Reprinted from AMERICAN JOURNAL OF TROPICAL MEDICINE AND HYGIENE
Vol. 9, No. 3, May, 1960
Printed in U.S.A.

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Physicians in Guatemala have recognized poliomyelitis in sporadic form and in occasional small epidemics for many years, but reported cases are very few. Actual numbers would appear greater than recorded in official vital statistics of the country, because casual observations of rural as well as urban populations reveal frequent paralytic sequelae typical of this disease in all age groups. Such individuals usually state that "paralysis" was first noted during early childhood, commonly following an attack of "bad fever". The single previous report of poliomyelitis in Guatemala, that of Monzón Malice,[1] described an outbreak "que se manifestó en muchos de los departamentos, en proporción tal vez no igualada con anterioridad." Fifty-four cases were reported from the entire country, 28 in Guatemala City. Nearly all were paralytic and 7 were fatal.

Poliomyelitis in Guatemala, as indicated in Table 1, has been less frequent and less severe, although an outbreak among 100 children in an orphanage in early 1959 resulted in 14 (6 paralytic) cases with 3 deaths. Other than the few scattered instances of bulbar poliomyelitis or polioencephalitis, official reports of clinical disease do not specify presence or absence of paralysis. Since no cases of nonparalytic poliomyelitis were reported as such, presumably all were paralytic. The distribution of males and females is essentially equal. Data are not available by age, but children are primarily involved. The occasional paralytic case among children of business and professional people and among foreigners serves to alert private physicians to the dangers of this disease.

As has been established for a number of tropical countries, clinical observations suggest that poliomyelitis infection in Guatemala is far more common than hitherto recognized. To determine this, samples of serum were obtained from 100 adult patients admitted to the Guatemala City General Hospital for conditions unrelated to poliomyelitis. These patients were mainly of low income status and resided in Guatemala City or in nearby towns and villages. Serums were sent to the Department of Infectious Disease, UCLA School of Medicine, where they were tested for presence of neutralizing antibodies to all three types of poliovirus. The results indicate that this group of adults, not known to have had clinical poliomyelitis, had had considerable past experience with all three types of poliovirus.

METHODS

Blood was collected asceptically, the serum separated, samples sent by air to Los Angeles‖ in sterile screw-capped vials and stored at −20° C until examined. Serums were tested for neutralizing antibodies to each of the three types of poliovirus by tissue culture methods employing HeLa cells.[2] Neutralization was determined by direct microscopic examination of cell cultures for cytopathic effect of virus, following the procedure of Syverton, Scherer and Elwood.[3] The test strains of virus were: Mahoney (Type I), MEF-1 (Type II) and Saukett (Type III).

After inactivation of serums in a waterbath at 56° C for 30 minutes, serial dilutions were made in balanced salt solution. Dilutions were 1:4, 1:8, 1:16, 1:64, 1:256, and 1:1024. Aliquots (0.1 ml) of serum dilutions were mixed with 0.1 ml of each of the virus prototypes containing 100 $TCID_{50}$ of virus, and allowed to stand at room temperature for 30 minutes. Next, 0.1 ml of each virus-serum mixture, followed by 0.9 ml maintenance solution containing 20% chicken serum, was transferred to a tube of HeLa cells and incubated at 37° C in a slanting position for 5 to 6 days. Cell cultures were washed with balanced salt solution prior to addition of serum-virus mixture in order to remove human serum incorporated in the growth medium.

Tubes were examined daily and the neutralization titers of the serums were determined by

* INCAP Publication I-144.

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‖ Kindly transported by Dr. Edward K. Markell.

TABLE 1

Reported cases of Poliomyelitis, Republic of Guatemala, 1953–1958

Year	Estimated population 1st July*	Number of deaths	Cause specific death rate (× 100,000)	Number of cases†	Incidence per 100,000 population
1953	3058339	23	0.75	not available	not available
1954	3158694	17	0.54	60	1.90
1955	3258010	36	1.10	83	2.55
1956	3346690	37	1.10	70	2.09
1957	3450742	46	1.33	55	1.59
1958	3545901	not available	—	72	2.03

* Dirección General de Estadística (Census Bureau), Guatemala, C. A.

† Dirección General de Sanidad Pública (National Health Department), Guatemala, C. A.

microscopic examination for the dilution at which destruction of HeLa cells by the virus (cytopathic effect) was inhibited by homotypic neutralizing antibody. The controls consisted of retitrations of all the virus types used and the inclusion of known type-specific antiserum neutralization tests against the prototype viruses.

RESULTS

All three types appear to be thoroughly seeded throughout the population. The frequencies of single types of infection with poliovirus and by various combinations of types are given in Table 2. Some 33 persons had neutralizing antibodies to all three types of virus, 34 to two types and 29 to one type of virus only. The serums of only four persons of the 100 failed to reveal neutralizing antibodies to any type of poliovirus in a titer of 1:4 or more. A summary of individual titers of neutralizing antibodies against the three types of poliovirus is recorded in Table 3.

A group of 100 medical students at the University of California at Los Angeles was similarly examined. These subjects were young adults between the ages of 19 and 23. They resided in the Greater Los Angeles urban area and were from families of comparatively high socio-economic status living under high levels of sanitary and public health practices. The results are compared in Table 2 with the Guatemalan serums. The UCLA students gave measurably less evidence of exposure to poliovirus than did the Guatemalans. Nineteen per cent had no antibody, and only 8% had antibodies to all three types of poliovirus.

For further comparison, data from the Guatemalan and the UCLA sera, together with similar data published by Gelfand, Fox and Montoya[4] on sera from an adult urban group of low socio-economic status in Lima, Peru, are given in Table 4. Among the latter individuals, none lacked antibodies of some type and a total

TABLE 2

Frequency of neutralizing antibodies to the viruses of poliomyelitis among young adults of Guatemala and southern California

	Guatemala N = 100	UCLA Students N = 100
No antibodies	4	19
Antibodies to 1 type only	29	42
Type I	22	19
Type II	2	8
Type III	5	15
Antibodies to 2 types only	34	31
I and II	10	12
I and III	11	11
II and III	13	8
Antibodies to all 3 types	33	8

TABLE 3

Titers of poliovirus neutralizing antibody in 100 Guatemalan adults, 1955

Titer*	Type I	Type II	Type III
Less than 4	24	41	38
4	20	13	11
8	13	11	7
16	22	16	16
64	13	11	6
256	2	2	3
1024 or more	6	5	19

* Expressed as the dilution of serum neutralizing 100 $TCID_{50}$ of virus.

TABLE 4

Comparative sero-immunity to poliovirus among groups of individuals in Guatemala, southern California and Lima, Peru

Group age (years)	Number of sera	Percentages of sera with neutralizing antibody					
		Type I	Type II	Type III	Mean†	All types present	No type present
UCLA students (19–23)	100	50	36	42	43	8	19
Guatemalan (20+)	100	76	58	62	65	33	4
Lima, Peru* (20+)	25	96	88	88	91	76	0

* Data presented by Gelfand, Fox and Montoya.[4]

† Mean of the percentages for each type considered separately.[4]

of 76 persons had antibodies against all three types of poliovirus. In general, antibodies to a particular virus type were about two-thirds as frequent in the UCLA series as in the Guatemalan; antibodies among the Peruvian group were uniformly more frequent than in the Guatemalan series.

The data indicate that by the time of young adulthood infection with one or the other of the three types of poliovirus is a common occurrence in Guatemala, despite the relative infrequence of clinically evident paralytic poliomyelitis. Type 1 infection was most common, 76 of 100 Guatemalan adults having had experience with this virus, while 62 had had Type III infection and 58 had had Type II.

DISCUSSION

Since only 100 persons were examined, the results here reported have the recognized limitations of small numbers. They do indicate a greater frequency of poliomyelitis infection in Guatemala than in the United States and certainly show that all three types are well established in the Guatemalan population. At the same time, it is evident that the poliovirus infection rate is only two-thirds as great in the Guatemalan series as in a comparable urban population in Peru; the mean percentage of sero-immunity[4] being 65 for the former and 91 for the latter.

Infection with poliovirus of all three types is also much more common among the population of Guatemala than the known occurrence of clinical disease would indicate. In view of the presumed oral-fecal spread of poliovirus and because of poorer environmental sanitation and habits of personal hygiene among families of the lower social classes, the wide dissemination of poliovirus is not surprising.[5] That overt paralytic poliomyelitis is so rarely seen could indicate (1) that the majority of the individuals exposed come in contact with the virus at an early age when passive immunity from the mother is still present or when other host factors make the occurrence of paralytic diease less likely, or (2) that the prevailing strains of virus are relatively avirulent.[5, 6] Since susceptible non-residents coming to Guatemala, particularly young adults, not infrequently develop paralytic poliomyelitis, it would appear that some wild strains of virus are fully virulent.

As the risk of exposure at an early age lessens in Guatemala under the impact of improved personal hygiene and environmental sanitation, the expectation is that children will not acquire their experience with poliomyelitis virus at as early an age as now, a time when resistance to paralytic disease is high. Paralytic poliomyelitis thus will likely increase along with an increase in age at which antibodies to poliovirus tend to appear. Such changes in the relative frequency of inapparent and overt infection have occurred in many parts of the world as environmental conditions improve. That the above trend is occurring in Guatemala is suggested by the considerable percentage (35%) of the adult population possessing no sero-immunity to the viruses of poliomyelitis. One might anticipate overt disease among these individuals.

The greatest risk at present appears to be among non-residents or transient individuals who previously may not have had contact with these infectious agents. When they contract febrile illness of indefinite nature, poliomyelitis should enter strongly into the differential diagnosis. The evidence of this study suggests that foreigners traveling to Guatemala and similar areas in the tropics and subtropics should be protected in advance by immunization with polyvalent poliomyelitis vaccine.

SUMMARY

The objective of the present study was to determine the frequency of poliovirus infection in Guatemala, primarily the inapparent infections occurring there. Sero-immunity, as indicated by serum neutralization tests in HeLa cell cultures, was demonstrated to all three poliovirus types. Among a group of 100 adults, 76 individuals had antibodies to Type I, 58 to Type II, and 62 to Type III; none of the group was known to have had overt or clinical poliomyelitis. It is concluded that polioviruses prevail in the Guatemalan population to a much greater extent than the occurrence of clinical disease would indicate. It has also been pointed out that 35% of the individuals tested failed to show seroimmunity to poliomyelitis.

Poliomyelitis must be taken into account by the physician in Guatemala in the differential diagnosis of any atypical fever, especially in non-residents. Vaccination with polyvalent poliomyelitis vaccine is highly desirable for foreigners entering tropical and subtropical areas and the probability that vaccination will become increasingly desirable for residents of Guatemala is suggested. The risk of paralytic poliomyelitis is greater than commonly realized.

ACKNOWLEDGMENT

The valuable suggestions of Dr. John Gordon, Professor of Epidemiology, School of Public Health, Harvard University, are gratefully acknowledged.

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