



BRIEF REPORT

Epidemiological Characteristics of Scrub Typhus in Korea, 2009

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Abstract Objectives

Currently, the incidence of scrub typhus has increased in urban areas. In this study, we described the epidemiological characteristics of scrub typhus cases reported in the urban areas of Korea in 2009.

Methods

We analysed the case investigation reports of scrub typhus cases that were collected in Korea in 2009. Specially, the different risk factors such as fieldwork and outdoor activity were compared to urban and rural areas, and six urban cities. Statistical analysis was performed using χ^2 test.

Results

A total of 4,461 cases (including 1,663 suspected cases) were analysed in this study. Among these, the case reports of 4,254 cases had complete addresses. The cases with outdoor activities were 720 (85.2%) in urban areas. In Daegu and Daejeon, the number of cases participated in outdoor activities was 32 (34.4%) and 23 (31.5%), respectively. In other urban areas, cases with outdoor activities were more than 85%.

Conclusion

The most common infection risk factor was outdoor activity in urban areas. However, the proportion and distribution of outdoor activities were different in urban areas. These results will be used to establish strategies for effective prevention and management in urban areas.

1. Introduction

Scrub typhus (tsutsugamushi disease) is a febrile illness caused by rickettsial bacteria such as *Orientia tsutsugamushi*.¹ Scrub typhus is categorized in Group III of the notifiable communicable diseases. In Korea, scrub

typhus is the most common rickettsial disease, with more than 6,000 cases reported annually since 2005 and 4,995 cases reported in 2009.

According to the National Notifiable Disease Surveillance System, the proportion of cases identified in farmers decreased from 43.3% in 2001 to 25.0% in 2009.

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According to National Notifiable Disease Surveillance System, the scrub typhus cases in urban areas increased from 388 (20.0%) in 2002 to 1,345 (26.9%) in 2009. However, most of these studies have been performed in rural areas that are endemic for scrub typhus, and little attention has been paid to cases in urban areas. This study aimed to describe the epidemiological characteristics of scrub typhus cases in urban areas.

2. Materials and Methods

Investigation of a scrub typhus case (including suspected cases) was legally conducted by the public health care center officials. The investigation results were reported to the Korea Center for Disease Control and Prevention (KCDC) through web system. The case investigation report included demographics, clinical factors, diagnosis, and infection risk factors within 1 month before the onset of scrub typhus.

We analysed the case investigation reports of scrub typhus cases that were collected in Korea in 2009. The cases were classified into two groups according to their area of residence. The urban areas in this investigation included Seoul, Busan, Daegu, Incheon, Gwangju, Daejeon, and Ulsan, whereas the rural areas included Gangwon, Gyeonggi, Chungbuk, Chungnam, Jeonbuk, Jeonnam, Gyeongbuk, Gyeongnam, and Jeju. A total of 4,461 case investigation reports (including 1,663 suspected cases) were collected in 2009. The number of

case reports with complete addresses was 4,254, which include 1,028 from urban areas and 3,226 from rural areas (Figure 1).

All the cases were classified by occupation as either farmers or non-farmers. "Farmers" were defined as farmers, forest workers, stock breeding workers, and landscaping workers. "Non-farmers" were defined as officers (students, office workers, and experts), housewives, unemployed, and outdoor workers (fisheries, mining industry employees, construction workers, etc.).

Infection risk factors included fieldwork and outdoor activities. "Fieldwork" was defined as continuous agricultural, forestry, or stock breeding work, as well as working in vegetable gardens. "Outdoor activity" was defined as the activities that non-farmers irregularly participate in, which may be related to agriculture (such as assisting farmer relatives) or leisure (such as climbing, gathering chestnuts, mowing around graves, etc.).

In outdoor activities, the government-run public work projects provide temporary employment to people by public sector. This occupation involved mainly maintenance of hiking trails, deforestation, and cutting grass. In case where the occupation was not reported but the infection risk factor was, the occupation category classified by describing and frequency of infection risk factors.

In this study, we described the epidemiological characteristics of scrub typhus cases that occurred in 2009 according to gender and region. Scrub typhus cases from Ulsan were excluded from the analysis in urban

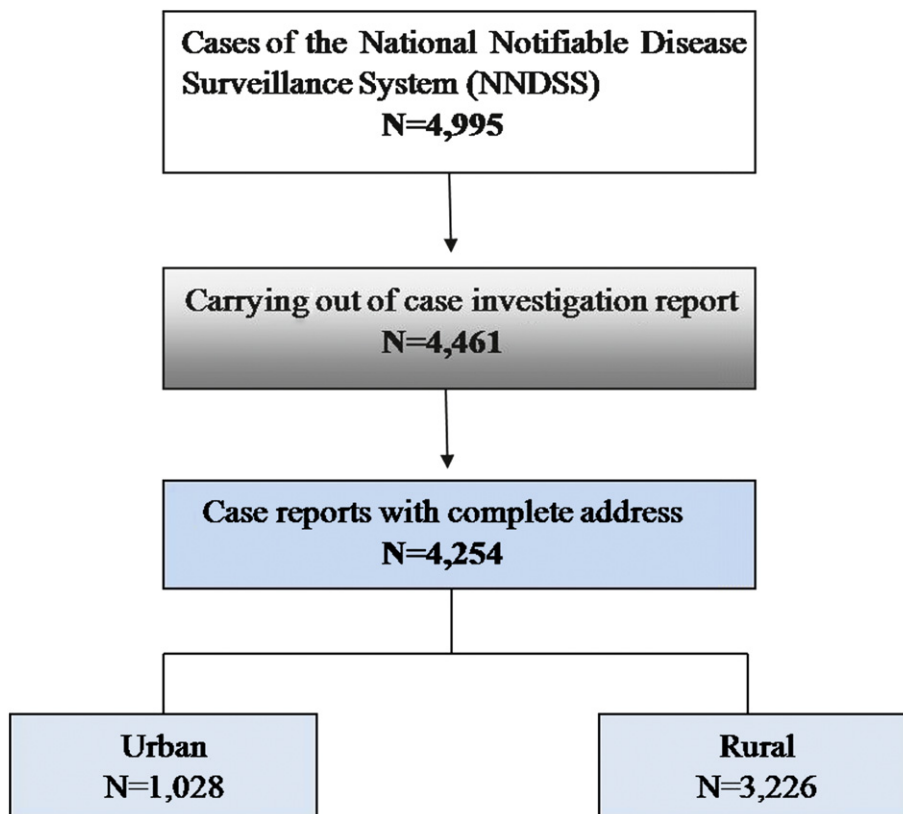


Figure 1 Study population flow chart.

Table 1 General characteristics of scrub typhus cases between January and December 2009 in Korea

Item	Male	Female	Total	<i>p</i> *	
Age (yr)					
<50	415 (24.8)	453 (16.3)	868 (19.5)	<0.001	
50–59	342 (20.4)	600 (21.6)	942 (21.1)		
60–69	431 (25.7)	741 (26.6)	1,172 (26.3)		
≥70	488 (29.1)	990 (35.6)	1,478 (33.1)		
Occupation					
Farmers	750 (50.4)	1,232 (47.0)	1,982 (47.8)	0.037	
Non-farmers	739 (49.6)	1,390 (53.0)	2,129 (52.2)		
Region					
Urban					
Seoul	49 (3.1)	58 (2.2)	107 (2.5)	0.486	
Busan	112 (7.0)	176 (6.6)	288 (6.8)		
Daegu	36 (2.3)	65 (2.4)	101 (2.4)		
Inchon	32 (2.0)	47 (1.8)	79 (1.9)		
Gwangju	41 (2.6)	52 (2.0)	93 (2.2)		
Daejeon	73 (4.6)	95 (3.6)	168 (3.9)		
Ulsan	68 (4.3)	124 (4.7)	192 (4.5)		
Sub-total	411 (25.7)	617 (23.2)	1,028 (24.2)		
Rural					
Gangwon	7 (0.4)	31 (1.2)	38 (0.9)		
Gyeonggi	155 (9.7)	186 (7.0)	341 (8.0)		
Chungbuk	50 (3.1)	120 (4.5)	170 (4.0)		
Chungnam	233 (13.9)	380 (14.3)	603 (14.2)		
Jeonbuk	233 (14.6)	417 (15.7)	650 (15.3)		
Jeonnam	209 (13.1)	429 (16.2)	638 (15.0)		
Gyeongbuk	114 (7.1)	199 (7.5)	313 (7.4)		
Gyeongnam	192 (12.0)	268 (10.1)	460 (10.8)		
Jeju	6 (0.4)	7 (0.3)	13 (0.3)		
Sub-total	1,189 (74.3)	2,037 (76.8)	3,226 (75.8)		
Month					
January–September	131 (7.8)	192 (6.9)	323 (7.3)	0.486	
October	907 (54.3)	1,482 (53.3)	2,389 (53.7)		
November	600 (35.9)	1,049 (37.7)	1,649 (37.0)		
December	33 (2.0)	58 (2.1)	91 (2.0)		
Infection risk factor					
Only fieldwork [†]	673 (46.3)	1,135 (46.8)	1,808 (46.6)	0.706	
Only outdoor activity [‡]	692 (47.7)	1,161 (47.9)	1,853 (47.8)		
Both fieldwork and outdoor activity	87 (6.0)	130 (5.4)	217 (5.6)		
Non-recognized infection risk factor					
Impossible to estimate	198 (88.4)	341 (95.0)	539 (92.5)	0.003	
Possible to estimate	26 (11.6)	18 (5.0)	44 (7.5)		
Major symptoms					
Fever	1,450 (86.5)	2,433 (87.4)	3,883 (87.0)	—	
Chill	1,052 (62.8)	1,739 (62.4)	2,791 (62.6)		
Eschar	1,254 (74.8)	2,167 (77.8)	3,421 (76.7)		

Data *n* (%).* χ^2 test; [†]Fieldwork was defined as continuous agricultural, forestry, or stock breeding work, as well as working in vegetable gardens; [‡]Outdoor activity was defined as the activities that non-farmers irregularly participate in, which may be related to agriculture (such as assisting farmer relatives) or leisure (such as climbing, tracking, gathering chestnuts, mowing around graves, etc.).

areas because 35% of these cases did not have infection risk factors.

The analyses were conducted using SAS statistical package version 9.1.3 (SAS Inc., Cary, NC, USA). Statistical analysis was performed using χ^2 test, and a p value < 0.05 was considered as significant.

3. Results

3.1. Epidemiological characteristics ($N = 4,461$)

A total of 4,461 cases (including 1,663 suspected cases) were analysed in this study. Among these, the case reports of 4,254 cases had complete addresses. Most of the cases were in the age range of 60–69 years in both males ($N = 277$; 26.9%) and females ($N = 856$; 26.5%).

The farmer's occupation was the most common occupation as 1,982 (47.8%) cases, in both male 750

(50.4%) and female 1,232 (47.0%) cases (Table 1). Between October and November, 4,129 (90.7%) cases were reported (Table 1).

A total of 2,060 (53.4%) cases participated in outdoor activities. The infection risk factor was not recognized in 583 (13.1%) cases. A total of 41 (7.0%) scrub typhus cases had workplaces or residences either located near a mountain/hill or infested with mice. Furthermore, three (0.5%) cases did not participate in any outdoor activities although a member of their family did. It was impossible to determine the infection risk factor in 539 (12.0%) cases. The median duration between symptom onset and diagnosis was 5 days (range, 0–117 days) (Table 1).

3.2. Epidemiological characteristics by region ($N = 4,254$)

The number of scrub typhus cases aged below 50 years was 265 (25.8%) and 564 (17.5%) in urban and rural

Table 2 Epidemiological characteristics of scrub typhus cases by region between January and December 2009 in Korea

Item	Urban*	Rural	Total	p^\dagger
Gender				
Male	411 (40.0)	1,189 (36.9)	1,600 (37.6)	0.072
Female	617 (60.0)	2,037 (63.1)	2,654 (62.4)	
Age (yr)				
<50	265 (25.8)	564 (17.5)	829 (19.5)	<0.001
50–59	259 (25.2)	620 (19.2)	879 (20.7)	
60–69	277 (26.9)	856 (26.5)	1,133 (26.6)	
≥70	227 (22.1)	1,185 (36.7)	1,412 (33.2)	
Occupation				
Farmers	149 (16.4)	1,752 (58.1)	1,901 (48.5)	<0.001
Non-farmers	757 (83.6)	1,261 (41.9)	2,018 (51.5)	
Month				
January–September	76 (7.4)	202 (6.3)	278 (6.5)	0.514
October	541 (52.7)	1,729 (53.7)	2,270 (53.4)	
November	385 (37.5)	1,227 (38.1)	1,612 (38.0)	
December	24 (2.3)	63 (2.0)	87 (2.0)	
Infection risk factor				
Only fieldwork [‡]	125 (14.8)	1,612 (56.6)	1,737 (47.0)	<0.001
Only outdoor activity [§]	696 (82.4)	1,051 (36.9)	1,747 (47.3)	
Both fieldwork and outdoor activity	24 (2.8)	184 (6.5)	208 (5.6)	
Outdoor activities				
Non-farmers irregularly participate in agricultural activities	241 (33.5)	484 (39.2)	725 (37.1)	<0.012
Climbing and tracking	135 (18.8)	199 (16.1)	334 (17.1)	0.135
Gathering chestnuts	100 (13.9)	186 (15.1)	286 (14.6)	0.479
Government-run public work projects	46 (6.4)	57 (4.6)	103 (5.3)	0.090
Mowing around graves	53 (7.4)	81 (6.6)	134 (6.9)	0.498
Others	188 (26.1)	298 (24.1)	486 (24.9)	0.328

Data n (%).

*Includes Seoul, Busan, Daegu, Incheon, Gwangju, Daejeon, and Ulsan; [†] χ^2 test; [‡]Fieldwork was defined as continuous agricultural, forestry, or stock breeding work, as well as working in vegetable gardens; [§]Outdoor activity was defined as the activities that non-farmers irregularly participate in, which may be related to agriculture (such as assisting farmer relatives) or leisure (such as climbing, tracking, gathering chestnuts, mowing around graves, etc.);

^{||}Government-run public work projects provide temporary employment to people by public sector.

areas, respectively. The number of farmer cases in urban and rural areas was 149 (16.4%) and 1,752 (58.1%), respectively (Table 2). The number of cases participated in outdoor activities in urban and rural areas was 720 (85.2%) and 1,235 (43.4%), respectively (Table 2).

3.3. Epidemiological characteristics by urban areas ($N = 1,028$)

The proportion of cases aged below 50 years was more than 20% in all urban areas. Incheon had the highest proportion of cases aged below 50 years ($N = 36$; 45.6%). Outdoor activity was observed in more than 70% of the cases in all urban areas. In particular, 98 (98.0%) cases had a history of outdoor activity in Seoul (Table 3). The distribution of outdoor activities differed between urban areas. In Daegu and Daejeon, the number of cases participated in fieldwork was 32 (34.4%) and 23 (31.5%), respectively, which was higher than that in other urban areas. Among all urban areas, Busan had the highest number of cases ($N = 33$; 14.2%) participated in

government-run public work projects, and their occupations included outdoor activities (Table 3).

4. Discussion

Recently, the incidence of scrub typhus has increased in the urban areas. In this study, we described the epidemiological characteristics of scrub typhus cases reported in the urban areas of Korea in 2009. A total of 4,129 (90.7%) cases occurred between October and November 2009. Of these, 2,784 (62.4%) were female and 2,650 (59.4%) were 60 years or older. These results were consistent with those of the previous studies.^{1–6} The proportion of scrub typhus cases in Chungnam, Jeonnam, and Jeonbuk areas was much more than that in any other region. A previous study correlated with higher mean chigger indices of *Leptotrombidium pallidum* and *Leptotrombidium scutellare*.⁷ There were no significant differences between males and females in the seasons; however, a previous study⁶ reported that the number of female cases increases during early autumn, whereas the number of male cases increases in late autumn.

Table 3 Epidemiological characteristics of scrub typhus cases between January and December 2009 in urban areas

Item	Seoul	Busan	Daegu	Incheon	Gwangju	Daejeon
Gender						
Male	49 (45.8)	112 (38.9)	36 (35.6)	32 (40.5)	73 (43.5)	41 (44.1)
Female	58 (54.2)	176 (61.1)	65 (64.4)	74 (59.5)	95 (56.5)	52 (55.9)
Age (yr)						
<50	36 (36.6)	64 (22.2)	22 (21.8)	36 (45.6)	38 (22.6)	30 (32.3)
50–59	24 (22.4)	89 (30.9)	26 (25.7)	14 (17.7)	40 (23.8)	15 (16.1)
60–69	28 (26.2)	74 (25.7)	28 (27.7)	15 (19.0)	44 (26.2)	26 (28.0)
≥70	19 (17.8)	61 (21.2)	25 (24.8)	14 (17.7)	46 (27.4)	22 (23.7)
Month						
January–September	9 (7.8)	18 (6.2)	15 (14.6)	13 (15.9)	7 (4.1)	10 (9.3)
October	81 (69.8)	126 (43.6)	58 (56.3)	40 (48.8)	105 (61.8)	67 (62.6)
November	26 (22.4)	137 (47.4)	29 (28.2)	26 (31.7)	55 (32.4)	26 (24.3)
December	0 (0.0)	8 (2.8)	1 (1.0)	3 (3.7)	3 (1.8)	4 (3.7)
Infection risk factor						
Only fieldwork*	2 (2.0)	25 (9.7)	25 (27.0)	7 (11.1)	22 (14.1)	20 (27.4)
Only outdoor activity [†]	97 (97.0)	229 (89.1)	62 (66.0)	54 (85.7)	128 (82.1)	50 (68.5)
Both fieldwork and outdoor activity	1 (1.0)	3 (1.2)	7 (7.4)	2 (3.2)	6 (3.8)	3 (4.1)
Outdoor activities						
Non-farmers irregularly participate in agricultural activities	24 (24.5)	94 (40.5)	28 (40.6)	19 (33.9)	30 (22.4)	17 (32.1)
Climbing and tracking	19 (19.4)	44 (19.0)	12 (17.4)	5 (8.9)	30 (22.4)	10 (18.9)
Gathering chestnuts	14 (14.3)	18 (7.8)	5 (7.2)	9 (16.1)	28 (20.9)	7 (13.2)
Government-run public work projects [‡]	1 (1.0)	33 (14.2)	1 (1.4)	1 (1.8)	6 (4.5)	0 (0.0)
Mowing around graves	17 (17.3)	10 (4.3)	1 (1.4)	9 (16.1)	8 (6.0)	6 (11.3)
Others	31 (31.6)	48 (20.7)	29 (40.6)	18 (32.1)	29 (21.6)	19 (34.0)

Data n (%).

*Fieldwork was defined as continuous agricultural, forestry, or stock breeding work, as well as working in vegetable gardens; [†]Outdoor activity was defined as the activities that non-farmers irregularly participate in, which may be related to agriculture (such as assisting farmer relatives) or leisure (such as climbing, tracking, gathering chestnuts, mowing around graves, etc.); [‡]Government-run public work projects provide temporary employment to people by public sector.

There were significant differences in age, occupation, and infection risk factors between urban and rural areas ($p < 0.001$). Of the cases that were analysed in urban areas, 617 (60.0%) were female, 757 (83.6%) were non-farmer, and 524 (51.0%) were below 60 years old. Previously,^{3,4} farmers and elders (≥ 60 years of age) were considered a high-risk group. However, our results suggest that even more attention should be paid to the non-farmers.

The most common infection risk factor was outdoor activity in urban areas. The distribution of outdoor activities differed between urban areas. The proportion of fieldwork in Daegu and Daejeon was higher as compared with that in other urban areas. The proportion of government-run public work projects of outdoor activities was the highest in Busan among the urban areas. Thus, control measures need to be established according to regional epidemiological characteristics. Of the 46 cases in Busan, 33 (71.7%) participated in government-run public work projects. The government-run public work projects included many occupations, such as maintenance of hiking trails, deforestation, and cutting grass. This occupation characteristic could result in high exposure to chigger mites.

Our study has some limitations. This study was a descriptive study; therefore, we could not find out risk factors and the exact infection pathway. Moreover, cases were not classified as suspected and confirmed case.

This article described the epidemiological characteristics of scrub typhus cases in urban areas of Korea. Our results suggest that a scrub typhus education and surveillance system is needed, particularly in urban areas. Further works are required to determine the infectious risk factors in urban areas by laboratory confirmed case-control study.

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