The High Cost of Being Poor

Water

Blanca Adrianzen T., Lima, Peru, George G. Graham, MD, Baltimore

Longitudinal anthropometric and socioeconomic assessment was made of 127 families of children admitted to the British American Hospital in Lima, Peru, with malnutrition in 1961 to 1971. In 1972, those recruited during 1961 to 1966 had higher incomes and were more likely to have running water and electricity than those recruited later, who were more likely to be using candles or kerosene and to buy water in cylinders, at a unit cost 16.7 times higher. Mean midparental heights were equal, but the children from families with water and electricity services were taller for their age.

Expenditures for illumination were similar, whether for electricity or for candles or kerosene, but the cost of water by volume was very much higher in families without running water. When expenditure was expressed as percentage of income or as the amount of working time to pay for water, the differences were even greater: 2.6% to 2.7% vs 0.4% to 0.7% and 423 to 445 vs 71 to 129 minutes/month.

During more than 12 years between Jan 4, 1961, and Dec 31, 1971, we have been following surviving children who were admitted under our care to the British American Hospital in Lima, Peru, with the diagnosis of severe malnutrition. During the last six years we have included their entire immediate families in the study, that now covers 167 families. This report deals with only 127 of these families. With the exception of eight families into which eight of our expatients were adopted, they belong to a very low-urban socioeconomic level, coming from the peripheral slums or *barriadas* of greater Lima.

This report deals with the cost of a single basic commodity, water, seldom considered of major importance in the budget of most families. The importance of an abundant supply of pure water for the maintenance of a decent standard of living and hygiene is not questioned.[1] We have analyzed the type of water service, the amount consumed, and its cost in absolute terms, in relation to total family income, and to the amount of time worked to pay for it. To the extent possible, we have compared its cost to that of another basic necessity, artificial illumination. We have also re-

Fig 1.—Water supply for a sector of one of the peripheral slums of Lima. Most of the homes visible have already evolved from the original straw mat construction. Very dry desert soil is evident.

Submitted for publication Nov 12, 1973; accepted Jan 24, 1974.

From the Instituto de Investigacion Nutricional Miraflores (Lima), Peru (B. Adrianzen T.), and the Department of International Health, School of Hygiene and Public Health, the Johns Hopkins University, Baltimore (Dr. Graham).

Reprint requests to 615 N Wolfe St, Baltimore, MD 21205 (Dr. Graham).

lated the data on water consumption and cost in 1972 to the growth of children of the families, based on the heights of their members in the same year. In populations in which undernutrition is the rule rather than the exception, we consider this to be the single most convenient expression of nutritional state and general health over long periods of time.[2]

Materials and Methods

These families have one common denominator: at least one child who, in early life, was malnourished enough to be admitted to the hospital. Of the 167 families, 91 correspond to admissions during the years 1961 through 1966. Twenty-two of the 91 are not included: one is living in the United States, 14 do not pay for water, and seven receive it from their employer. Eighteen of the 76 families corresponding to admissions during the years 1967 through 1971 are excluded: 11 do not yet pay for water, six receive it from their employer, and one adoptive family enjoys a standard of living very much higher than that of the remaining families. We have included 69 from the first group and 58 from the second, a total of 127 families.

They entered the study when the index case of malnutrition was discharged from the hospital: anthropometric, clinical, and socioeconomic data were obtained at this time, six months later, 12 months after discharge, and yearly thereafter. At least one visit was made to the home. On the date of each periodic evaluation the entire family was transported to our unit.

Anthropometry.—This included height, weight, and head circumference. Height of children was converted to a height age, that to which it corresponded on the 50th percentile of a commonly used US standard.[3] The height quotient used in this report was the height age as a percentage of chronologic age, each to the nearest month. It allowed us to compare or to average children of different ages and sex, and to compare the same child at different ages.

Clinical Examination.—Children being seen for the first time, particularly young infants, were examined thoroughly. If a child was sick, all the necessary diagnostic services were provided free, as were most medications and all immunizations.

Socioeconomic Status.—On the first visit a detailed social history was obtained, and on each subsequent visit it was brought up to date. For each member of the family it included place of origin, length of residence in Lima, marital state, formal education, state of health, personal hygiene,

Table 1.—Distribution of Families According to Year of Admission Into Program and the Type of Water Service, 1972

Group	Year of Admission	Type of Water Service: Private	Common Spigot	Cylinders	Totals
1	1961-1966	30 (43.5%)	16 (23.2%)	23 (33.3%)	69 (100%)
2	1967-1971	7 (12.0%)	6 (10.3%)	45 (77.6%)	58 (100%)
Totals		37 (29.1%)	22 (17.3%)	68 (53.6%)	127 (100%)

Table 2.—Monthly Averages (±SD) for Income, Water Consumption, and Amounts Paid for Water and Lighting in Soles

Type of Service	Group	Income in Soles	Water in cu Meter	Amount Paid for Water or Lighting: in Soles	% of Income	Minutes of Work
Private water and sewerage	1†	6,505 ± 5,240	28.6	43 ± 21	0.7	129
	2	6,034 ± 2,947	21.4	32 ± 13	0.5	125
Electricity	1	...	...	84 ± 56	1.3	224
	2	...	...	55 ± 19	0.9	206
Common water spigot	1	4,609 ± 3,780	12.7	19 ± 13	0.4	71
	2	3,695 ± 352	16.1	24 ±14	0.7	100
Electricity	1	...	...	60 ± 38	1.3	216
	2	...	...	53 ± 22	1.4	207
Water in cylinders	1	4,283 ± 2,386	4.5	113 ± 63	2.6	445
	2	3,571 ± 1,952	3.9	98 ± 53	2.7	423
Candles or kerosene	1	...	...	74 ± 32	1.7	285
	2	...	...	64 ± 24	1.8	308

* Figures based on a percentage of income and minutes of work during the year 1972, by 127 families divided by types of services.
† Group 1 corresponds to 1961 to 1966 admissions, group 2 to 1967 to 1971.

Table 3.—Hypothetical Mean Cost of Water for One Tub Bath in 1972 for 127 Families According to the Type of Water Service

Type of Water Service	Income in Soles per: Month	Minute	Cost of Water in Soles/cu Meter	Cost of Water for Tub Bath, 0.25 cu Meter: Soles	Minutes of Work
Private	6,416	0.45	1.50	0.38	0.8
Common spigot	4,360	0.30	1.50	0.38	1.3
Cylinder	3,812	0.26	25.00	6.25	24.0

Table 4.—Midparental Height and Age, Height Quotient of Siblings and Patients, and Age (1972) by Type of Water Service

	Type of Water Service: Private	Common Spigot	Cylinders
No. of patients (N)	32	20	74
Mean midparental height, cm ± SD	153.3 ± 4.6	154.1 ± 5.1	154.5 ± 4.5
Mean midparental age, yr ± SD	42.5 ± 7.4	41.9 ± 8.8	35.4 ± 6.4
Mean height quotient of sibs ± SD	78.1 ± 7.6	76.1 ± 8.7	73.2 ± 8.9
Mean height quotient of patients ± SD	71.8 ± 10.6	72.5 ± 11.9	68.6 ± 11.9
Mean age of ex-patients, mo ± SD	107.3 ± 34.8	101.8 ± 30.4	88.0 ± 34.2

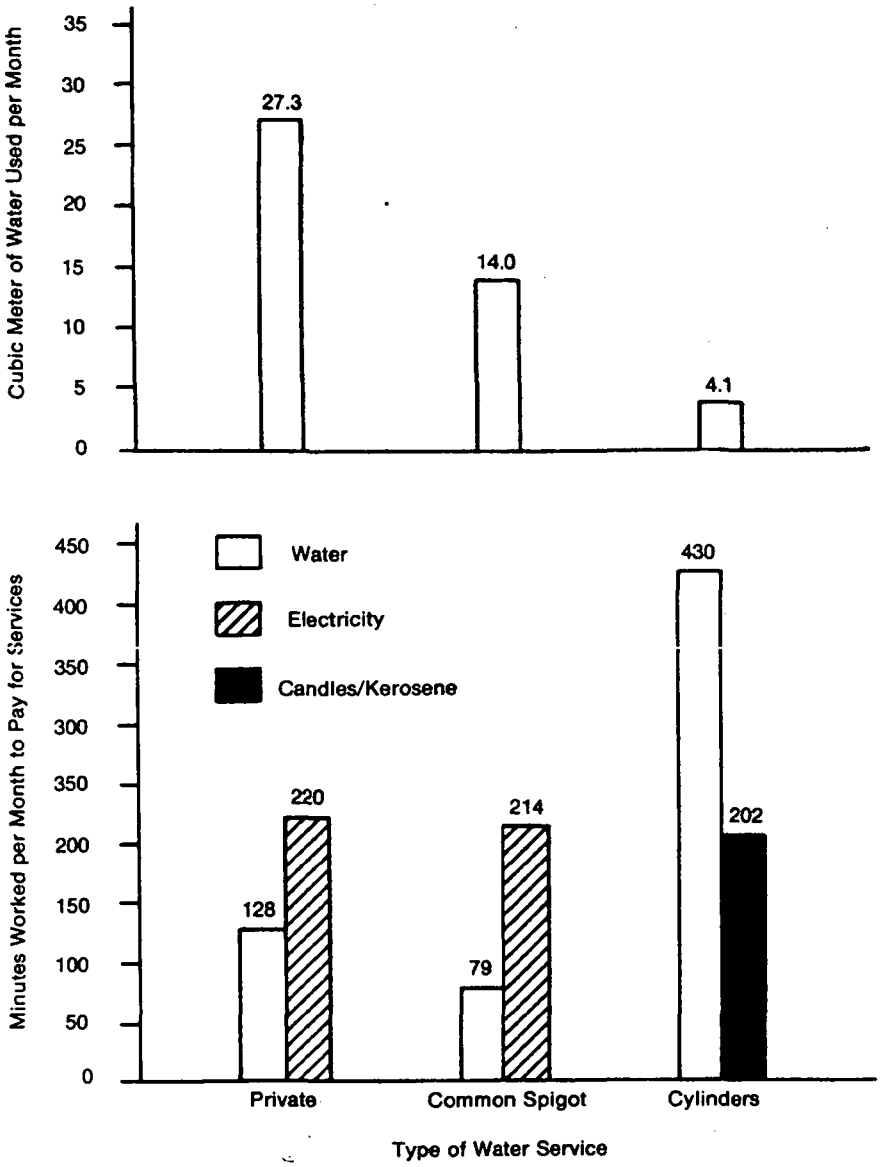

Fig 2.—Monthly consumption of water and its cost in terms of minutes worked to pay for it, relative to that for illumination, by types of water service.

occupation, total income, disposable income (for the home), and expenses. Among the latter we specified amounts for rent, water, lighting, fuel, street lighting and garbage collection, transportation, clothing, and food. For the home itself we included location, ownership, conditions of occupation, type, construction materials, composition, services, sleeping facilities, population density, furniture, condition, and state of hygiene.

In a previous report we related the later growth of the index case of malnutrition in many of these same families to various socioeconomic indexes.[2] In the present one we are looking at the cost of a single basic item, water. Not all the families enjoy the same type of service for water or for lighting. Some have the advantages of private metered water and sewerage services; others, though having these same services available, share them with other families living in the same unit or *callejón*, where water is provided by a single common spigot or *caño común*, with a single meter. The cost is prorated. In the newer peripheral slums there is still another type of central water service, but without sewerage facilities. Families with this type of service have been excluded from this study, as the water from a strategically located common spigot is not metered and they do not yet pay for it. Still another group of families do not have water or sewerage services, and have to acquire water from tank trucks and store it in cylinders or barrels (Fig 1)—they are included in our analysis.

Those families with private water or a common spigot had electric light; those with no water service used candles or kerosene lamps for lighting.

The 127 families are divided into two groups, 1 and 2, on the basis of the recruitment dates, 1961 to 1966 and 1967 to 1971, and by the three types of water service: private water and sewerage, common spigot, and cylinders.

Results

Thirty-seven families, 30 from group 1 and only seven from group 2, enjoyed private water and sewerage services.

Twenty-two families, 16 from group 1 and six from group 2, used a common spigot.

Sixty-eight families, 23 from group 1 and 45 from group 2, had no water service and had to buy it in cylinders. These results are summarized in Table 1.

Table 2 summarizes the total monthly family income in Soles (one US dollar = 43.38 Soles as official rate), the amount of water purchased (derived from amount paid), the actual amounts paid for water and lighting, the percentage of monthly incomes represented by each expense, and the minutes of work that the expense represented each month. The families are divided by type of water service and by group (1 or 2).

Those families with private water services had a substantially higher income than those who used a common spigot or bought water in cylinders. The income of these last two sets of families was not different, whether they belonged in group 1 or group 2. In all three sets, the income of group 1 families (recruited in 1961 to 1966) was higher than that of group 2 (1967 to 1971). This is not surprising as parental age and length of residence in Lima were greater for the group 1 families.

The families with private services consumed roughly twice as much water as those with a common spigot and, because they paid the same rate, spent twice as much. Those with no water service spent two to six times

as much money for one third to one seventh as much water as the others; they also spent as much on candles or kerosene as was spent for electricity by the others.

When the expenses for water or lighting are expressed as a percentage of income or as minutes worked to pay for them, the greater expense to those without services is further exaggerated. In Fig 2 the consumption of water and the minutes of working time to pay for water and lighting for the three types of water service are shown. Groups 1 and 2 have been combined.

The above estimates are based on an average cost of 1.50 Soles per cubic meter of water from the public system and of 25 Soles/cu meter when it is bought in cylinders. The actual charge is 5 Soles for a cylinder holding 0.20 cu meter.

The charge for 1 kw hour of electricity is 0.80 Sol. An ordinary candle burns four hours and costs 1 Sol, or 0.25 Sol/hr. One liter of kerosene costs 0.60 Sol and burns four hours, or 0.15 Sol/hr.

Table 3 illustrates the hypothetical very high cost of an average tub bath (0.25 cu meter of water) for those families without services, expressed either in money or, more dramatically, in number of minutes of working time to pay for it. The mean hourly wage for the families having private services was the equivalent of US .62, while for those without such services it was US .36.

The mean height quotients of the expatients and their siblings in the families with no services were significantly lower ($P<.05$) than those of the other two sets of families combined (Table 4). Because of the preponderance of group 2 families in this set, the mean ages of parents and of expatients were significantly less. Midparental heights were not different.

Comment

The segregation of these poor families by type of water service enjoyed, and by the dates of recruitment into our study, indicates that upward mobility with time is indeed possible. The presence of a severely malnourished infant or small child in the family is generally an indicator of social decompensation, establishing a very low point in the fortunes of each family. For group 1 families this low point was in 1961 to 1966 and by 1972, when midparental age was substantially higher, they enjoyed better incomes than group 2 families and 66.7% of them had electricity and running water (private or from a common spigot). By the same date, the group 2 families, whose "low point" was more recent (1967 to 1971), had lower midparental ages, lower incomes, and only 22.3% enjoyed the same amenities. Some of the families in group 1 still had lower incomes and did not have running water or electricity by 1972, despite their longer stay in the capital city.

The lower mean height quotient of the expatients in those families without these basic services was suggestive of a poorer environment for "catch-up" growth. Part of the difference might be due to the shorter length of time elapsed since discharge, although most of the "catch-up" in height quotients occurs in the first two or three years after discharge.[4]

Although those families living in the most primitive homes spent roughly the same amount of money for lighting as those who had good services, this represented almost 2% of their income instead of 0.9% to 1.4%, and they were using candles or kerosene instead of electricity. The obvious conclusion is that if the services were extended, they would be able to pay the going rate for a much safer and more efficient form of illumination, on the assumption that it could be provided at the same cost. For a variety of reasons, this might not be true.

The water situation is a much more dramatic one: the poorest families are spending 2.6% to 2.7% of their income for water while families supplied through common water spigots or private services spend 0.4% to 0.7%. The actual amounts spent are two to six times greater than those spent by the families that are economically most advantaged, and more important, for this amount they are getting as little as one seventh the volume of water, the unit cost being 16.7 times greater. Hence, it is quite obvious that these families could and would bear the cost of at least a rudimentary system of piped pure water. When one looks at the potential cost of one tub bath, one realizes the enormous difficulty faced by these people in keeping themselves, their children, and their clothing "presentable," and cannot help but admire the mothers who do just that.

On the basis of these data it would seem that the extension of the public water system to these slums, with all the implications for a better quality of life, is not only desirable but economically reasonable.

Supported by Research grant AM-09980 from the National Institutes of Health, Public Health Service and Research Contract csd/2946 with the Agency for International Development, Department of State.

References

1. Fair GM, Geyer JC: *Elements of Water Supply and Waste-Water Disposal.* New York, John Wiley & Sons Inc, 1958, p 1.

2. Graham GG: Environmental factors affecting the growth of children. *Am J Clin Nutr* 25:1184-1188, 1972.

3. Stuart HC: In Harvie FH: *Pediatric Methods and Standards.* Philadelphia, Lea & Febiger Inc, 1958, p 21.

4. Graham GG, Adrianzen T B: Late "catch-up" growth after severe infantile malnutrition. *Johns Hopkins Med J* 131:204-211, 1972.