There was a strong correlation between feces-to-hand contamination occurred both by direct hand-to-mouth contamination and indirectly feces-to-mouth contamination (r = 0.94). There was also an average of 3.9 (SD 4.6) feces-to-mouth episodes per household/12 hours occurred by both direct hand-to-mouth contamination and indirectly by hand-washing caused soiled hands which were then placed in the mouth. There was a strong correlation between feces-to-hand contamination and feces-to-mouth contamination (r = 0.94). There was an association between feces-to-mouth contamination and the number of stools deposited in the house (r = 0.96). For each additional stool deposited, the risk of stool borne typhoid fever increased by the average of 0.27 in feces-to-mouth episodes.

The study concluded that removing hands from the mouth and the mouth from the stool was important in reducing the perception concerning whether poultry roaming in the house presented a risk to young children.

**Introduction**

Diarrheal disease is an important factor in the infectious disease burden in developing countries. In Peru, children under three years of age have a diarreal incidence of 10 episodes per child-year, which can significantly affect their growth rates. One important cause of diarrheal diseases in Lima children less than one year of age is *Campylobacter jejuni*. The number of diarrhea cases in Lima children is significantly affected by the presence of *Campylobacter jejuni* in chicken stool.

**Methods**

**Study Sites**

The study was done in two populations: rural and urban communities. The rural population is peri-urban shanty towns where children are at risk for contamination from poultry. The urban population is the peri-urban shanty town of Lima, Peru.

**Observation Data**

Ten families from Huascar participated in an in-depth behavioral observation study, with a total of 21 children under five years of age. All the families had at least one child under two years of age, and domestic chickens which were not corralled and not allowed access into the house. The data was collected from the Pampas families that participated in the poultry raising practices survey. The socioeconomic survey described age, sex, level of education, and occupation of all members of the family. Questions on housing quality included the materials used to build the house, number of rooms, ownership of radios, televisions, refrigerators, and presence or absence of a latrine. The number and type of animals belonging to the house owners were also registered.

**Direct Observation Data**

Tenth families from Huascar participated in an in-depth behavioral observation study, with a total of 21 children under five years of age. All the families had at least one child under two years of age, and domestic chickens which were not corralled and not allowed access into the house. The data was collected from the Pampas families that participated in the poultry raising practices survey. The socioeconomic survey described age, sex, level of education, and occupation of all members of the family. Questions on housing quality included the materials used to build the house, number of rooms, ownership of radios, televisions, refrigerators, and presence or absence of a latrine. The number and type of animals belonging to the house owners were also registered.

**Survivability of C. jejuni in Domestic Chicken Feces**

Stool samples were taken from C. jejuni-infected chickens in a household in Huascar, Canto Grande. A clonal swab was taken immediately after the chicken defecated and another swab was taken from the stool on the ground. The samples were taken on the ground of a sun-exposed patio, was fenced in with a metallic wire and marked with its respective identification number. For 24 and 48 hours, additional samples were taken. All the samples were immediately placed in Cary Blair media containing Skirrow's antibiotic supplement, and processed by direct plating on blood agar with Butzler's supplement. Another sample was inoculated into thioglycolate broth from the samples. Following antibiotic sensitivity tests: vancomycin 10 μg/ml, polymyxin B 2.5 IU/ml and trimethoprim 5 μg/ml. The plates were incubated immediately while the broth was refrigerated for 24 hours and then plated with Butzler's agar. All plates were incubated at 37°C under microaerophilic conditions. Campylobacter species were identified based on colony morphology, gas-plate production, and spiral analysis in the Gram stain.

**Results**

The interaction between toddlers and poultry was observed for a total of 119 hours in 16 households. The majority of the poultry raised chickens (n = 94, chickens/house = 4.4). Three out of 10 families also had ducks and turkeys. Chickens and ducks only were allowed to roam freely through the house for about one-third of the 12-hour observation period (Table 1). The number of poultry and the time they were in the house were correlated (r = 0.64), as were the number of observed stools and the time the animals spent within the house (r = 0.86).

**Discussion**

Children under four years of age were feces-to-hand episodes per 12 hours (Table 1). The risk of feces-to-hand contamination was from both fresh stool and from that deposited several days previously but not removed from the household surfaces. In three households where no observed defecations occurred, hand and oral contamination still happened with stools that had been deposited prior to the day of observation. The most important variables were number of droppings and number of minuses chickens were in the house.

There were about four feces-to-mouth episodes per child (Table 1). Children only rarely washed their hands before touching feces, and often put their fingers in their mouths, so feces-to-mouth contamination increased with increased chicken density (r = 0.94; feces-to-hand episodes and the number of poultry accounted for 93 percent of the variation in the dependent variable—the number of feces-to-mouth episodes. Neither feces-to-hand nor feces-to-mouth episodes were related to the number of young children in study families. For each additional chicken stool deposited during the day, there was an average increase of 0.27 in feces-to-mouth episodes.

**Poultry Raising Practices**

Seventy-eight mothers from the Pampas de San Juan participated in the poultry raising practices survey. Eighty-one (75 percent) of the mothers were migrants, usually from the sierra zones. Eighty-eight (88 percent) of the Lima-born mothers raised multiple types of poultry, only half of the migrant mothers raised other types of poultry in addition to chickens (27/54).

The major reasons given for a raising poultry (Table 2) included for home consumption and enjoyment of raising animals. The majority of mothers realized that commercial chickens were cheaper than those raised at home. When mothers were asked if they preferred commercial or domestic chickens cost more, 77/8 (71 percent) thought the commercial chickens cost more.
cials were cheaper while only 22/108 (20 percent) of the mothers claimed to have seen the child touching or eating animals during the previous two weeks.

Unwashed hands of toddlers in a puerile jugene are frequently contaminated with poultry feces. As 50 percent of the chickens in a puerile jugene are carriers of C. jejuni, the health risk to these toddlers is evident. We found that few of these feces-to-hand episodes were interrupted by hand washing.

Many puerile jugene mothers do not believe that chicken stew provides a similar nutritional value. One-third of the mothers also did not recognize animals feces as a disease-producing agency. The absence of running water in puerile jugenes and the high cost of the water used may be important factors discouraging hand washing. Even in developed countries where water is easily available, oral-faecal contamination is common. In observations in a rural primary school during an epidemiologic study of shigellosis, children showed that 50 percent of the children had contaminated their hands with Shigella after using the school toilet. Moreover, one-fifth of the children handled their face or sucked their fingers after using the toilet.

The risk of acquiring viable C. jejuni in the study area is augmented because the house floors are usually made of dirt or unpolished concrete, so the complete removal of poultry feces is difficult to achieve, and C. jejuni can survive in these environments for several days. Even when water is plentiful, in homes with free-ranging birds, it is not realistic to assume that mothers will be able to effectively interrupt transmission by hand washing.

In addition to C. jejuni, a small percentage (2 percent) of poultry were fecal carriers of Aeromonas species. The relationship of C. jejuni to the health risk in having chicken-feces contaminated with poultry droppings was evident. None of the free-roaming chicken samples exceeded Salmonella species. In both Peru and Bangladesh, originally a species is an infrequent cause of community epidemics of diarrhea.

The present study suggests similar socioeconomic background and characteristics. Families with and without poultry in a puerile jugene population, making it difficult to identify a target population. In addition, an intervention program would have to overcome common beliefs that intuitively encourage the transmission of C. jejuni. Many families raised uncorralled chickens even though they recognized that purchasing poultry was cheaper than home grown animals, believing that chickens grow better when they are corralled or confined. Many fathers agree that keeping poultry roaming freely through the house. This suggests that this behavior will be difficult to modify.

In Peru, as our data show, most individuals living in puerile jugenes have access to mass media. Most children are cueded to mass media and formal education in the school system could be utilized for intervention programs. These educational programs should emphasize the health risks to toddlers of raising free-roaming poultry within the household and the need to corral poultry and prevent their entrance into the house.

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