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HOUSING AND CERTAIN SOCIOENVIRONMENTAL FACTORS AND PREVALENCE OF ENTEROPATHOGENIC BACTERIA AMONG INFANTS WITH DIARRHEAL DISEASE IN PANAMÁ*

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ABSTRACT: A survey was made in Panamá of the dwellings of 1,819 infants with diarrheal disease who had been examined for the presence of enterobacterial pathogens. Each of six dwelling types encountered differed characteristically from each other, but five of the six types were substandard and their occupants were of low socioeconomic status. Enteropathogenic *Escherichia coli, Shigella,* and *Salmonella,* alone or in association with one another, were more frequently isolated from infants living in substandard dwellings than from better-kept houses. The differences in rates among the various substandard dwelling types (6.0 to 10.2%) were not significant but contrasted markedly with the zero infection rate observed in the better type of housing.

This report is the second in a series dealing with diarrheal disease in Panamá. The first described the results of a clinical and bacteriologic study with 1,819 infants brought for treatment to the outpatient clinic of the Children's Hospital in Panama City, Republic of Panamá.[1] The major complaint for which these infants were treated was diarrheal disease.

Recent trends in control of diarrheal disease have focused attention on the development of techniques for better clinical management of cases and for sanitary improvement of the environment.

Studies by several authors, including Stewart *et al.*,[2] Watt *et al.*,[3] and others,[4] have clearly demonstrated the close association of inadequate sanitation and poor personal hygiene with a high prevalence of diarrheal diseases and certain enteric pathogens. Other environmental factors likewise may influence the presence and magnitude of the diarrheal problem. An effort was made therefore to evaluate the role of certain socioenvironmental conditions on the group of infants with diarrheal disease described in our first report[1] and to determine whether the type of housing influences the prevalence of specific enterobacterial pathogens.

METHODS

As outlined in our first report,[1] pertinent data for each infant were obtained by interview with the parents of the child at the time of the visit to the clinic. This included name, sex, age, address, and length of residence at the address given. Concurrent observations on the type of construction of the house were recorded from visits to the area of residence in most cases. For the remaining houses, usually those from remote rural areas, the type was estimated from the interview records.

Additional information on the total number of housing units, the number of persons in each type of dwelling, and the proportion of the population of Panama City with access to certain water supplies and toilets within the city limits were estimated from data in the records of the "Instituto de Vivienda y Urbanismo"[5] (Housing and Urbanization Institute) and the "Censos Nacionales"[6] (National Census Bureau).

All the information recorded reflects the housing conditions of the infants with diarrheal disease. The home visits to the patients made possible a classification of the dwellings according

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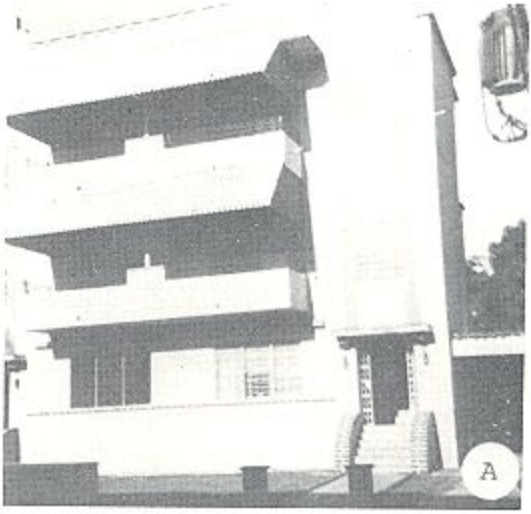
FIGURE 1. Photographs showing representative types of dwelling of the infants with diarrheal disease included in the study. **A**, well-kept apartment building in better area of Panama City. **B**, two-storey, wooden, multifamily tenement building in older section of City. **C**, cluster of make-shift squatter shelters in the center of Panama City. **D**, simple, semirural type of house within city boundaries. **E**, single-family house in semi-urban area of a town near Panama City. **F**, single-room rural dwelling with mud walls and thatched roof.


A


B


C


D


E


F

TABLE 1

Classification of dwellings by area of residence, construction, and socioeconomic status of occupants

Area of residence and construction	Dwelling type	Socioeconomic status
Panama City		
Single-family houses or apartments	1	Middle to high
Multifamily tenements	2	Low
Squatter shanties	3	Very low
Rustic houses in semirural areas within city limits	4	Low to middle
Areas near Panama City		
Varied, single- and multi-family structures, urban and semiurban	5	Low
Rustic and varied dwellings, rural	6	Very low

to area of residence and type of construction. Six types of dwelling were thus established, four in Panama City and two in nearby areas, as shown in Table 1 and Fig. 1, **A**–**F**. The following descriptions illustrate the different types encountered and the living conditions of the children included in the study.

Dwelling Type 1

These are well-kept single family houses and apartments (Fig. 1, **A**) in the better areas of Panama City occupied by middle- to high-income families. The plumbing in most units is connected to the city sewage system, some to septic tanks. Toilets generally are in good or excellent condition and are used exclusively by the family. With very few exceptions, piped city water serves these houses.

Dwelling Type 2

Located in the older, congested section of Panama City, these rows of wooden, two-storey multifamily tenements (Fig. 1, **B**) were built at the start of the century. The living conditions of the occupants (large, low-income families) are crowded. Usually there are only one or two sets of toilets and sinks connected to the city sewers on each floor of the tenement and must be shared by a great number of families. Besides being inadequate, these sanitary facilities are generally dirty and in poor condition. Water for cooking must be carried to the individual rooms where a make-shift kitchen, consisting of a small kerosene burner and a few pots and pans on a table, is located inside or just outside of the door. The buildings are usually not well-maintained, although individual differences exist among families.

Dwelling Type 3

These are clustered groups of make-shift squatter shelters lacking basic sanitation services (Fig. 1, **C**). Constructed with used or discarded materials (tin, wood, blocks, or even cardboard), they are put up overnight in any available space to serve as "temporary" habitations.

Shanty settlements are dispersed around Panama City on unused government or privately owned land, thus adding to critical urban problems. Squatter communities result from rural-to-urban migration of the population, owing to unsatisfactory socioeconomic conditions and ignorance in the rural areas.

The families living in these substandard shelters are of very low socioeconomic status, lack running water, and numerous families share a few improvised pit privies. A few public faucets served by city water are available to every 20 to 30 families.

Dwelling Type 4

In 1960, the boundaries of Panama City were extended into outlying rural areas; thus many inhabitants (low- to middle-income families) are within the city limits, but live under rural or semirural conditions. Most houses are simple, single-storey, low-cost dwellings of cement blocks, mud, wood, or a combination of these, with tin or tiled roofs (Fig. 1, **D**). Few two-storey, two-family units exist. Piped water, from the city or local community supplies, reaches about one-third of these dwellings. The remainder of the population has access to private or public wells, or obtains drinking water from unprotected surface sources.

In most instances, toilets are poor and inadequate; usually pit privies are shared by many families. However, most houses served by piped water have indoor flush-toilets connected to septic tanks.

Dwelling Type 5

Housing in general is of varied construction and located in towns near Panama City (Fig. 1, **E**). They consist of houses, tenements, and

TABLE 2

Selected sanitary facilities available to the population of Panama City by dwelling type*

Dwelling type†	No. of dwellings	Population	Population density			Percentage of population with access to:						
			Persons per dwelling	Rooms per dwelling	Persons per room	Piped city water	Drilled wells	Open surface water	City sewage	Septic tanks	Pit privies	No facilities
1	15,515	73,965	4.8	2.9	1.7	98.9	1.0	0.1	42.9	42.1	12.7	2.3
2	38,374	162,229	4.3	1.7	2.6	98.9	0.7	0.4	76.8	17.4	3.8	2.0
3	3,509	18,134	5.2	1.7	3.1	98.2	1.6	0.2	0	2.7	67.0	30.3
4	3,000	14,715	4.9	2.1	2.4	31.5	29.3	39.2	0	23.6	65.6	10.8

* Estimates based on figures in: *Censos Nacionales de 1960, Vol. II, Ciudad de Panamá, Dirección de Estadística y Censos, and Instituto de Vivienda y Urbanismo, Panamá 1965.*

† According to the classification shown in Table 1.

shanties similar to those in groups 2 through 4 in Panama City. Most are served by piped water from local aqueducts or from drilled wells on or near the premises. In communities lacking city sewage, septic tanks are the most common facility for the disposal of excreta. Few houses have indoor flush toilets. The inhabitants can be characterized as low-income families.

Dwelling Type 6

These are rustic dwellings of the rural areas. The most frequent type consists of walls of wood or *quincha*.* They have tin or thatched roofs, packed-dirt floors, and consist of a single room for the entire family (Fig. 1, **F**). Domestic birds and animals wander in and out of the house at will. Many of the animals also sleep indoors with the family.

Water sources are inadequate or lacking in some communities. The few drilled wells present are either individually owned or public. The latter are usually constructed by local self-help groups or by the government. Most of the time these wells are defective due to lack of maintenance by the community. They are usually located some distance from the dwellings and are used by many families. Other major sources of water are unprotected surface water from streams, rivers, and lakes.

Toilets are almost nonexistent, and the few pit privies are shared communally. These families are of very low socioeconomic condition.

* Made by plastering a mixture of mud and straw on a framework of wooden slats from shrubs and small trees.

RESULTS

Table 2 summarizes population density and certain selected water supplies available to the population of the metropolitan area of Panama City by dwelling type.

About 27% of the total population of the city lives in well-kept homes and apartments (type 1) having modern sanitary conveniences. The other 73% occupies substandard housing (types 2, 3, and 4) where sanitary facilities are notoriously inadequate. Of the total population of the city, about 60% lives in tenement slums, 7% in shanties, and 6% in rustic houses.

Fewer than two persons per room is characteristic for dwellings of type 1, while 2.4 to 3.1 occupants per room is typical for dwelling types 2, 3, and 4.

Although city water reaches most dwellings (Table 2), utilization is limited for many families of type 2 and type 3 dwellings because the source is distant from the dwelling. Occupants of houses in semirural areas (type 4) within Panama City limits take their water from varied sources, including unprotected streams and springs.

For dwelling types 1 and 2, the most common means for disposal of excreta are flush-toilets connected to city sewage, but residents of the slum tenements (type 2) share such facilities communally. For those living in shanties (type 3) and in rustic, semirural dwellings (type 4), pit privies are the usual means of disposal. However, in the latter two groups, an appreciable number of households has no sanitary facilities for excreta disposal.

Table 3 shows that most cases of diarrheal disease came from urban housing in Panama City

TABLE 3

Prevalence of enterobacterial pathogens in infants with diarrheal disease by dwelling type

Dwelling type*	No. of infants examined	Those with pathogens (%)	Those harboring particular pathogens (%)		
			EEC†	*Shigella*	*Salmonella*
1	52	0.0	0.0	0.0	0.0
2	828	8.6	5.7	1.8	1.1
3	411	6.3‡	3.9	2.2	1.0
4	118	10.2§	7.6	2.5	0.8
5	67	6.0	3.0	1.5	1.5
6	343	9.0	6.4	0.9	1.7
Total	1,819	7.9	5.3	1.7	1.2

* According to classification shown in Table 1.
† Enteropathogenic *Escherichia coli*.
‡ Two infants had *EEC* and *Salmonella*; another had *EEC* and *Shigella*.
§ One infant had *EEC* and *Salmonella*.

and other nearby towns. Infants from the tenements (45.5%) and shanties (22.5%) made up the bulk of the city cases, while those from rural housing (type 6) accounted for 19% of the study population. A small number of cases (3.7%) was represented by infants from urban houses in communities other than Panama City (type 5).

The prevalence of enteropathogenic *E. coli*, *Shigella*, and *Salmonella* by dwelling type is also shown in Table 3. These organisms, alone or in association with one another, were more frequently isolated from infants living in substandard dwellings than from better-class houses. The differences in rates among the various substandard dwelling types were not significant at 0.05 level when tested by the chi-square test.

The two most frequently encountered pathogens were *E. coli* 055:B5 and 0128:B12. Twenty (59%) of 34 *E. coli* 055:B5 were isolated from infants living in type 2 dwellings, while *E. coli* 0128:B12 was more equally distributed among infants of dwelling types 2, 3, and 6. For other pathogens, the numbers were very small.

DISCUSSION

Diarrheal disease associated with infectious agents is influenced to a large degree by social and environmental conditions present in a given area. The demonstration of specific or single environmental factors as contributors to higher prevalence of disease is at times difficult. Recent studies, however, have associated specific sanitation deficiencies with high rates of enteric disease. For example, Beck, Muñoz, and Scrimshaw presented evidence for correlation between high *Shigella* rates and lack of sanitary facilities, poor housing, limited water supply, and poor personal hygiene in Guatemala.[7] Schliessman *et al.*, in the United States, observed that there were nearly twice as many cases of diarrhea among persons living in dwellings having outside privies than among those whose houses had indoor toilets.[11] Watt and his associates, also in the United States, noted that in areas of inadequate sanitary facilities, poor housing, and low income, *Shigella* infections were the major cause of diarrheal disease.[12]

We have attempted to relate prevalence of specific enterobacterial pathogens to the type of dwelling occupied by infants with diarrheal disease. The dwellings were considered a useful and satisfactory index of social and economic influences on frequency of infection since they reflected, in most respects, the sanitary condition prevalent in the household. Single factors such as social class of the dwelling inhabitants, the degree of overcrowding, the availability and quality of water, and access to adequate excreta-disposal facilities were not considered individually. The type of housing with its inherent sanitation deficiencies and domestic conditions was taken as a whole.

Each of the six dwelling types differed characteristically from each other. The well-kept urban homes and apartments (type 1) exhibited structural and sanitary conditions far superior to those of the other five groups. Enterobacterial pathogens were not isolated from the infants living in these dwellings. Tenement buildings in Panama

City (type 2) with their substandard housing units were slightly better structurally than the lowest class of dwellings, the squatters' shanties of the city (type 3), and the rural rustic houses (type 6).

Infection rates for enteropathogenic *E. coli*, *Shigella*, and *Salmonella* among infants from the various groups of substandard dwellings contrasted significantly with the zero infection rate observed in infants from the better-type housing (type 1).

Thus, it would seem that although there were appreciable differences in the quality of dwellings among the various substandard types (2 through 6), the environmental and social conditions influencing infection with these pathogens were similar.

Other variables may conceivably be just as important as type of dwelling. Bruch *et al.* found that in certain Guatemalan villages the habits of the people and the density of the population were more important determinants of diarrheal diseases than the type of housing.[9] The standard of living, in general, likewise influences enteric infections. Shigellosis, for instance, has already become a relatively rare disease in the most economically favored communities where water supplies are usually best developed.[10] On the other hand, health authorities still consider that no single factor approaches the significance of a safe, adequate water supply in reducing the prevalence of enteric infections.[11]

Combined community and individual efforts supported by governmental agencies become necessary in large areas of the world in which enteric infections and diarrheal diseases are still serious health problems. Planned programs for adequate housing, provision for a safe water supply within each dwelling, if possible, safe removal of human excrement, and improvement in the general standard of living will undoubtedly be accompanied by a significant decrease in the frequency and severity of diarrheal diseases due to enteric infections.

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