

## AN EVALUATION OF THE RÔLE OF THE FOOD HANDLER IN THE TRANSMISSION OF AMEBIASIS

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Since the Chicago epidemic of amebic dysentery in 1933, the importance of infected food handlers in the transmission of amebiasis has become a subject of controversy. In a comprehensive report (1) which followed an investigation of the Chicago affair, it was concluded that food handlers could have had little if any part in the causation of the epidemic. Although this conclusion could not be applied to food-handler transmission in general, the extensive investigations surrounding the epidemic were such as to throw considerable uncertainty upon the plausibility of this method of dissemination.

Previously, nearly all students of amebiasis had assigned to food handlers a rôle of considerable importance, many believing this group to constitute the chief source of amebic infections. For example, the well-expressed views of Craig (2) reflect to a more or less degree those which have been accepted by almost every writer on the epidemiology of amebiasis. He states (page 1235, paragraph 1): "*The contamination of food and drink by food handlers, who are passing the cysts of *E. histolytica*, the so-called 'carriers,' is undoubtedly the most common and most important method of transmission in many localities and certainly so in towns and cities having an impounded water supply and where sanitation is otherwise excellent. Food handlers in our hotels, restaurants, lunch counters, roadside refreshment stands, and other places where food is handled and sold, are the chief sources of amebic infection . . . and it may be stated that the contamina-*

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tion of food and drink handled by infected food handlers is practically a certainty unless the greatest care is taken regarding personal hygiene and the cleanliness of the hands of those who handle the food."

Despite the fact that food-handler transmission seemed to be too well established to countenance any doubts that may have arisen during the Chicago epidemic, the controversy was continued by the presentation of further evidence which again questioned the plausibility of the food-handler concept. Spector and Buky (3) conducted experiments to determine the likelihood of the contamination of food by infective material on the hands of food handlers. They found that but few cysts of *E. histolytica* would survive beyond five minutes although the fouling of the hands of their volunteers was far in excess of that which would be likely to occur even with a most careless carrier. Subsequently, Spector, Foster and Glover (4) reported that they could only find *E. histolytica* cysts in the finger nail scrapings and hand washings of but 5 of 74 carriers, although these were examined immediately after defecation and prior to washing their hands.

Both Craig (2) and Andrews (5) contend, however, that the short time of survival of cysts on the hands of carriers is still ample to permit the contamination of food if handled directly after leaving the toilet, and they conclude that Spector's experiments do not stand as an obstacle to the acceptance of the food-handler mode of transmission.

One phase of the problem which neither Craig nor Andrews appears to have considered is that the experiments of Spector and her co-workers indicate that only minute quantities of cysts occur even on the excessively fouled hands of a food handler, and, as it is probable that further dispersion would take place in the contamination of food, the number of cysts finally ingested would be few indeed. This postulates the establishment of human infections with but a single or few cysts of *E. histolytica*, an assumption which is warranted only on theoretical grounds. This seems further to question the tenability of the food-handler theory.

It is apparent from these considerations that no final con-



clusions are permissible, but there is reason to believe that there are certain limitations to the operation of food-handler transmission and these limitations suggest that the importance of this method of dissemination may have been over-emphasized.

It seemed that a more promising approach to the problem than hitherto made would be to examine groups which have been served food and drink by carriers, and to determine if the presence of infected food handlers actually augmented the amebiasis incidence in such groups. Such an approach became possible during a recent survey of the occurrence of *E. histolytica* in Navy groups (6) in which it was apparent that conditions were such as to be unusually favorable for transmission by food-handlers.

#### METHODS

The investigation is presented in two parts. The first is a study of the incidence of *E. histolytica* infections resulting from food-handler contacts made by Navy groups on foreign duty, the exposures occurring in places serving food and drink to the men while on shore leave. The second part is a study of the incidence of amebiasis in naval messing units aboard ship, these groups having been attended by numerous carriers serving as cooks or mess attendants.

With but a few exceptions three fecal examinations were made on each man, the first specimen having followed the administration of a mild cathartic. Since Andrews (7) reports that catharsis markedly increases the chances of detecting protozoal infections, it seems probable that the procedures employed revealed a large majority of all infections. All protozoal diagnoses in the fresh preparations were confirmed by iron-hematoxylin stained preparations, using the short method described by Johnson (8).

It is obvious that infections acquired prior to the exposures described in the present study had to be taken in account. The expected rate was determined by the examination of naval recruits at the Norfolk Naval Training Station in Virginia. The results are shown in Table 1.

The groups selected for examination represent men from all parts of the United States. Examinations done on 206 recruits

showed that 11.3 per cent harbored the dysentery protozoan, a rate which agrees remarkably well with Craig's (9) summary of nearly 50,000 examinations, in which an average of 11.6 per cent was found for the general population of the United States. The 14.7 per cent incidence among men from the Southern United States was almost twice that for recruits from other parts of the country, the rate of these latter being 7.8 per cent. It is therefore apparent that the expected rate for any Navy group will range between 8 and 15 per cent, and that rates falling within these

TABLE 1

*Control study—Endamoeba histolytica infection rates for naval recruits*

RESIDENCE	NUMBER EXAMINED	INCIDENCE OF <i>E. HISTOLYTICA</i>
		<i>per cent</i>
Recruits from southern states.....	129	14.7
Recruits from all other states.....	77	7.8
Average infection rate for recruits from all parts of the United States.....	206	11.3
Average rate, general population, all parts of the United States. From Craig (9).....	49,336	11.6

limits should be ascribed to amebiasis acquired previously to the exposures described in the present investigation.

#### I. RESULTS OF CONTACTS WITH FOOD HANDLERS ASHORE

Examinations were made on three naval groups on foreign duty. The following considerations are of significance in evaluating the infection risk of these groups: (a) The men had on repeated occasions obtained food and drink in various establishments ashore during their tour of duty which extended over a period of one to three years. (b) The sailors, often having but limited funds, tended to patronize eating places of an inferior hygienic and sanitary order. (c) That a large proportion of attendants in such places were natives having little appreciation of the importance of either personal hygiene or of the employment of cleanly methods. (d) Lastly, that the exposures were made in countries of high amebic endemicity and consequently the carrier rates among the native food handlers were unusually high.



The first Navy group, comprised 218 men of which 9.6 per cent were found to have *E. histolytica* infections, or an incidence which in falling well within the range of expected rates as determined in the control study, indicates that the conditions of exposure had not affected to any significant degree the previously existent *histolytica* rate. The men of this group had been stationed aboard a gunboat on tour of duty in Panama where the food-handler exposures occurred ashore in Panama City. Surveys by Faust (10) have shown between 15 and 20 per cent of Panamanians to be carriers of *E. histolytica*; consequently, it is reasonable to assume the existence of a fairly high carrier rate among the food handlers employed in the many places which served food and drink to the men.

Another group included the crews of two destroyers having a complement of 254 men. An actual infection rate of 9.8 per cent was found, or again a rate which was not greater than would be expected irrespective of the exposures experienced by this group. These men had visited ashore in cities and villages of the coast and interior in nearly every country of Central America and Northern South America. The hygienic conditions in many of the places in which food and drink was served was of a most primitive type. The exact incidence of carriers among food handlers in these countries of the American Tropics is not known, but this region is termed by James (11) as one of the "... world's hotbeds of *histolytica* infections. . .," and there can be little doubt but that infected food handlers are plentiful. Surveys by James (12) and Faust (10), and the experience of the authors, indicate that between 10 and 70 per cent of the native populations harbor the parasite, the exact incidence varying with the locality.

The third group included men stationed at the Submarine Base in the Canal Zone, these men being frequently exposed to food handlers in Colon City under conditions very similar to those in Panama City. Of the 251 men examined, the actual rate was 9.6 per cent, an incidence which when compared to the expected rate, again indicates a lack of newly acquired infections.

Comparisons of actual and expected infection rates in the three groups, considered as a whole, reveal a most interesting result.

Questionnaires returned by 647 men revealed that 256 of these had previously resided in the Southern United States while 391 of the men were from other parts of the country. Regrouped in this manner, the control study (table 1) shows that 14.7 per cent *E. histolytica* infections is the expected rate. Actually 13.3 per cent were parasitized. Similarly, in the latter group, the actual infections amounted to 7.8 per cent or again, almost identical with the expected rate which in this case is 8.4 per cent. The close agreement of these actual and expected rates, therefore, justify the conclusion that the described exposures did not result in any significant increase in the number of amebic infections.

#### II. INCIDENCE OF AMEBIC INFECTIONS IN NAVAL MESSING UNITS SERVED BY INFECTED FOOD HANDLERS

The officers and crew aboard naval vessels are served food in individual messing units. The officer's mess is entirely separate having its own cooks and mess attendants while the crew is divided into several messing units having their own attendants, but served in common from a central galley or kitchen. All food handlers engaged in the preparation or serving of food were included in the examinations and only units were considered in which the turn-over in personnel had been minimal.

The sanitary details of all messes were uniformly satisfactory. It is to be noted, however, that the maintenance of personal hygiene aboard ship requires a considerable amount of initiative on the part of the crew. The limitation of space aboard ship requires considerable restriction in the number of sanitary conveniences for washing purposes. This situation is particularly true for submarines and smaller naval vessels. For this reason, naval messes on ships of this type were particularly selected for study for these appeared to be conditions favorable for transmission by food handlers.

As shown in table 2, there were no *E. histolytica* carriers serving in 8 of the individual messing units.

The infection rate among those served varied from 3.3 to 25.0 per cent, some of these indices being undoubtedly influenced by the small size of the groups. In all, there were 149 persons



served, with 17 carriers, or 11.4 per cent infected. The expected incidence of this group, as determined from results in the control group (table 1) is 11.3 per cent, or almost identical with the actual incidence.

Table 3 summarizes the results of examinations in 11 naval messes, all of which in these cases were served by one or more infected food handlers.

In five messes, none of the men served by carriers were infected, while in the remaining six messes, the incidence of *E. histolytica*

TABLE 2

Control study—incidence of *E. histolytica* in naval messing units; no infected food handlers

MESS	FOOD HANDLERS		COMPOSITION OF MESS		
	Number	<i>E. histolytica</i> carriers	Number served	Number infected	Per cent infected
Marines.....	10	None	30	1	3.3
Crew.....	7	None	33	2	6.1
Officers.....	8	None	8	1	12.5
Marines.....	11	None	30	4	13.3
Crew.....	8	None	34	6	17.6
Officers.....	6	None	5	1	20.0
Officers.....	4	None	5	1	20.0
Officers.....	4	None	4	1	25.0
Messes not served by carriers (8).....	58	None	149	17	11.4
Expected incidence of <i>E. histolytica</i> irrespective of food handler exposures (table 1).....					11.3

infections showed the same variations as the messes presented in control study (table 3) in which no carriers were among those preparing or serving food.

The last two groups in table 3 show rates higher than the expected rates, but the 25.0 per cent incidence in one is based on examination of but four individuals. The 21.7 per cent incidence in the next to the last group (table 3) occurred in a mess unit of 37, but it will be observed that there is a similar group of 34 in the control study (table 2) in which 17.6 per cent were found to be

infected, although no carriers had served in this group. Furthermore, it was found that the mess with a 21.7 per cent incidence was composed of a high proportion of men from Southern States, in which case the expected rate would also be high.

Comparing as a whole the two groups, one composed of 149 individuals, in which no carriers were among those serving them, and the other, comprising 196 men served by twenty infected

TABLE 3

*The incidence of E. histolytica in naval messing units served by infected food handlers*

MESS	FOOD HANDLERS		COMPOSITION OF MESS			
	Number	<i>E. histolytica</i> carriers	Months of service	Number served	Number infected	Percentage infected
Petty officers.....	11	4	7, 6, 5, 1	13	0	0.0
Officers.....	17	3	7, 7, 14	12	0	0.0
Petty officers.....	8	1	27	10	0	0.0
Officers.....	3	1	22	3	0	0.0
Officers.....	9	1	24	6	0	0.0
Crew.....	6	1	2	32	1	3.1
Crew.....	11	1	2	35	2	5.7
Petty officers.....	15	1	1	10	1	10.0
Crew.....	11	2	3, 2	34	4	11.8
Marines.....	19	4	1, 2, 2, 1	37	8	21.7
Officers.....	3	1	6	4	1	25.0
Messes served by carriers (11)....	113	20	7.1*	196	17	8.7
Messes not served by carriers (8)...	58	0		149	17	11.4
Expected range of <i>E. histolytica</i> rates in unexposed groups (Table 1)...						7.8-14.7

\* Average.

food handlers, the former shows an infection rate of 11.4 per cent while the latter shows only 8.7 per cent to be infected. The infection rate in the one group, therefore, was not augmented by the presence of infected food handlers, and the incidence of *E. histolytica* in both groups falls within a range of 8 to 15 per cent which the control study shows may be ascribed to infections acquired prior to naval service.



## DISCUSSION

One can scarcely object to the view that food handlers may under certain circumstances transmit amebic infections to others, but the important question is whether such an event is of common occurrence. The evidence presented in the introduction of this report showed that there were severe limitations involved in the mechanism of food-handler transmission, suggesting that such dissemination could not be considered of importance. In the present investigation this postulate has been put to a practical test under such conditions as to particularly favor transmission by food handlers. Thus, in few places in the world is the general carrier rate as high as among natives of the American Tropics, and added to this hazard is the fact that the natives employed as food handlers were largely of a class in which there could be no doubt that breaches in personal hygiene were of frequent occurrence. While not as extreme, the conditions aboard ship were also of the very nature which advocates of the food-handler theory have stressed as being dangerous. This unusual combination of circumstances was one which would seem inevitably to lead to dissemination; yet it did not do so, a result which might have been anticipated from the suggestive work of others.

This failure of transmission under such favorable conditions suggests that food-handler dissemination cannot be of common occurrence. It appears that such factors as desiccation may militate against the successful transference of infective material by the hands of carriers, or possibly that small numbers of cysts will not suffice to establish amebic infection in others. Whatever factors may limit transmission by food handlers, there seems to be little doubt that it can occur only on the part of a most uncleanly person.

In view of the lack of dissemination on the part of uneducated natives, not generally appreciative of the importances of personal hygiene, it cannot be justifiably claimed that widespread reforms directed against food handlers are necessary in the United States. The appearance of high community indices or cases of amebic

dysentery, should cause a search for obvious sanitary defects before suspecting food handlers.

#### CONCLUSION

In a controlled study of 14 groups, comprising in all 919 persons which had been served food and drink by carriers of *E. histolytica*, there was no evidence to support the belief that infected food handlers were important agents in the transmission of amebiasis.

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