leukocyte count was $178 \times 10^9/L$ with $3.56 \times 10^9/L$ polymorphonuclear neutrophils and $172 \times 10^9/L$ lymphocytes. Three peripheral blood samples were cultured for detection of bacteria and fungi. On day 27, septic shock developed in the patient. A blood culture showed an *Escherichia coli* strain susceptible to piperacillin-tazobactam, aminoglycosides, and quinolones. Amikacin was added to the treatment regimen. Nonetheless, the patient died on day 28.

Two blood cultures for bacteria in aerobic vials grew the day of the patient's death, but tests of blood cultures for fungus remained negative. After Gram staining, gram-positive spherical unicellular organisms were observed (Figure). After 48 hours of incubation, creamy, yeast-like colonies grew on chocolate agar (bioMérieux, Marcy l'Etoile, France), but not on Sabouraud agar containing gentamicin and chloramphenicol (Becton Dickinson). Microscopy and the API 20C AUX system (bioMérieux) identified *P. wickerhamii*.

Sequencing the 18S rDNA with the primers Pw18SF 5'-TCAAAA GTCCCGGCTAATCTCGTGC-3' and Pw18SR 5'-CGCTTTCGTGCCT CAATGTCAGTGTT-3' confirmed the identification. The sequence of the amplified product was compared with sequences published in the database of the National Center for Biotechnology Information (Bethesda, MD, USA). The most likely identification, according to BLAST analysis (www.ncbi.nlm.nih.gov/blast/Blast.cgi), was *P. wickerhamii*.

In vitro susceptibility tests were performed by the Etest method (AB Biodisk, Solna, Sweden), on RPMI agar. *P. wickerhamii* was found to be