

Water and Hygiene: The Case of North Carolina Farmworkers

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Abstract

This study uses a linear regression model to examine the determinants of reported personal hygiene practices of children in 87 migrant and seasonal farmworker families in eastern North Carolina. The results suggest that by ensuring that families have water piped into multiple taps in the house, hand-washing is substantially increased and that by having access to heated water and showers, bathing of children, too, may be substantially increased. It is concluded that if hygiene practices of farmworkers are to be improved, enforcement of existing State and Federal legislation will have to be improved and amendments to this legislation enacted.

Health among migrant and seasonal farmworkers and their families in the U.S. is very poor. Ninety percent of the world's population lives in countries with life expectancies over 50 years (18), yet the life expectancy for migrant farmworkers in the U.S. is just 49 years (2). While differences in mortality between the farmworker and the general community in the U.S. (with a life expectancy of 75 years (18)) exist at all ages, the largest differences are among infants and young children. As in poor communities throughout the world (16), these elevated child mortality levels are largely attributable to high levels of transmission of infectious diseases, with diarrheal diseases playing an important role.

Recent surveys in Massachusetts (12), Maryland (8), Illinois (17) and North Carolina (4,5) have shown that parasites can be identified in the feces of 30% to 50% of migrant farmworkers and that diarrheal pathogens are frequently isolated from the feces of symptomatic and asymptomatic children of farmworkers. As in most developing countries, pathogens can be most frequently isolated in the stools of young children (5).

Of particular concern to the public health of the community at large is the extraordinarily high prevalence of *Giardia lamblia*, a protozoan which is the most frequent cause of water-borne epidemics of diarrhea in the U.S. (3) and which has been documented as the cause of reported outbreaks of diarrhea in day-care centers (1), where it is spread from person-to-person. Whereas *G. lamblia* is isolated in only 3% of the stools examined by state public health laboratories throughout the country (15), 30% of migrant farmworkers' children under 12 years old in North Carolina harbour the parasite (4).

The conditions of the camps in which migrant farmworkers in this area live have been aptly described as "crowded, filthy and dilapidated (2)." While seasonal workers do not live in officially-designated camps, their housing, which is usually supplied by the farmer for whom they work, is generally substandard housing which has been abandoned by the farmer.

Epidemiological studies in the U.S. (7,13,17) have documented the link between these inadequate sanitary conditions and diarrheal diseases among rural Americans, and have led the Occupational Safety and Health Administration (OSHA) to conclude that "the lack of basic sanitation and hygiene is a principal factor in the transmission of fecal-borne bacterial and viral diseases and other debilitating parasitic infections (11)."

Over the past decade, research on the relationship between water and health in poor communities has shown that water-washed diseases (which are affected primarily by personal hygiene practices) are generally more important than the classic water-borne diseases (6). In the particular case of *G. lamblia*, for instance, a recent review by the World Bank concluded that "endemic transmission of giardiasis is likely to be by person-to-person transfer, especially in conditions of poverty, overcrowding and inadequate water supply and sanitation (6)."

The objective of this study was to examine the determinants of water-related personal hygiene practices (specifically hand-washing and bathing) for children under 10 years old in farmworker families in North Carolina. Based on these results, recommendations are made for the implementation of policies which would be likely to improve hygienic practices and thus reduce the transmission of diarrheal diseases among the children of farmworkers in North Carolina.

Method

The Study Population

In the months of May through September, large numbers (usually about 50,000 per year) of migrant farmworkers join the resident "seasonal" farmworkers in harvesting cucumbers, peppers, sweet potatoes and other vegetable and fruit crops in eastern North Carolina. For the

10,000 Hispanic, Haitian and non-Haitian Black farmworkers and their families living in Johnston, Sampson and Harnett counties and within a 35-mile radius of Newton Grove, an important source of health care is the Tri-County Community Health Center.

For this study, all farmworker families who had children under 10 years old attending the Tri-County Community Health Center were considered eligible for participation in the study. Recruitment took place over a three-month period in the summer of 1984. Families were identified when they attended the Health Center and asked about their willingness to participate in the study. In two cases, families chose not to participate, and in 10 cases it was not possible to locate the families for subsequent home interviews. The final sample consisted of 87 families which had 192 children under 10 years of age. All data were collected using a standard questionnaire by one of the authors (WB), assisted by translators who had worked as farm workers, were familiar with the area, and spoke Spanish or Creole. Mothers were interviewed in their houses, usually during the evening after dinner.

The Questions Asked

During the home interviews a standard questionnaire was used to ask mothers about: the frequency of hand-washing and bathing of children; the quantities of water used for these activities; ethnic group; age of the child; level of water service (household connection or outside tap); size of the washtub used for bathing the child; availability of heated water; level of maternal education; exposure to hygiene education; household size; and work status of the mother.

The Hypotheses Tested

The data are used to test the hypothesis that hygiene-related behavior, specifically the frequency of hand-washing and bathing of children, and the quantities of water used for these activities, are affected by: ethnic group; age of the child; level of water service; availability of heated water; level of maternal education; exposure to hygiene education; household size; work status of the mother; and size of washtub used for bathing children.

Analytic Method

The hypotheses are tested by estimating the coefficients of an Ordinary Least Squares multiple regression model.

FINDINGS

Sizes and Characteristics of the Samples

A preliminary tabular analysis of the data showed that the handwashing and bathing patterns were different for children under and children over 2 years of age; and, where there was more than one child in an age group (i.e. 0-2 or 3-10 years of age) in a household, the mother's responses were identical for each child in this age group. It was therefore decided that the number of observations would be determined as follows:

- a. If the family had one or more children under 2 years old, there would be one observation in the "under 2" group; and
- b. if the family had one or more children between 2 and 10 years of age, then there would be one observation for this age group.

From this procedure it emerged that there were a total of 125 observations to be used in the subsequent analyses of frequency of handwashing (Outcome Variable #1) and bathing of children (Outcome Variable #2). This full population was not available for analyses of the determinants of the quantities of water

used for handwashing (Outcome Variable #3) and bathing (Outcome Variable #4), because it was not possible to estimate the quantities used for these purposes when a tap was used directly. Accordingly, the sample of children used in the analysis of the quantity of water of water used for handwashing was limited to those children who did not wash their hands directly at taps (but used wash-basins for this purpose), while the sample of children used in the analysis of the quantity of water used for bathing was limited to those children who were bathed in washtubs. The full population of observations, grouped according to the handwashing and bathing categories, are presented on Table 1. From this table it can be seen that:

- (a) where all observations are used there are a total of 125 observations;
- (b) for analyses of the quantity of water used for handwashing (where analysis is restricted to those who do not use water taps for handwashing), there are a total of 75 observations;
- (c) for analyses of the quantity of water used for bathing (where analysis is restricted to those who do not use

Table 1
Reported water use and hygiene practices for children of migrant farmworkers in North Carolina, 1985.

	Those who use showers for bathing	Those who use washtubs for bathing	Those who do not bathe at all	TOTAL
Those who use water taps for handwashing	22	27	0	49
Those who use washbasins for handwashing	2	30	0	32
Those who do not wash hands at all	6	37	1	43
TOTAL	30	94	1	125

Table 2
Selected characteristics of migrant farmworker families who responded to questions about water use and hygiene practices in North Carolina, 1985.

	Ethnic Group			Maternal Education		Family Size	
	Black	Hispanic	Haitian	0-6 yrs	> 6 yrs	2-5 yrs	> 5 yrs
1. Full sample (N = 125)	26%	54%	19%	51%	49%	66%	34%
2. Those who don't use taps for handwashing (N = 76)	18%	57%	25%	61%	39%	66%	34%
3. Those who don't use showers for bathing (N = 95)	26%	54%	20%	49%	51%	68%	32%

showers for bathing), there are 95 observations.

On Table 2 selected characteristics of families in the three samples used in subsequent analyses are presented. The composition of each of the samples appears to be roughly equivalent.

Results of the Statistical Analyses

The results of the regression analyses are presented on Table 3. As is common in investigations of the determinants of health-related behavior and health outcomes (14), the proportion of total variance in the dependent variable which

is explained by the regression (measured by the R-squared value), is modest (between 18% and 37%). In three of the four regressions, however, the F-value is high, indicating that the proportion of the variation in the dependent variable which is explained by the independent variables is greater than would be expected by chance.

(a) Ethnicity:

The regression coefficients for Non-Haitian Blacks and Hispanics indicate that children in these ethnic groups wash their hands less frequently and that they use less water for this purpose than do

Haitians. Compared with Haitians, non-Haitian Blacks and Hispanics bathe their children substantially less frequently.

(b) Maternal Education:

The children of more educated mothers have their hands washed substantially more frequently, and use larger quantities of water for handwashing.

(c) Maternal Work Status:

Where mothers work outside of the home, children's hands are washed substantially less frequently, with substantially smaller quantities of water used for this purpose.

(d) Help with Childcare:

Where someone other than the mother helps take care of the child, the children's hands are washed rather less frequently.

(e) Water Availability:

Effect on Handwashing:

The values of the regression coefficients for line (a) represent the effects of providing access to adequate water use facilities for those who have a water supply outside of the house, and show that the effect of this improvement in service is to substantially increase the frequency of handwashing. Similarly, the value of the regression coefficients for line (b) represent the effect of the next level of service improvement (viz. provision of a house connection) and indicate that, for those who do not use the tap directly for handwashing, the quantity of water used for handwashing is reduced when this service improvement is provided. Finally, the regression coefficients for line (c) indicate that when the final service improvement is provided (viz. multiple taps are provided within the house) there is a large increase in the frequency of handwashing.

Effect on Bathing:

The regression coefficients for line (a) show that, as a water supply outside of the house is supplemented by access to adequate bathing facilities, so the frequency of bathing and the quantity of water used for bathing children increase substantially. There appears (lines b and c) to be little effect on the frequency of bathing by providing either a single tap or multiple taps. In interpreting the regression coefficients for quantity of water used for bathing, it should be borne in mind that analysis was restricted to those who did not shower directly but continued to use wash-basins. For this group the effect of improved access ap-

Table 3
Effect of Explanatory Variables on Hygiene Practices of Children of Migrant Farmworkers in North Carolina, 1984.

EXPLANATORY VARIABLES	DEPENDENT VARIABLES			
	HANDWASHING		BATHING	
	Frequency (# times/child/day)	Quantity used (liters/child/day)	Frequency (#times/child/week)	Quantity used (liters/child/week)
I: SOCIO-ECONOMIC DETERMINANTS				
Ethnic Group:				
Black: (Yes = 1; No = 0)	-0.61 (1.09)	-15.56 (1.37)	-7.94 (2.84)	-105 (0.57)
Hispanic (Yes = 1; No = 0)	-0.96 (2.18)	-11.32 (1.45)	-6.27 (3.09)	-139 (0.98)
Age Group:				
(0-2 yrs = 1; 3-10 yrs = 0)	-0.21 (0.80)	-0.29 (0.06)	1.17 (0.96)	-19 (0.21)
Maternal Education:				
(Continuous, in years)	0.06 (1.28)	1.33 (1.34)	0.08 (0.33)	-3 (0.21)
Household Size: (Continuous)	0.04 (0.47)	0.47 (0.28)	-0.01 (0.02)	43 (1.59)
Maternal Work Status (Yes = 1; No = 0)	-0.52 (1.82)	-7.76 (1.56)	-0.43 (0.32)	7 (0.08)
Help with childcare: (Yes = 1; No = 0)	-0.33 (1.01)	-0.47 (0.64)	0.93 (0.61)	50 (0.49)
II. ENVIRONMENTAL DETERMINANTS				
Water Availability:				
a. Access to facilities: (Yes = 1; No = 0)	0.58 (1.28)	4.44 (0.63)	2.48 (1.17)	325 (2.54)
b. House Connection: (Yes = 1; No = 0)	-0.31 (0.95)	-10.64 (1.85)	-0.80 (0.52)	43 (0.40)
c. Multiple Taps: (Yes = 1; No = 0)	1.13 (2.74)	9.39 (0.81)	-1.07 (0.56)	-333 (2.43)
Hot Water Heater: (Yes = 1; No = 0)	-0.07 (0.17)	-2.25 (0.34)	5.21 (2.85)	26 (0.22)
Hygiene Education (Yes = 1; No = 0)	-0.14 (0.50)	0.17 (0.03)	2.28 (1.83)	55 (0.64)
Size of Washtub: (Continuous, in liters)	-	-	-	2.4 (4.90)
F-value	2.42	1.11	4.65	3.64
R-squared	0.21	0.18	0.33	0.37
No. of observations	125	75	125	95
Dependent Variable				
Mean	1.7	9.6	12.3	497
Standard Deviation	1.5	19.1	7.5	446

Note: The absolute value of t ratios is reported in parentheses beneath the regression coefficients.

pears to be to reduce the quantity of water used for bathing. However, if it had been possible to estimate the quantities of water used for bathing by those who shower then this effect would almost certainly be reversed.

(f) Availability of Heated Water:

The availability of heated water markedly increases the frequency of bathing.

(g) Exposure to Hygiene Education:

Prior exposure to hygiene education appears to have little effect on hand-washing practices, but has a substantial effect on the bathing of children. Where mothers have been exposed to health education, their children are bathed substantially more frequently.

(h) Size of Container Used for Bathing:

The quantity of water used for bathing children who are bathed in washtubs is increased substantially where the size of the washtub is larger.

(i) Summary of Principal Findings:

The principal findings with direct policy implications are thus:

(i) If access to facilities (such as washbasins) were to be provided for those who presently did not have such access, the frequency of handwashing (which averages 1.7 times per day for the population) would be increased by about 0.6 times per day among those who were provided with these improved facilities. Likewise, if in-house water supplies were made available to those who presently do not have access to such facilities, the frequency of handwashing would increase by 1.1 times per day among those who were furnished with this improved service.

(ii) If heated water were made available (either in the home or at easily accessible public facilities) to those who presently do not have access to heated water, the frequency with which children are bathed (which averages 12.3 times per week for the study population) would increase by 5 times per week for those who were supplied with this improved service.

DISCUSSION

These findings have implications for both the content and enforcement of legal provisions relating to sanitation in migrant workers' camps. Existing North Carolina State Law (9) covering all temporary farm labor camps holding ten or more people requires that the source of water be located less than 200 feet from

each housing unit, and that warm water be made available for bathing facilities at each camp. As a result of cutbacks in State funding, inspections of camp sanitation facilities by local health departments have been curtailed in recent years. Consequently the number of violations (for, among other things, "failing sewage systems, dirty toilets, accumulation of solid waste, no hot water, and in some cases no water at all, dirty living quarters, extremely dirty food service facilities, inadequate or no refrigeration of food") (10) have increased substantially. To the State sanitation authorities "it was very obvious that the lack of manpower to make frequent visits to the migrant camps had caused the overall level of sanitation to drop drastically" (10).

This study suggests that:

(i) to maximize the frequency of hand-washing it is necessary to have multiple taps inside the house with facilities (such as wash-basins) for the use of this water; and,

(ii) to maximize the frequency of bathing it is necessary to have heated water available, and that it is sufficient if that heated water is available through showers and wash-basins at an easily accessible public facility rather than in each individual house.

In conjunction with the well documented relationship of these hygiene practices with health, these findings suggest that existing legislation be amended to ensure that dwellings occupied by the families of migrant farmers be supplied with in-house, heated water, and that the resources required for enforcement of such a standard be made available.

References

1. Black, R.E., A.C. Dykes, S.P. Sinclair and J.G. Wells (1977). Giardiasis in Day-care Centers: Evidence of Person-to-person Transmission, *Pediatrics* 60:486-491.
2. Chaze, W.L. (1982). Migrant Farmworkers Still Face a Harsh Life, *U.S. News and World Report*, August 9:36-37.
3. Craun, G.F. (1979). Water-borne Giardiasis in the United States: A Review, *American Journal of Public Health* 69:817-819.
4. Edwards, R. (1984). Breaking the Life-cycle of Parasitic Disease. *Endeavors*: pp. 15-17. University of North Carolina at Chapel Hill.
5. Elkins, D.B. (1977). The Comparative Epidemiology of Intestinal Helminth Infections Among Children of Five Selected Social Communities. M.S. Thesis, Department of Parasitology, School of Public Health, University of North Carolina at Chapel Hill.

6. Feachem, R.G., D.J. Bradley, H. Garelick and D.D. Mara (1983). *Sanitation and Disease: Health Aspects of Excreta and Wastewater Management*. Wiley, New York.
7. Hollister, A., D. Beck, A. Gittelsohn and E. Hemphill (1985). Influence of Water Availability on Shigella Prevalence in Children of Farm Labor Families. *American Journal of Public Health* 45:354-362.
8. Maryland Advisory Committee (1983). Migrant Workers on the Maryland Eastern Shore. *Federal Register* 49(42):7603.
9. North Carolina (1980). Sanitation of Agricultural Labor Camps, Article 13-A, Chapter 130-166 of the North Carolina General Statutes, Raleigh, North Carolina.
10. North Carolina Department of Health (1981). Migrant Labor Sanitation Activities, 1981, 3 pages, Greenville, North Carolina.
11. Occupational Safety and Health Administration (1976). Preamble in OSHA Field Sanitation Standard: Proposed Rule. U.S. Department of Labor, Washington D.C.
12. Ortiz, J.S. (1980). The Prevalence of Intestinal Parasites in Puerto Rican Farmworkers in Western Massachusetts, *American Journal of Public Health*, 70:1103-1105.
13. Schlesselman, D., F. Atchley, M. Wilcomb and S. Welch (1958). Relation of Environmental Factors to the Occurrence of Enteric Diseases in Areas of Eastern Kentucky. *Public Health Monograph* No. 54. U.S. Department of Health, Education and Welfare, 33 pages.
14. Schultz, T.P. (1984). Studying the Impact of Household Economic and Community Variables on Child Mortality, *Population and Development Review* 10:215-236.
15. Shultz, J. (1979). Comment, in W. Jakubowski and J.C. Hoff (editors), *Water-borne Transmission of Giardiasis*, Report EPA-600/9-79-001, U.S. Environmental Protection Agency, Cincinnati, Ohio.
16. Snyder, J.D. and M.H. Merson (1982). The Magnitude of the Global Problem of Acute Diarrhoeal Diseases: A Review of Acute Surveillance Data, *Bulletin of the World Health Organization* 60:605-613.
17. Tulsy, K.G. and E.A. Lichter (1977). Survey of Intestinal Parasites in Children of Migrant Farmworkers in Rochelle, Illinois. *J. Lincoln School of Medicine* 404-416.
18. World Bank (1985). *The World Bank Atlas*, Washington, DC. p 22.

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