Relation of Reported Cases of Typhus Fever to Location, Temperature, and Precipitation
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RELATION OF REPORTED CASES OF TYPHUS FEVER TO LOCATION, TEMPERATURE, AND PRECIPITATION [1]

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Approximately 36,000 cases of murine typhus fever in this country have been reported to the Public Health Service for the period 1913–1944. These are distributed within almost all States, but nearly 95 percent have been from North Carolina, Georgia, South Carolina, Florida, Alabama, Mississippi, Louisiana, and Texas (figure 1). Morbidity data used in this study of association between reported cases and temperatures and precipitation have been limited to these eight States.

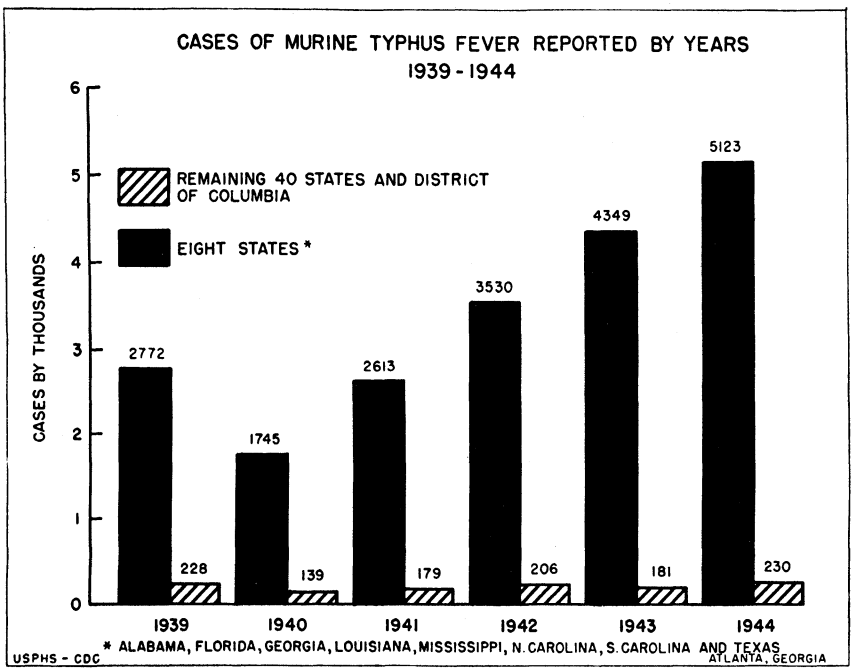


FIGURE 1.

Reports of typhus fever have increased numerically since its discovery due to improved diagnostic procedures, greater familiarity with the disease, and, perhaps, an actual increase in the incidence of the disease. With the exception of 1940 (figure 1), the number of cases reported has increased each year since recognition of the disease.

[1] From Communicable Disease Center, Bureau of State Services, Atlanta, Ga.

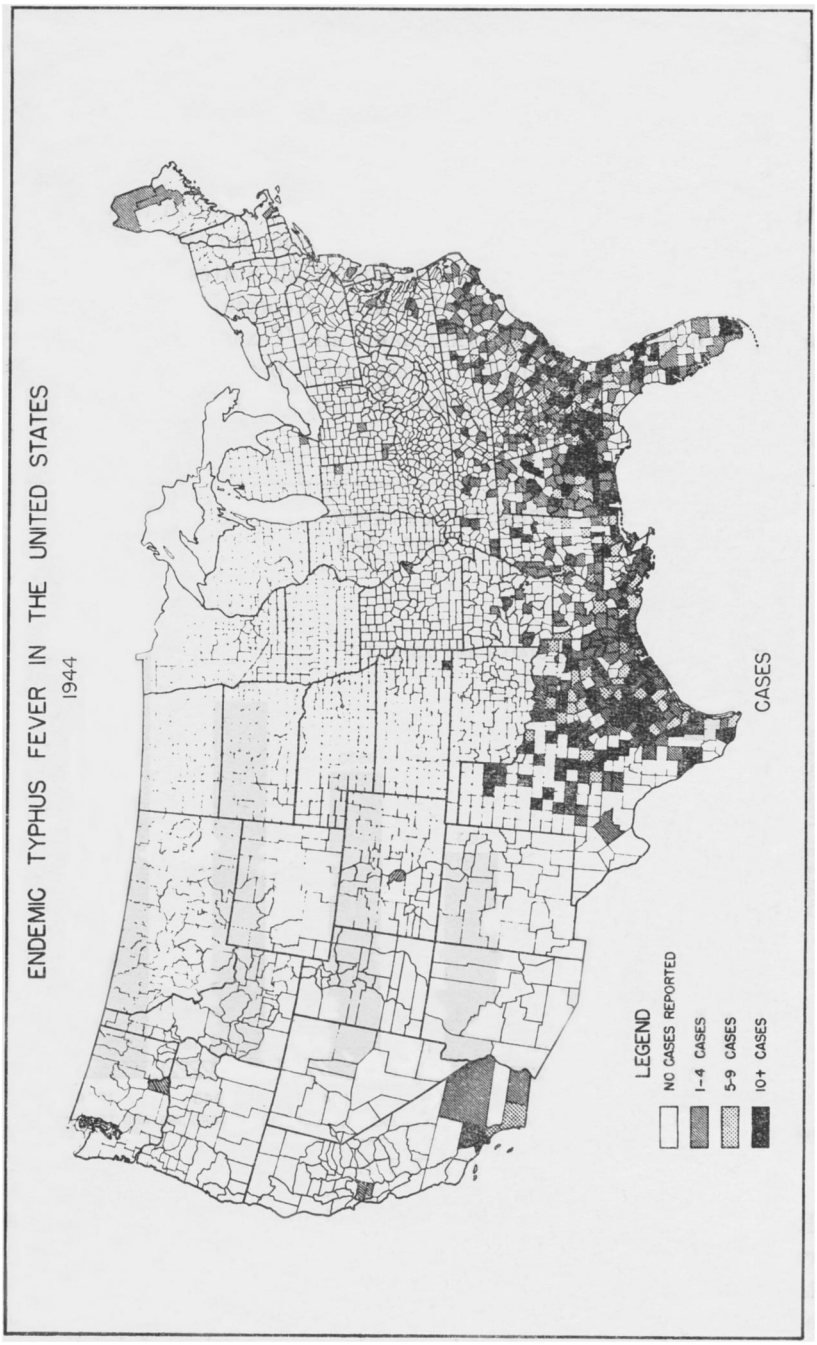


FIGURE 2.

This increase has been particularly noticeable in recent years. Sixty percent of all cases reported were during the 31-year period, 1913–1944, inclusive.

Cases reported during the 6-year period, 1939–1944, are the basis of this study. These were unequally distributed among and wi States. Spot maps of the successive years, however, show concentra-

AVERAGE MONTHLY INCIDENCE OF MURINE TYPHUS PER 100,000 POPULATION ACCORDING TO LATITUDE IN THE COMBINED AREA OF THE THREE STATES OF S.CAROLINA, N.CAROLINA AND GEORGIA FOR 6 YEARS 1939-44

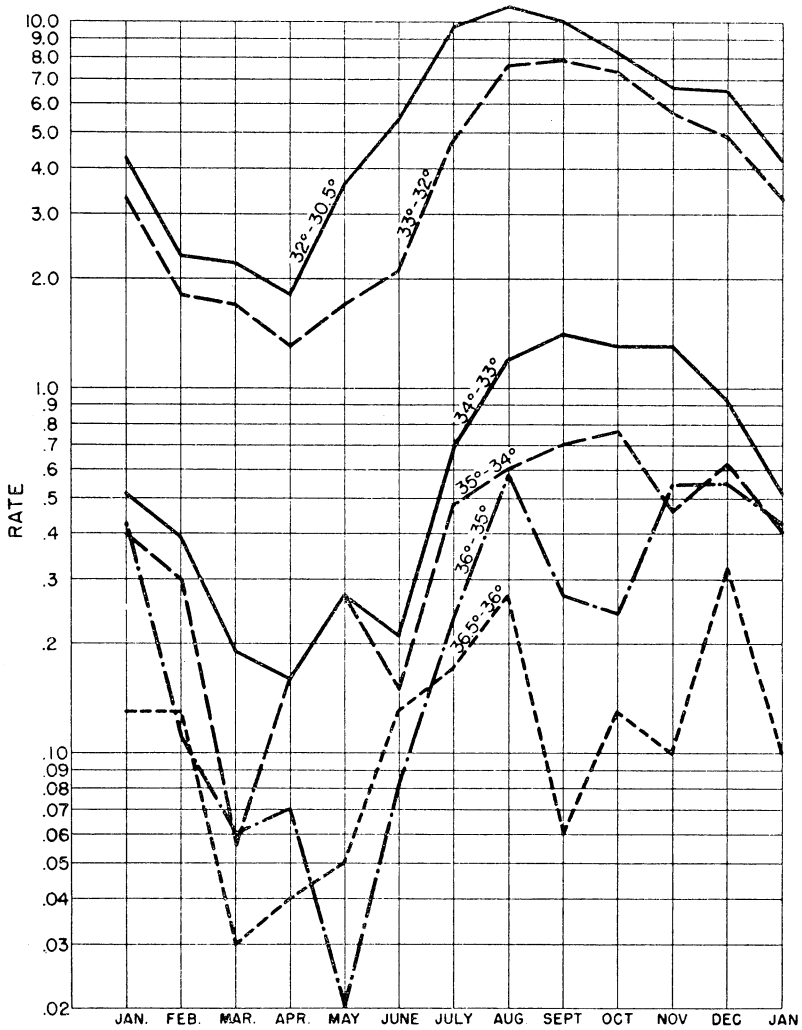
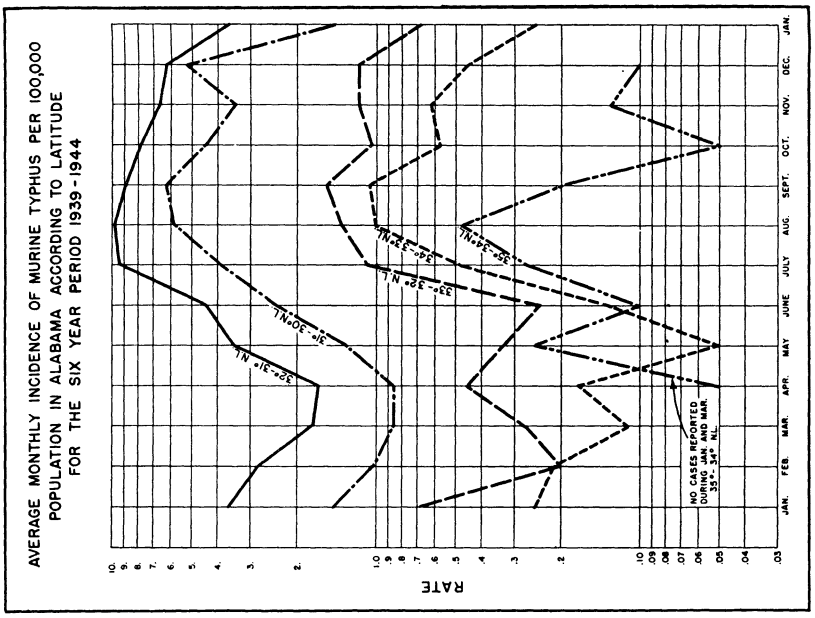


FIGURE 3.



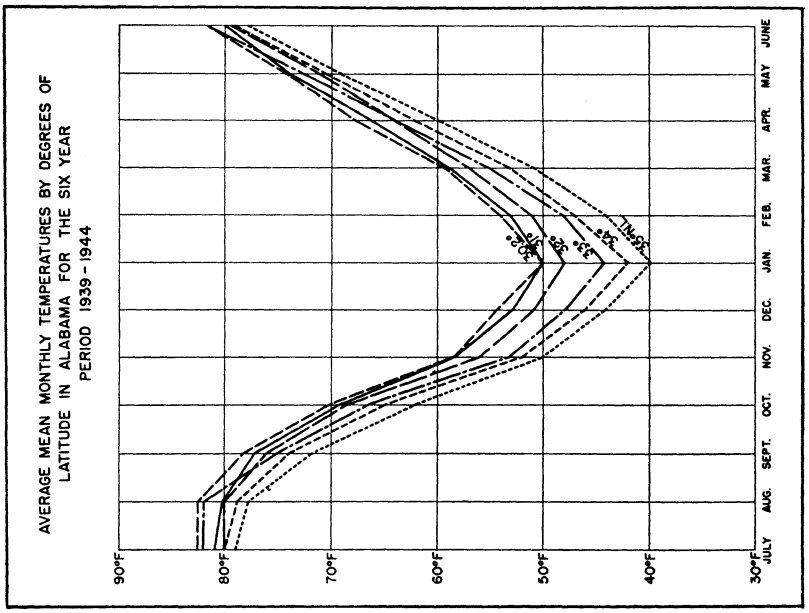


FIGURE 4.

tions in the same areas and indicate the occurrence of areas of different intensity. The heaviest foci occur in a belt from the Atlantic coastline of South Carolina and Georgia westward along the northern border of the Gulf of Mexico into the central portion of Texas (figure 2).

The concentration of reported cases diminishes north of this zone. These observations indicate a definite geographic localization of the disease as recognized previously by Maxcy (*1*) who found that endemic typhus fever occurring in Alabama in 1926 was generally confined to the southern portion of the State.

Distribution of Typhus Fever Cases

Figure 1 indicates reported cases of typhus fever in the United States by years from 1939 to 1944.

The location of cases of typhus fever reported during 1944 in the eight high-morbidity States is shown on figure 2. The pattern is representative of the distribution of reported cases for each year of the study. The majority of the cases was reported from Georgia, Alabama, and Texas.

Figures 1 and 2 suggest that specific physiography or climatology may be a causative factor in the occurrence of typhus fever. Figure 3 indicates the seasonal distribution of average monthly rates of reported typhus fever by latitudinal zones for the States of South Carolina, North Carolina, and Georgia for the 6 years, 1939–1944. This picture is representative of the entire endemic typhus fever area. Seasonal distributions are essentially similar in each zone, the lowest incidence occurring during the winter and spring months; the highest in the summer and fall months. Similarity of seasonal incidence in all zones suggests that uniform basic determinants, presumably biologic, operate in all zones, and that the difference in rates may be explained by secondary influences, such as temperature and rainfall, which vary geographically.

Temperature

Figure 4 shows the mean monthly temperatures by degrees of latitude in Alabama for 1939–44. The temperature chart is representative of all States studied with exception of Florida. The average monthly incidence of reported typhus fever cases per 100,000 population in Alabama by latitude is shown in figure 5. Although the seasonal incidence of reported cases for each zone is similar, there is a consistently progressive increase in rates for each zone southward from 35°–34° N. including 32°–31°. The fact that the rate in zone 31°–30° was lower than that of 32°–31° is not explained by low

temperatures of winter months (fig. 4). Comparison of figures 4 and 5 shows a significant association between low typhus morbidity rates and low temperatures of winter months for each respective degree of latitude northward from 31°.

Table 1 shows average annual incidence by latitude of murine typhus fever reported in eight States from 1939–44. Rates were higher in southern than in northern latitudes, except in Florida. This table indicates that transmission of typhus fever occurred infrequently north of 33°. It is possible that the lower temperature of winter months in northern latitudinal zones was one of the factors producing low rates of typhus fever.

In 1940 the number of cases reported was approximately 37 percent lower than in 1939. (fig. 1). This reduction occurred in six States: Louisiana and Mississippi showed no decrease. Reports of

TABLE 1.—*Average annual incidence of murine typhus fever per 100,000 population* [1] *for the 6-year period, 1939–44, by State and latitude*

North latitude	North Carolina	South Carolina	Georgia	Alabama	Mississippi	Louisiana	Texas	Florida	Total
36½°–36°	1.6	----	----	----	----	----	0.0	----	1.5
36°–35°	3.2	----	----	----	----	----	3.2	----	3.2
35°–34°	6.7	4.7	2.9	1.7	1.2	----	6.2	----	4.2
34°–33°	----	7.7	8.9	5.1	0.4	----	3.4	----	4.5
33°–32°	----	34.3	54.2	9.5	4.5	3.2	11.1	----	17.8
32°–31°	----	----	71.9	65.6	7.7	5.1	10.5	----	30.8
31°–30°	----	----	68.8	37.0	18.8	8.3	25.8	17.9	21.1
30°–29°	----	----	----	----	----	9.2	24.1	13.6	18.5
29°–28°	----	----	----	----	----	----	25.6	12.4	19.8
28°–25°	----	----	----	----	----	----	23.6	11.4	15.3
Total	3.4	9.0	32.1	17.3	4.0	6.9	15.6	13.8	13.4

[1] The 1940 census population figures have been used throughout for estimating incidence.

the United States Weather Bureau indicate that temperatures for January of 1940 were abnormally low throughout the southern States. The lowest temperatures recorded during January 1940 in the extreme southern sections of the different States were as follows: South Carolina, 12°; Georgia, 10°; Alabama, 6°; and Texas, 3°. In the northern part of all four States the temperature fell to several degrees below zero. This was the only significant climatological change found which affected the entire area of the six States in which decrease of reported typhus fever cases was noted. The reduction, coincident with unusually low winter temperatures, tends to confirm the suggested role of temperature in transmission of typhus.

Indications are that the transmission of typhus fever is reduced at a mean monthly temperature below 45° to 48° F. (fig. 4). Highest rates were reported when mean monthly temperatures for any winter month were 48° or above.

Nonconformity of Florida data may be explained by excessively high summer temperatures, although comparison of rates between the same degrees of latitude in Texas and Florida having comparable temperatures during winter months do not bear out this hypothesis (table 1). Possibly, cases reported are not comparable. Reports from portions of Georgia and Florida in the same latitude are inconsistent. The Georgia rate for the 31°–30° north latitude zone was 68.8, while the Florida rate for the same zone was only 17.9. These wide differences in rates of reported cases within the same degree of latitude are not explained by physiographic or climatologic conditions.

Precipitation

Rainfall is a factor which can deter the development of ectoparasite populations of rodents and thus may be associated with reported typhus fever rates. Studies were made of association between average annual precipitation and typhus fever rates by latitude zones and between monthly precipitation and reported typhus fever cases. These studies indicated no significant association between precipitation and reported cases for the time periods and geographic locations studied.

Statistical Association With Temperature and Precipitation

Table 2 shows product-moment correlation coefficients solved by various combinations of the data to test degree of association mathematically. This shows that: (a) higher coefficients result when temperature is correlated with reported cases than when precipitation is correlated; (b) when monthly averages for the period are corre-

TABLE 2.—*Correlation coefficients of reported typhus incidence, temperature, and precipitation for Alabama and Georgia, 1939–44*

	Alabama 31°–32° r-S. E.	Georgia 31°–32° r-S. E.
ITEMS STUDIED BY MONTHLY DATA:		
1. January temperature: January cases, etc.	0. 32±0. 11	−0. 34±0. 10
2. January temperature: February cases, etc.	.53± .08	.54± .08
3. January precipitation: January cases, etc.	.01± .12	.20± .11
4. January precipitation: February cases, etc.	.00± .10	.09± .12
5. January precipitation: March cases, etc.	.02± .12	−.01± .12
ITEMS STUDIED BY MONTHLY AVERAGE DATA:		
6. January temperature: January cases	.52± .21	.60± .18
7. January temperature: February cases	.84± .09	.63± .18
8. April temperature: May cases, etc.	.65± .20	.75± .15
9. January precipitation: January cases, etc.	−.07± .29−	.12± .25
10. January precipitation: February cases, etc.	.02± .30	.25± .11
11. January precipitation: March cases, etc.	−.04± .29	.23± .14

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lated, the coefficients and their accompanying standard errors are accentuated, and usually the coefficients are increased; (c) no significant degree of correlation is shown between monthly precipitation and reported cases; (d) a fair degree of correlation is shown between temperature and reported cases for each zone.

Summary

1. The paper presents analyses of the incidence of reported typhus fever and its association with latitude, precipitation and temperature for eight southern States where 95 percent of typhus fever in the United States occurred during the period 1939–44.

2. Typhus fever was concentrated in the area between 31° and 33° north latitude. Progressively greater rates were encountered southward in the zone.

3. Seasonal incidence of reported typhus fever cases was similar in all latitudes. Lowest number of cases was reported in winter and spring months and greatest number in months of August, July, or September. This indicates that basic biological factors favoring propagation of the disease operated similarly in all latitudes and suggested the possibility that climatic factors were associated with transmission of the disease.

4. Relative homogeneity of summer temperatures in the southern States suggests that low monthly temperatures of winter might be associated with reduction of the disease. Decline of cases in 1940, following an unusually cold month of January, adds credence to this thesis.

5. No significant degree of association was found between precipitation and rates of reported typhus fever.

REFERENCES

(*1*) Maxcy, Kenneth F.: An epidemiological study of endemic typhus (Brills Disease) in the southeastern United States. Pub. Health Rep. **41:** 2967–2995 (1926).

(*2*) Climatological Data: Annual, and monthly reports by States, Weather Bureau, U. S. Department of Commerce.

(*3*) Morbidity Data: Division of Public Health Methods, Public Health Service, Washington, D. C.; Statistical Branch, Communicable Disease Center, Public Health Service, Atlanta, Ga.