Hygiene behaviour and hospitalized severe childhood diarrhoea: a case–control study

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The relationship between personal and domestic hygiene behaviour and hospitalized childhood diarrhoea was examined in a case–control study of 356 cases and 357 controls from low-income families in metropolitan Manila. Indices of hygiene behaviour were defined for overall cleanliness, kitchen hygiene, and living conditions. Only the indices for overall cleanliness and kitchen hygiene were significantly associated with diarrhoea. An increasing excess risk of hospitalization with severe diarrhoea was noted as the ratings for standards of hygiene became lower, and this excess risk persisted even after controlling for confounding variables. The implications of our findings for the control of diarrhoeal disease are discussed.

Introduction

Increasing attention has been focused on the promotion of hygiene as an intervention for the control of diarrhoeal diseases with an infectious etiology. Hygiene behaviour interventions can reduce the transmission of enteropathogens by the faecal–oral route. For example, provision of an improved water supply and sanitation reduced the incidence of diarrhoea among young children by 20–27% (*1–2*); however, a combination of a clean water supply and good personal and domestic hygiene produced a reduction of about 40% (*3*).

Although it is generally assumed that poor hygiene behaviour increases the risk of diarrhoeal disease, there is little rigorous quantitative evidence to support this premise. In 1984 a review of several studies on the role of behavioural factors in diarrhoeal disease epidemiology reported that the findings were inconclusive and did not firmly associate specific behaviours with particular levels of risk (*4*).

More recent studies have examined specific water–sanitation behaviours in relation to the occurrence of diarrhoea. Such behaviours have included, in Bangladesh, handwashing before food preparation, open defecation by ambulatory children, inattention to proper disposal of garbage and faeces, etc. (*5*); in Burma, the methods used by mothers to clean children after defecation (*6*); in the Philippines, the manner of disposing of the faeces of under-2-year-olds (*7*); and in Papua New Guinea, compound hygiene (*8*). The results of some of these studies were consistent with an association between a particular hygiene behaviour and an increased risk of diarrhoea.

This article describes an analysis of the relationship between personal and domestic hygiene behaviour and hospitalized severe childhood diarrhoea. The study was conducted in 1989 in metropolitan Manila (population, about 7.6 million) and consisted of two phases—the first, an ethnographic study and the second, a case–control study. The findings presented here relate to the latter phase.

Methods

Selection of cases and controls

A case was a child under 5 years of age who was a resident of metropolitan Manila, and who had been admitted to the free service of a government hospital with diarrhoea that began <7 days previously. A control was a child whose age matched that of a case (±6 months), who had not had diarrhoea within 30 days prior to recruitment into the study, who lived in the same neighbourhood as the case, and who used or would have used the free service of a government hospital for a serious diarrhoeal episode.

After discharge of a potential case from hospital, the child concerned was visited at home. The search for an eligible control started with the house located immediately to the right of that of the case and continued to the next house until a suitable individual was identified.

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A total of 363 potential cases and 363 potential controls were identified over the period April–October 1989; of these, 356 cases and 357 controls participated. All study subjects belonged to low-income families, as determined by the occupation of the head of the household.

Data collection

Two research instruments—an interview schedule and an observation checklist—were formulated, based on the description of local hygiene practices that had been gathered during the first phase of the project. The interview schedule collected data on the following: sociodemographic profile; knowledge about diarrhoea; practices of the mother, e.g., cleaning the child, disposal of faeces, and feeding practices; previous experience with diarrhoea; environmental sanitation; nutritional anthropometry; use of health services; and the habits of the respondents. The schedule was administered in Filipino to the mother or caretaker of the study child at home, about 2–4 weeks after the first home visit.

Because information on hygiene practices collected by interviewing mothers may not correlate well with the practices actually observed (*9*), we employed also an observation checklist. This checklist included observations on the following: the general cleanliness of the home, of the mother, and of the children; practices related to the defecation/urination of young children; water-handling behaviour; food and drink preparation practices; and the structure of the housing. The items on the checklist were observed and rated (based on a set of criteria) at the time of the home interview.

The field staff consisted of two research assistants, with a degree in public health, and six interviewers, who were medical technology graduates. The research assistants recruited the hospital cases and neighbourhood controls, and supervised and carried out spot-checks on the interviewers; the latter administered the interview schedule and completed the observation checklist. The case/control status of the household being interviewed and observed was not known by the interviewers. All of the interviewers underwent rigorous training on the use of the research instruments and exhibited good levels of inter-rater agreement for selected items on the checklist. The κ statistics for the assessment of the cleanliness of various items were as follows: interior of the house (0.66); floor (0.72); exterior environment (0.45); appearance of the index child (0.70); and appearance of the mother (0.47).

Definition of exposure variables

Three indices of personal and domestic hygiene practices were used as exposure variables. From the results obtained with the observation checklist, items that were hypothesized to be related to a factor (see below) were grouped together and their ratings analysed using the method of maximum likelihood in the SPSS program. Variables that were held on an *a priori* basis to be related to a factor were found to be highly correlated with that factor. The following factors were defined: overall cleanliness, kitchen hygiene, and living conditions. Assessment of overall cleanliness was based on the general appearance of the house, both inside and outside, and on the physical appearance of the mother/caretaker and the index child. Kitchen hygiene was assessed by the cleanliness rating of food and water storage containers and by the sanitary condition of the cooking and eating areas. Living conditions were a measure of life-style, and were defined not only by the sanitary conditions inside and outside the house but also by the type of accommodation, e.g., the number of rooms and the presence or not of a dining-table. These derived factors were used as exposure variables in the analysis.

A factor score was generated for each exposure variable and for each study subject. Lower scores indicated better hygienic conditions. Scores in the lowest quarter of the range were taken to be "low"; those in the middle 50%, as "moderate"; and those in the highest quarter, as "high". For example, the factor scores for overall cleanliness were –1.73 to 2.37 (i.e., a range of 4.1) and a quarter of this range was 1.025. Thus a low score corresponded to a value less than or equal to –0.705; a moderate score to a value greater than –0.705 but less than or equal to 1.345; and a high score was greater than 1.345.

Statistical analysis

The strength of the association between the exposure variables and severe diarrhoeal disease was estimated using the odds ratio (OR). To adjust the OR for the effects of confounding and to preserve in the analysis the matching by age and neighbourhood, we performed a conditional logistic regression using EGRET software (*10*). Point and interval estimates of the effect measure were calculated.

The following risk factors for diarrhoeal diseases were taken as potential confounders: age; sex; occupation of the head of the household; educational level of the mother; number of children <5 years of age in the household; feeding practices; excreta disposal practices; water supply; and degree of utilization of health services (measured by enrolment in "under-6-clinics"). Nutritional status and a family history of diarrhoea over the previous 2 weeks were not controlled in the analysis, since these risk factors are influenced by hygiene behaviour. Thus, they were taken to be intervening variables in

the causal pathway; controlling for them would have biased the estimate of the effect measure.

Results

Profile of the study subjects

Most of the study subjects were aged <2 years, and because cases and controls were age-matched, their mean ages were similar (11.5 months for cases and 11.8 months for controls). Table 1 shows selected characteristics of the cases and controls. The proportion of males was higher for the cases (57.6%) than the controls (49%), and a greater proportion of cases were not breast-fed (25.3%) than controls (17.9%). These differences were statistically significant. Wasting (as indicated by weight-for-length) and stunting (as indicated by length-for-age) were significantly commoner among the cases than the controls. The proportion of cases whose weight-for-length was more than two standard deviations below the NCHS median value (*11*) was 17.5%, while only 5.4% of the controls were in this category; the corresponding proportions for length-for-age were 41.5% and 32.0%. A greater proportion of the cases (73.6%) than controls (65.3%) did not have piped water in their homes, but all cases and controls were supplied by the metropolitan water system. The remaining characteristics that were examined were similar for both cases and controls. Most of the heads of households were production or service workers, and most of the mothers had been educated to high-school level or lower. While most of the families possessed flush toilets, a substantial proportion did not have sanitary toilet facilities.

Table 1: **Selected characteristics of cases and controls**

	% of cases (n = 356)	% of controls (n = 357)
Sex:		
Male	57.6	49.0
Female	42.4	51.0
Feeding pattern:		
Exclusive breast-feeding	23.9	28.6
Mixed feeding	50.8	53.5
Not breast-fed	25.3	17.9
Nutritional indicators:		
Low weight-for-length	17.5	5.4
Low length-for-age	41.5	32.0
Occupation of head of household:		
Production/service/skilled	71.1	77.0
Unskilled worker	14.9	15.7
Farmer/fisherman	2.2	1.7
Unemployed/housework	11.8	5.6
Mother's educational level:[a]		
Elementary school	30.4	28.2
High school	53.1	52.9
Vocational school graduate	1.7	3.7
≥1 year in college	14.8	15.2
Excreta disposal facility:		
Flush toilet	68.0	72.2
None	32.0	27.8
Water supply (piped):		
Tap in home	26.4	34.7
Public/neighbour's tap	73.6	65.3

[a] Unknown for 4 cases and 9 controls.

Hygiene behaviour indices

Indices for the following hygiene behaviours were measured: overall cleanliness, kitchen hygiene, and living conditions. The distribution of cases and controls into the categories "low"; "moderate", or "high" is shown in Table 2; in this scheme, low indicated better hygienic conditions. Because data on certain variables used to define the indices were missing for some study subjects, this particular analysis involved less than the total number of study subjects. For all three indices, the controls tended to have lower scores than the cases. In general, there was evidence that higher scores were associated with increasing rates of diarrhoeal disease.

These findings were, however, based on crude estimates. Since diarrhoea can be influenced by a number of factors, adjusted odds ratios were estimated (Table 3). The results indicate an increasing excess risk of diarrhoea with declining standards of hygiene for overall cleanliness and kitchen hygiene but not for living conditions. Relative to the group with a low score in overall cleanliness, the groups with middle and high scores had twice (OR = 2.0) and about four times (OR = 3.9) the rate of diarrhoeal disease, respectively. For kitchen hygiene, OR = 2.7 for the middle group and OR = 5.3 for the high group. No significant association was observed between the indices for living conditions and diarrhoeal disease. As expected, the estimated intervals for the adjusted measures were less precise than those based on crude calculations.

Discussion

The study examined the relationship between hygiene behaviours and the incidence of severe diarrhoea among young children admitted to govern-

Table 2: **Distribution of cases and controls according to the level of hygiene behaviour index**

Index level	No. of cases	No. of controls	Odds ratio
Overall cleanliness:			
Low	20 (7.5)[a]	60 (23.0)	1.0 —
Middle	206 (77.5)	187 (71.6)	3.3 ; *2.5, 4.4*[b]
High	40 (15.0)	14 (5.4)	8.6; *5.7, 12.9*
Total	266 (100.0)	261 (100.0)	
Kitchen hygiene:			
Low	18 (7.5)	53 (23.2)	1.0 —
Middle	186 (77.8)	160 (70.2)	3.4; *2.5, 4.6*
High	35 (14.7)	15 (6.6)	6.9; *4.6, 10.4*
Total	239 (100.0)	228 (100.0)	
Living conditions:			
Low	31 (10.3)	58 (18.6)	1.0 —
Middle	203 (67.7)	222 (71.4)	1.7; *1.3, 2.2*
High	66 (22.0)	31 (10.1)	4.0; *2.9, 5.5*
Total	300 (100.0)	311 (100.0)	

[a] Figures in parentheses are percentages.
[b] Figures in italics are the 95% confidence intervals.

ment hospitals with acute diarrhoea. The exposure variable was measured using indices of hygiene behaviour that were based on the observable effects of such behaviour (*12*). The data used to define these indices were readily obtained using the observation checklist. Since the indices were expressed as ratings of the observer's assessment of the hygiene-related attributes of the households, both the validity and reliability of the data collected were largely dependent on the observer's training and on the availability of suitable rating criteria.

Our findings indicate a strong association between the indices for overall cleanliness and kitchen hygiene and diarrhoea; however, potential sources of bias must be considered since there are alternative explanations.

The study compared hospital cases with neighbourhood controls, the selection of the latter being dictated by practical considerations. It was easier to locate an appropriate control in the neighbourhood where cases lived than in the hospitals from which the cases were recruited, since apart from diarrhoea most of the children in the hospitals had infectious diseases, which could have been associated also with the exposure being studied. Use of neighbourhood controls, however, could have biased the results, since it is not uncommon that selection factors operate in the admission of patients to certain hospitals; the cases and controls might therefore not be comparable in terms of such selection factors. To address this, we compensated for possible selective admission of cases by including an item on hospitalization in the selection criteria for controls. Thus, the controls selected were comparable with the cases in terms of their potential utilization of hospital services.

The method of recruiting controls (one control from the neighbourhood of each case) resulted in neighbourhood matching. The cases and controls were also matched by age (±6 months), in as much as age is a strong risk factor for diarrhoeal disease. The age and neighbourhood matching were preserved in the analysis to avoid bias in the estimated effect measure.

Despite efforts to conceal the case or control status of subjects from the interviewers/observers, this status became clear during the home visit in most instances. This could have resulted in a differential assessment of information, including the exposure data in the two groups. From the data collected, however, there was no indication that cases were consistently assigned more negative ratings than controls. For a few items on the checklist, controls were given poorer hygiene ratings than cases. Analysis of the data on the three dummy variables on the interview schedule (cigarette smoking, coffee drinking, and vegetable consumption) indicated, however, that for these variables the distribution of cases and controls was very similar. Furthermore, the specific hypothesis under investigation was never discus-sed with the interviewers/observers. Thus, it is unlikely that observation bias could fully account

Table 3: **Adjusted odds ratio and 95% confidence intervals (CI) for the association between severe diarrhoea and the hygiene behaviour indices**

Index level	Odds ratio	
	Point estimate	95% CI
Overall cleanliness:[a]		
Low	1.0	—
Middle	2.0	1.1; 3.6
High	3.9	1.5; 10.4
Kitchen hygiene:[b]		
Low	1.0	—
Middle	2.7	1.5; 4.8
High	5.3	2.0; 14.3
Living conditions:[c]		
Low	1.0	—
Middle	0.9	0.2; 19.7
High	1.5	0.1; 33.4

[a] For 198 matched pairs.
[b] For 201 matched pairs.
[c] For 263 matched pairs.

for the observed association between the exposure and diarrhoea.

Inaccurate information about the disease and exposure status of the study subjects was a source of misclassification bias. As far as misclassification of disease status is concerned, the recruitment of cases from hospital admissions provided reasonable assurance that the child was really suffering from severe diarrhoea. The possibility of admitting a mild case of diarrhoea was remote, since the number of beds is limited and the clinical criteria for admission are therefore strict. Clinical data on the diarrhoeal episode revealed that the cases admitted had at least two of the following signs and symptoms: dehydration; three or more bowel movements per day (average, six); mucus or blood in the stools; vomiting; abdominal pain; and tenesmus. The controls were probably not misclassified since their mothers were asked only to recall an episode of diarrhoea within the previous 30 days.

The indices of hygiene behaviour were based on data collected by on-site observation, an approach that probably yields more accurate information than interviews. Nevertheless, it was possible that there was misclassification of the exposure factor for the cases. The latest episode of diarrhoea may have altered the hygiene practices of the mothers of cases, and the sanitary practices when the data were collected could have been better than those used when the episode of diarrhoea occurred. This did not apply to the controls. Such differential misclassification could have underestimated the true strength of the observed association.

Potential confounders were identified and controlled both in the design and analysis phases of the study. In the design phase, confounding arising from socioeconomic status was controlled by restricting the selection of cases and controls to families of low socioeconomic status. Using conditional logistic regression techniques, we adjusted the measure of the effect for potential confounders.

Our findings suggest that for the young children who used the free public hospitals, unhygienic practices were a very important risk factor for severe diarrhoea. This was reflected in the indices for overall cleanliness and kitchen hygiene but not in the index for living conditions. While the first two of these indices were entirely defined by variables that reflected hygiene practices, the index for living conditions was based not only on cleanliness but also on socioeconomic status. Since the cases and controls were all from low-income families, there was probably little variation in their socioeconomic characteristics; hence, the observed absence of association with living conditions was not entirely unexpected.

A significant implication of our findings is the potential use of hygiene behaviour to control severe diarrhoea. The existence of a strong and probably causal association between diarrhoeal disease and the exposure factor provides a basis for health education programmes. It can be inferred in general that in an economically deprived sector of the population that has access to adequate and safe water supply, the promotion of hygiene behaviour can be expected to reduce substantially the incidence of severe diarrhoea. Whether or not the presence of a safe and adequate water supply influences the effect of hygiene behaviour on diarrhoea was not examined in the study. The lower cost of a health education programme compared with that of other measures, such as improving housing facilities, makes interventions designed to promote hygiene behaviour more attractive. The next challenge therefore is to develop suitable interventions for the effective education of mothers and also of the general public on appropriate hygiene behaviour.

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Résumé

Habitudes d'hygiène et diarrhée sévère chez l'enfant: étude cas-témoins

La relation entre les indices d'hygiène personnelle et domestique et la diarrhée sévère chez l'enfant (exigeant une hospitalisation) a été examinée au cours d'une étude cas-témoins portant sur 356 cas et 357 témoins provenant de familles à faible revenu de l'agglomération de Manille. Etait défini comme cas un enfant de moins de 5 ans admis dans un hôpital public gratuit pour une diarrhée ayant débuté moins de 7 jours auparavant, qui résidait dans l'agglomération de Manille et dont l'adresse était connue. Le témoin était un enfant de même âge (± 6 mois), n'ayant pas souffert de diarrhée dans les 30 jours précédant son recrutement dans l'étude, habitant dans le même quartier que le cas, et qui a ou aurait été admis dans un service hospitalier public gratuit pour un épisode grave de diarrhée. Trois indices exprimant les habitudes d'hygiène personnelle et domestique, utilisés comme variables d'exposition, ont été

définis d'après les données recueillies sur une liste de contrôle. Parmi ces indices, les indices concernant la propreté générale de l'habitation et l'hygiène de la cuisine étaient associés de façon significative avec la diarrhée, le risque de diarrhée augmentant lorsque les normes d'hygiène diminuaient. Toutefois, il n'a pas été démontré d'association entre le troisième indice, traduisant les conditions d'habitation, et la diarrhée. La mise en évidence d'une association forte, probablement causale, entre la diarrhée et les facteurs d'exposition indique que des programmes d'éducation pour la santé portant sur les habitudes d'hygiène, en particulier du point de vue de la lutte contre les maladies diarrhéiques, devraient être prévus à l'intention des mères et du grand public.

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