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Serological Groups of *Shigella* in Japan and Neighboring Countries. A Review

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Abstract

An outline of the distribution of shigellae in Japan, Korea, Taiwan, Hong Kong, Continental China, the Philippines, and other countries to the south is presented in the form of a survey from data compiled in the literature in terms of the spectrum of *Shigella* group. Japan is the only country to date with *S. sonnei* in an absolute majority, though it is gradually increasing also in the other areas. *S. dysenteriae* and *S. boydii* are seldom detected in urban communities of Japan but the former is found at a rate of 5 to 10 per cent in the other countries except Taiwan and Hong Kong. The latter appears in the same proportion, particularly in Vietnam. In Japan, the change in the ratio of *S. flexneri* and *S. sonnei* has been demonstrable in minute, year by year steps since 1951. In Korea, Taiwan, Hong Kong, and Mainland China an identical change is taking place approximately within a given period of time.

Shigella sonnei is holding the top rank in isolation rates in Japan at present for outnumbering other serogroups. In this connection it appeared most desirable to collect information on the group and type distribution of shigellae in Korea, Taiwan and Hong Kong from and to which the traffic is becoming heavier year by year. Fortunately, thanks to collaborators in those countries, the author had an opportunity to acquire accurate data and could make good use of donated strains. He also received personal information, in addition to valuable publications. Furthermore it was possible to take a broad view of the latest situation in Mainland China, the Philippines, Vietnam and some other countries to the south with the help of literature search, so that the author is in a position to discuss the distribution of *Shigella* groups in those countries as well as Japan. The serotypes of groups of A, B and C, and the colicine types of group D will be reported later.

Special Contribution

Japan during the Past 15 Years

The dysentery morbidity rate per 100,000 population in Japan was 18.3 in 1948 and rose to 29.3, 59.8, 110.0, 130.1, 124.1, and 111.9, respectively, in the years of 1949 to 1954. Since then, after remaining steady at around 70 to 90, it gradually decreased from 1962 on, and revealed again a low peak, 49.5, in 1965. This curve, of course, is primarily programed by various causes at work within Japan. However, the prevalence of shigellosis in the several years after 1951 may well be regarded as being influenced to some extent by the Korean conflict.

In Japan, the classification of the genus *Shigella* according to the International Nomenclature and Taxonomic Scheme became generally known in about 1950, and the summarized results of typing practiced by all prefectural and municipal public health laboratories have been made public every year by the Ministry of Health and Welfare since 1955. Fortunately, the data from 1951 to 1954 are available in two compilations by Nishide et al. (1955). Table 1 that lists the per cent incidence of each *Shigella* group and Fig. 1 that indicates the relative fluctuations of *S. flexneri* and *S. sonnei*, are based on data taken from these reports.

As shown in Table 1 and Figure 1, the proportion of *S. sonnei* (group D) gradually increased till 1963 and took a leading position in 1964, dominating over *S. flexneri* (group B) which had occupied the first place until that time. The report of 1966 is not yet available officially, but the author is able to report reliable data, 0.0/18.4/0.0/81.6 (the same parameters in the arrangement of Table 1 – called

Fig. 1. Dysentery case rate, 1948–1966; Mutual relation between *S. flexneri* and *S. sonnei*, 1951–1965 in Japan

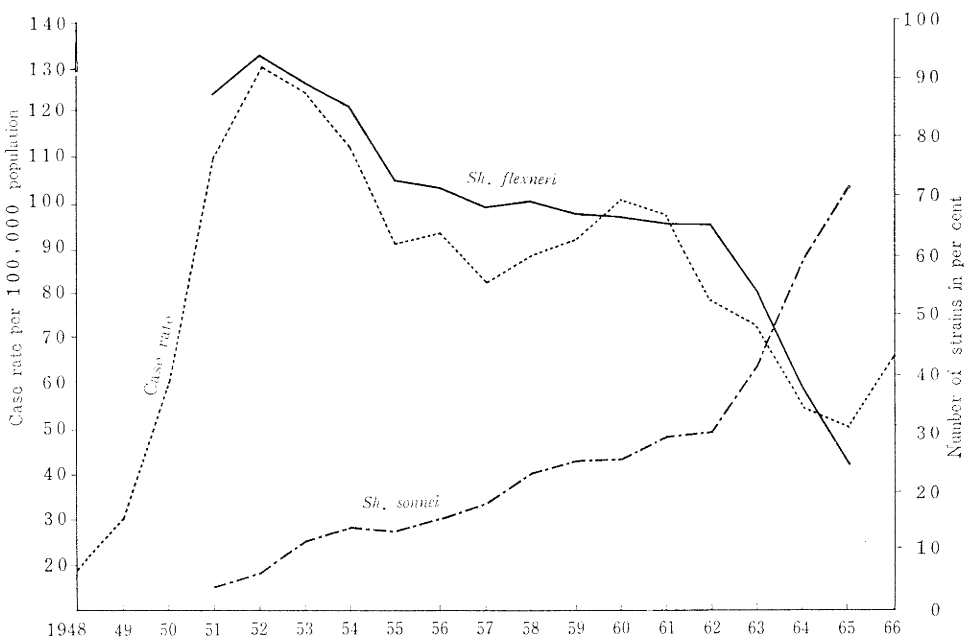

Table 1. *Shigella* serogroups in all Japan, 1951–1965

Year	No. of strains	Group distribution (in per cent) A	B	C	D	UC
1951	25,451	0.3	86.9	–	4.2	8.6
1952	48,534	0.4	93.2	0.0	6.3	0.0
1953	58,681	0.4	88.6	0.0	11.1	0.0
1954	54,045	0.5	85.9	0.0	13.6	0.2
1955	27,594	1.2	72.6	0.1	13.2	12.8
1956	29,335	1.3	71.3	0.2	15.7	11.4
1957	27,050	0.9	68.3	0.1	18.0	12.6
1958	29,886	0.9	69.0	0.2	23.0	7.0
1959	31,799	0.5	67.4	0.1	25.9	6.1
1960	37,280	0.9	67.6	0.1	25.3	6.1
1961	39,508	0.8	66.2	0.1	29.2	3.7
1962	33,387	0.4	64.5	0.1	30.7	4.2
1963	31,611	0.6	54.7	0.0	41.7	2.9
1964	25,825	1.0	37.6	0.1	59.6	1.7
1965	26,750	1.5	24.1	0.1	72.8	1.5

The following symbols are used in the tables:
Quantity is zero –
Data not available ···
If rate is more than 0 but less than 0.05 0.0
A,B,C, and D are synonymous with *S. dysenteriae*, *S. flexneri*, *S. boydii*, and *S. sonnei*, respectively. UC means unclassifiable or undetermined.

here "spectrum") from the report of a working group on "Drug-resistant Dysentery in Japan" which consists of the staffs of several stationary isolation hospitals, public health laboratories in Central Japan, and the National Institute of Health in Tokyo. The results obtained by this group in the last five years (including 1966) are shown in Table 2. Some unexpected aspects can be observed in the spectra when analyzing the data of sporadic cases in six large cities along the central axis of Japan, namely, a decrease of group B and an increase of group D

Table 2. *Shigella* serogroups in urban districts of Japan; data on strains isolated from sporadic cases

Year	No. of strains	Group distribution (in per cent) A	B	C	D	UC
1962	6,701	0.0	83.2	–	16.8	–
1963	6,948	0.0	69.3	–	30.7	–
1964	5,236	0.0	56.1	–	43.9	–
1965	5,756	0.0	40.2	–	59.8	–
1966	7,568	0.0	18.4	–	81.6	0.0

which took placd in sudden steps in the past five years, and a conversion period setting in about one year later than the respective period in the whole of Japan.

The occurrence of dysentery due to group A and C organisms is not always a weighty problem confronting Japan, at least not from the epidemiological point of view. Strains belonging to group A number now some three hundred from all parts of collected in a year, and those of group C only fifty at the most. They are practically absent in Tokyo, Osaka and other large cities.

In 1952, *S. boydii* (group C) was isolated in Japan for the first time. In the following years, it was detectable in a small per cent (recorded as below 0.2) every year. Since organisms of this group were isolated at considerably high rates in Korea during the Korean conflict, as it will be discussed later, it is not impossible to consider that the epidemiologic picture in Japan has been directly or indirectly influenced by that incidence.

Korea, Taiwan and Hong Kong

Although there was a wide prevalence of various epidemic diseases among the prisoners of war in the Korean conflict, bacillary dysentery was the most trouble-

some during the winter of 1950–1951. The results of the study of the isolates (chiefly from North Korean prisoners of war) related by Zimmerman et al. (1952) that was carried out over a four months' period, January through April 1951, and the outcome of typing reported by C. H. Chun (1959) of 3,732 strains cultured in United Nation Forces and allied laboratories from military personnel, refugees, prisoners of war, and Koreans who worked for the U. N. Forces in 1952 and 1953, are presented in the first five lines of Table 3.

It is seen from these data, as from the report of Im and Choi (1961) who studied strains isolated from Korean soldiers in 1952–1954, that first the rates of group A and C, especially of the latter, were generally higher than in Japan. Secondly, the proprotion of group D in U. N. Forces was markedly higher when compared with that in Koreans. There are two additional Japanese reports bearing reference to the first finding : 1.0/84.8/–/15.1 (866 strains in 1951, Nakaya et al.,

Table 3. Korea, Taiwan, and Hong Kong

Area, year and reference number	No. of strains	Group distribution in per cent				Remarks
		A	B	C	D	
Korea :						
1951[59]	734	1.5	97.2	0.7	0.3	Korean
1952[8][9]	2,977	6.6	91.8	0.4	1.2	Korean
1952	143	1.4	88.8	3.5	6.3	U. N. Forces
1953	449	5.4	92.6	0.4	1.6	Korean
1953	163	7.7	71.5	0.6	20.2	U. N. Forces
1952–54[25]	133	8.3	90.1	0.8	0.8	Kwangju
1961[3]	44	9.1	81.8	2.3	6.4	Taegu
1962–65[10]	109	13.1	76.1	2.8	7.3	Taegu
Taiwan :						
1950[51]	140	3.6	96.4	···	–	Northern part
1949[49]	107	0.9	99.1	···	–	Armed Forces, Taipei
1950	498	1.2	98.4	···	0.4	
1951	97	–	99.0	···	1.0	
1952	85	–	100.0	···	–	
1951–53[55]	136	–	94.8	···	5.2	Univ. Hosp.
1956–63[22][23]	206	–	90.8	–	9.2	Ser. Vac. Lab.
1961,62[58]	50*	–	72.0	–	20.0	Prov. Child. Hosp.
1962,63[50]	102	–	75.4	–	24.6	
Hong Kong :						
1959–64[24]	171	–	61.4	1.2	37.4	Univ. Dpt. Path. Bact.
1960[17]	1,260	0.0	87.1	0.1	12.8	Gov. Path. Inst.
1961	1,349	0.1	81.5	0.1	18.3	
1962	1,268	0.0	67.9	0.1	32.0	
1963	1,228	0.1	76.5	0.2	23.2	

* Number including 4 unidentified strains.

1952) and 0.3/87.1/−/12.6 (5,950 strains from the beginning of 1951 to the first quarter of 1953, Ministry of Health and Welfare, 1953). As for the second observation, the results obtained by Vaichulis et al. (1967) and by Gaines et al. (1968) in Vietnam which will be discussed later, showed the same tendency.

The relative frequencies observed during the confused times in Korea continue on the whole to these days. It is worthy of noting that the rate of group A (type 1 of it for the most part) is above 10 according to the latest information by Doki Chun et al. (1966). Group B still ranks top, while group D exhibits a slight tendency to increase.

The greater part of literature in North Korea remains unacccessible. The author knows only one competent report, by Uh-chil Cho from Chongjin Medical College, available as an abstract, entitled "Biological characteristics and epidemic types of dysentery bacilli isolated from children", published in Korean in "Korean Medicine", January, 1966. It states that 47 out of 327 *Shigella* strains isolated from gastroenteritis cases in the coastal districts were O-inagglutinable and that 33 of these strains could be classified after being restored to the agglutinable state as follows: 31 *S. flexneri*, one each a Schmitz type and a *S. sonnei*.

There are six suggestive reports concerning group and type classification of shigellae in Taiwan (see the central part of Table 3). Also in Taiwan, group B exceeded the other groups in per cent throughout the years from 1949 to 1963. Organisms belonging to A group, which were detectable at low rate during several years around 1950, are not found at present. Attempts to detect members of the C group date from a study of the Taiwan Serum Vaccine Laboratory in 1956 using commercial antisera (products of the Kitasato Institute and of Difco Laboratories), but no strain of that group has yet been found. The rate of *S. sonnei* has increased to 9.2 in the years of 1956 −1963, and to 20.0 and 24.6 according to the reports of Yu et al. (1962) and of Wang (1965) who examined specimens from children with diarrhea between March 1961 and August 1963. In short, judging from the latter three reports, the situation in Taiwan——in reality in Taipei City and its suburbs —— is very similar to that of six large cities in Japan in corresponding years (Table 2). As for predominance of B group shigellae at that time the report of Nakaya et al. (1967) serves as a reference. Fifteen out of 30 monkeys (*Macaca cyclopis*) transported from Taiwan by air in August 1963 to a certain place of Shizuoka Prefecture, Japan, had diarrhea, from three severe cases of them *S. flexneri* 4b could be isolated.

In the report of Huang and Chan-Teon (1965) from the Department of Pathology and Bacteriology, University of Hong Kong, and the results provided by the Hong Kong Government Pathological Institute cited in that report (lower part of Table 3), the tendency of *S. sonnei* to increase in the years 1959−1964 was also demonstrated. The situation in Hong Kong where both group A and group C have been isolated at low rates, about one per cent and less, and group B has commanded a majority, was quite alike to that in all of Japan during the pre-1963 period (Table 1).

Continental China

In the literature on Continental China, the report of Ouyang (1940) in Peking (34.5/65.5/−/−, 1930−1938) and of Wang and Yui (1944) in Chentu (54.8/44.9/−/1.3, 1943) are not to be disregarded, though they are now old. Referring to them, it can be said safely that dysentery due to Shiga bacilli prevailed in China during the war. Twenteen additional data gathered from the literature available to the author are summarized in Table 4.

Hou (1962) compared his findings with seven reports published in the past 30 years in Peking stated that the per cent proportion of Shiga bacilli gradually decreased from 34.4 to less than one, while that of Sonne bacilli increased from 0.5 to 26.4. Meanwhile the per cent rate of *S. flexneri* varied between 87.8 and 62.7.

The increase of *S. sonnei* especially in large cities of Continental China in the Nineteen Fifties is quite remarkable. It may be presumed that the superior avidity of this group was revealed some years ahead of Japan. This presumption is further fortified by a review of Liu (1959) (in that report a table of Azhinov, 1955, showing the yearly fluctuation of *Shigella* groups in the Soviet Union from 1946 to 1954, has been cited). However, there remains some room for consideration, because the surveys in Shanghai, as well as in Foochow, and the survey of Li et al. (1960) in Peking were performed by examining specimens of hospitalized children. Still the rates of group A were generally higher than in Japan, irrespective of the year of survey. The same can be said about group C. These findings are considered characteristic for Continental China at that time.

From the beginning of the Sixties, the literature available in Japan has markedly decreased. Only two but interesting con-

Table 4. Continental China

Year and reference number	No. of strains	Group distribution in per cent					Region
		A	B	C	D	U C	
1954, 55[13]	811	7.4	71.8	0.1	20.7	−	Peking
1954−56[29]	392	2.3	87.8	−	10.0	−	
1959[30]	(98)	6.1	41.8	−	52.1	−	
1960[13][19]	322	4.0	62.8	0.6	26.4	6.2	
1953−55[48]	253	6.8	90.9	−	1.5	0.8	Tsinan
1956, 57[47]	621	5.0	87.4	0.3	6.8	0.5	
1953−56[33]	(451)*	−	33.7	···	37.5	0.9	Shanghai
1957[56]	(103)	1.0	48.5	−	50.5	−	Kiangsu Prov.
1954−56[27]	1,005	4.1	80.3	−	16.1	−	Hupeh Prov.
1956[57]	104	−	85.6	7.7	−	6.7	
1953−56[54]	(166)	4.2	42.8	1.2	48.4	3.0	Foochow
1957[21]	(396)	−	57.4	−	42.6	−	

The number in parenthesis indicates that of strains isolated from hospitalized children.

* Number including 123 mannitol-fermenters (unidentified).

tributions have been reported mountain solitudes. The first one was presented by Chang et al. (1964) of the Medical Biological Institute in Kumming. In three years from 1960 to 1962, 412 *Shigella* strains were isolated from monkeys which were bread in Yünnan Province and transferred to the institute for laboratory studies. The spectrum of these strains was 9.4/90.0/−/0.6. Secondly, Tyan et al. (1966) isolated 35 strains of group B and 3 strains of *S. sonnei* in two hospitals in the boundary of Human and Kweichow Province, and furthermore they stood a chance of obtaining eight strains of *S. dysenteriae* 1 in an epidemic case among the Miaos, a sparse mountain race in South China.

Philippines and Other Countries to the South

According to the Philippine Health Statistics of 1964, the morbidity rate per 100,000 population of gastroenteritis and colitis was 737.0 for all age groups. The death rate was 51.4. Furthermore, it was shown that about two-thirds of the cases and deaths were infants and children under five years of age. There may be complicated reasons for this but first the actual state of bacillary dysentery in Philippines, the group and type of the causative agent, have to be clarified.

The *Shigella* group spectrum, based on data related personally by the Bureau of Research and Laboratories in Manila, is 11.6/73.2/4.4/10.5 (86 strains, 1962–64). Additional data found in the literature were 2.7/80.6/−/16.7 (36 strains, Philippine General Hospital, 1957) and 7.2/83.4/−/9.4 (445 strains, San Lazaro Hospital, 1951, 1952).

The prevalence of bacillary dysentery in South Vietnam in the midst of war was described by Gilber and Greenberg (1967). According to them the incidence of shigellosis varied from 0.5 to 20.0 per 1,000 inhabitants. As for *Shigella* classification, there are two available reports, namely, the study performed by the Naval Preventative Medicine Unit in DaNang during a period from November 1965 to October 1966 (Vaichulis et al., 1967), and that by the U.S. Army Medical Research Team in Vietnam in cooperation with the Pasteur Institute of Vietnam, during a one-year period beginning December, 1965 (Gaines and Nhu-Tuan, 1968). The former report concerned itself with American personnel in a corps area afflicted with bacillary dysentery, the latter with Vietnamese nationals suffering from diarrhea principally in the Saigon area. The *Shigella* spectra calculated from these data are 4.5/47.6/7.9/40.0 (352 strains) and 6.8/67.2/9.2/16.8 (606 strains), respectively. It should be added that Vietnam is subject to more frequent outbreaks of dysentery due to C group organisms than other countries. Moreover, the rate of *S. sonnei* isolated from Americans is somewhat higher than in Vietnamese nationals.

The situation of North Vietnam can be estimated from the abstract of the report of Hoang et al. (1965) of the National Institute of Hygiene and Epidemiology in Hanoi. The results arranged in the form of a spectrum are 4.5/82.0/10.0/0.6 (1,121 strains).

Furthermore, there were a few surveys

carried out in Vietnam and Cambodia mainly by the staffs of the Pasteur Institutes of Paris and Saigon. *Shigella* group spectra arranged by this author are as follows : 7.8/83.3/3.7/4.7 (575 strains, South Vietnam, 1954, LeGal, Courmes et Bres, 1955); 8.7/61.8/8.6/20.9 (744 strains, thorough survey of Vietnam, Piéchaud et Szturm-Rubinsten, 1964); 2.5/80.2/2.6/14.7 (714 strains, Saigon, 1957–63, Institut Pasteur du Viêt-Nam, 1963); 4.5/79.2/9.2/16.8 (111 strains, Dalat, 1955–63, Institut Pasteur du Viêt-Nam, 1963); 4.5/86.9/1.4/7.2 (200 strains, Cambodia, 1960, Brumpt, Rubinsten et Piéchaud, 1960).

The report of Nanthavanij (1960) who identified 27 strains of *S. sonnei* out of 118 *Shigella* isolations in Thailand has been cited in the paper of Yu et al. (1962) in Taiwan.

Finally, this author reviewed the study of Takasaka et al. (1964) in the National Institute of Health of Tokyo. According to it, of the 587 monkeys received at the institute from Malaya and Cambodia between October 1962 and December 1963, 118 were positive for *Shigella*. As from several monkeys two types were isolated simultaneously, the number of *Shigella* strains came to 126. The spectrum was 4.0/64.3/–/31.7.

The Author's View

The most representative enteric infection in Southeast Asia is, of course, cholera. The reports from wartorne Saigon, where Gaines described the isolation of *Vibrio cholerae* from 1,879 fecal specimens obtained from 8,243 Vietnamese nationals suffering from diarrhea, and the communication of Sinha et al. (1967) on detecting that 1.3 per cent of the inhibitants of a delineated zone of Calcutta were cholera carriers, underline the above impression. However, considering the entire area of Asia, greater concern is due to bacillary dysentery.

As shown in this review, at present Japan is the sole country where the prevailling proportion of isolates is *S. sonnei*. While a tendency of annual increase in its rate may be admitted, *S. flexneri* still predominates in other countries of East and Southeast Asia. Moreover, *S. dysenteriae* exists only at a rate around one per cent in Japan as a whole but exists at the rate of 5 to 10 per cent in other countries except Taiwan and Hong Kong.

It is generally known that the pathogenicity of *S. dysenteriae* and *S. flexneri* is greater than that of *S. sonnei*. According to this view, dysentery in other countries, may be considered more serious than in Japan. However, in Japan, when shigellae are found in the stools, even in patients with slight attacks or in persons in an apparently healthy state, the law requires that the patient and the carrier must be isolated. It might be regarded irrational to compare the results of the report of cases in Japan with those in countries where only patients revealing distinct clinical sings were examined. It is desirable to grasp more accurately the situation in other countries by examining people there with similar conditions as in Japan.

Greater attention is being paid to many

other infectious diseases than to shigellosis in some countries. Examinations for this disease should be given preference by exact research for the sake of finding the cause of diarrheal diseases which are perdominant in the tropics and subtropics and which are particularly depriving infants of their lives. The same is the case with food poisoning in all age groups. The good intentions of the WHO which designated the subject "Diarrheal Diseases" as one of the projects of paramount importance should be appreciated very highly.

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日本とその近隣諸国における赤痢菌群分布の展望

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摘　要

日本，韓国，台湾，香港，中国大陸，フィリピン，さらに南方各国の赤痢菌分布を赤痢菌群スペクトラムの形に整理した資料で概観した．現在の日本は *S. sonnei* が絶対多数を占める唯一の国である．*S. dysenteriae* と *S. boydii* は日本の大都市一帯ではほとんど検出されないが，前者は台湾と香港を除くほかの国々で5～10%に見出され，後者は特にベトナムに大体この率で存在する．*S. flexneri* の減少と *S. sonnei* の増加が，日本では1951年以降逐年明示され，韓国，台湾，香港，中国大陸でも，ある時期において大体示されていた．特に中国大陸の大都会の小児患者分離株ではこの傾向が日本より早期かつ顕著であった．