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Characterization of hygiene habits and environments in children's care homes

Caracterización de hábitos de higiene y ambientes en lugares de atención integral a población infantil

Caracterização de hábitos de higiene e ambientes em locais de atenção integral na população infantil

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ABSTRACT

Objective: Identify the hygiene habits of children and caregivers in order to prevent and control infectious diseases in care environments in Bogotá, Colombia, as well as characterize the surface bacteria in these environments. **Method:** Instruments were designed, validated and applied to evaluate healthy habits, with samples taken from surfaces in kitchens, bathrooms, halls, mats, and tools in 230 locations. The isolated bacteria were classified using automated methodologies. **Results**: A total of 699 bacteria were isolated, with the largest growth percentage found in kitchens (36%). These results are contrary to what was observed, where most of the kitchens appeared to be clean. In the survey, 93% of the caregivers reported washing their hands before handling food, and 23% said they used personal protection items when handling food. **Conclusion**: There is a need for monitoring and interventions in hygiene and care habits in environments that care for children.

DESCRIPTORS

Child; Bacterial Infections; Hygiene; Infection Control; Infant Mortality; Pediatric Nursing.

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INTRODUCTION

Environmental conditions as a cause of disease among children is a relevant theme that has been extensively studied in recent years. In 2006, the World Health Organization (WHO) reported that 24% of the disease burden can be attributed to environmental factors, and 36% of deaths in children is due to contaminants in the environment[1]. There are initiatives around the world that promote safe environments for children. UNICEF points out that sustainable development starts from early childhood with safe and healthy children through improvement of nutritional conditions, water quality, environmental sanitation and controls on harmful exposure to contaminants and toxic substances[2]. Factors such as direct transmission of infectious agents among children, inadequate hand hygiene, and indirect transmission through the environment, often cause children who go to daycare centers to get sick. Although most of the isolated bacteria in these environments are low in pathogens, a study on daycare environments showed positive culture results in 60% of the samples. Toys are among the fomites with the highest pathogen agent load, for which reason various strategies have been studied to reduce microorganism loads on these surfaces[3].

An effective measure for preventing infection is hand hygiene. However, the use of protocols by caregivers is low, and there are various reports regarding the effectiveness of this type of intervention[4]. Environment-related infections are more frequent in developing countries; children in these countries lose eight times more years of healthy life per inhabitant than in developed countries. This problem requires governments to promote preventive health policies, conduct intersectoral work, and encourage intervention strategies, such as better hygiene measures and control of physical, chemical and biological risks that directly affect health and increase unhealthy behaviors in communities[1]. To implement these measures, it is important to characterize environments that care for children through identifying healthy habits as a baseline for establishing interventions and classifying microorganisms in order to investigate possible reservoirs and transmission routes. Based on the above, the objective of the present study was to identify healthy habits in children and their caregivers, and characterize the bacteria present in environments in which they receive care in a district of Bogotá (Colombia).

METHOD

Structure and design. This was an exploratory study of the environmental conditions and healthy habits of children and their caregivers. The study units were places where young children in situations of social risk receive comprehensive care. For the purpose of the study, these places were called Children's Care Homes (CCH).

Population and sample. The study was conducted in an area of Bogotá (Colombia), which had 897 CCH and a population of 11,973 children from 2 to 5 years of age. Based on this data, a convenience sample was taken in 230 CCH. The procedures were endorsed by the Ethics Committee of the Universidad Nacional de Colombia, in accordance with international standards. The informed consent of the participants was obtained during the visits to the CCH.

Design and validation of instruments. Two instruments were designed, validated and applied: a) a caregiver survey (Identification of healthy hygiene habits in children's care homes: IHH-CCH) and b) a checklist (Characteristics of the environmental conditions of children's care homes: CEC-CCH). The IHH-CCH questionnaire had 33 questions and assessed four dimensions: hand hygiene, water management, healthy surroundings and positive reinforcement of personal hygiene routines. The CEC-CCH checklist had 79 items and examined the healthiness of the surroundings. The environmental conditions dimension included three subscales: space, equipment and infrastructure, and the hygiene conditions dimension also had three subscales: sanitation and hygiene, food handling and personal hygiene habits. The checklist contained instructions and a training process for work teams in order to control possible bias during the observation and to ensure the stability of the test.

Microbiological tests. Samples were taken from surfaces in kitchens, bathrooms, and halls (places with higher concentrations of children) and surrounding areas (mats, toys and crayons), using a sweeping technique. The sampled kitchen surfaces were: counters, light switches, kitchenware, fridge door handles and faucets; in bathrooms: light switches, door handles, bathroom sinks and toilets; in halls: external and internal edges of tables and chairs; and in surrounding areas: external and internal edges of mats and surfaces of toys and crayons. The samples were collected after routine cleaning and disinfection procedures had been performed. They were then stored in Stuart means of transport (Copan innovation® - Italy) for a maximum period of 12 hours. Afterwards, they were seeded in blood agar (MacConkey and Hecktoen) and incubated at 37°C for 24 hours. Once growth was detected, the colonies were classified as Gram-positive or Gram-negative, and classified using the automated Vitek® 2 compact system (Biomerieux, Marcy l'Etoile, France). For classification, Vitek® 2- GP (21342) and Vitek® 2- GN (21341) cards were used, after seeding in a tryptic soybean medium.

RESULTS

In relation to hand hygiene, the caregivers said they knew the 10 steps (94%). In the observation period, however, less than 6% of the caregivers and 2% of the children did the full 10 steps. Ninety-three percent of the caregivers reported washing their hands before handling food, 80% after going to the bathroom, 37% after removing nasal secretions in children, and none washed their hands when coming in from the street. In contrast, during the observation period, only 2% washed their hands at the five times recommended by the WHO. According to the survey, 97% of the children washed their hands before

eating, 62% after going to the bathroom, and only 8% when coming in from the street. However, during the observation period, it was found that only 3% of the children washed their hands at the three basic times. In terms of positive reinforcement of personal hygiene routines, around 88% of the caregivers said they had received training and 69% of them educate the children in this regard. With respect to food handling, it was observed that 23% of the caregivers used personal protection items, and 35% had food handler certificates (KOH tests, co-cultures, nasopharyngeal secretion tests and sputum smear tests). In the observation it was found that 99% of the CCH stored some type of prepared food. Only 49% of the kitchens had separate cutting boards for meat, vegetables and fruit. Thirty-eight percent of the dish towels were dirty and used in these conditions. According to the survey, the kitchen, bathroom and hall areas were considered clean in 80% of the homes. It also indicated that caregivers used more than 17 combinations of substances for cleaning and disinfection, and over 60 ways for diluting sodium hypochlorite. As far as basic sanitation, all the CCH had potable water service and sewer, 78% had water tank, and 64% of them cleaned it every six months or more. Only 19% of the total number of CCH had a window that opened and closed. Table 1 presents a summary of the basic conditions and healthy habits observed and reported in the CCH, through the two measurement instruments.

Table 1 – Basic hygiene conditions and healthy habits of children and caregivers in children's care homes – Bogotá, Colombia, 2015.

Basic conditions and healthy habits	(%)
Home	
Stocking of bathrooms (soap, towels, cups)	74.9
Presence of animal and insect excrement	3.5
Food handling conditions	84.5
Caregiver	
Use of personal protection items	22.9
Appropriate and clean clothing	78.1
Nails cut, clean and without nail polish	62.3
Hand hygiene	3.7
Hand disinfection	2.0
Hand hygiene observed at the five times	2.8
Hand hygiene at the five times, reported by caregivers	93.0
Children	
Hand hygiene of children	2.1
Hand disinfection of children	0.4
Hand hygiene observed at three or more times	3.4
Hand hygiene at three or more times, reported by caregivers	48.0

In the 230 CCH, 699 isolated bacteria were identified (46% were Gram-positive and 54% were Gram-negative). Figure 1 shows the number of isolated bacteria together with the Gram stain classification at each of the sampling sites.

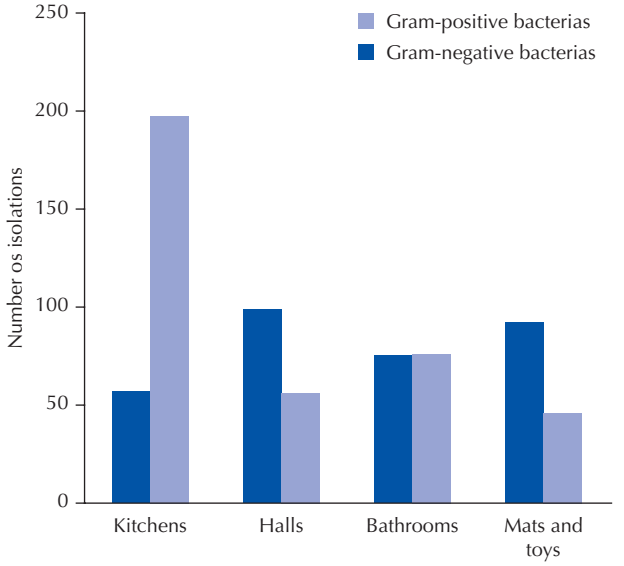

Figure 1 – Distribution of bacteria isolated in the sampling sites of the children's care homes – Bogotá, Colombia, 2015.

The highest percentage of bacterial growth was in kitchens (254 isolations, corresponding to 36%), compared to mats and toys with a lower percentage (139 isolations, corresponding to 20%). Of the 254 isolations obtained in kitchens, 78% were Gram-negative bacteria and 32 were generic; the microorganism with the highest number of isolations was *Klebsiella (K. oxytoca* y *K. pneumoniae)*. The surfaces of halls had the second highest percentage of isolations with 151 bacteria belonging to 22 genera, especially Gram-positive ones (64%); the bacteria with the highest frequency were *Pantoea* spp., *Staphylococcus hom hominis* and *Staphylococcus epidermidis*. In the bathroom, a total of 151 bacteria from 24 genera in equal proportions of Gram-positives and Gram-negatives were isolated, where the bacteria with the highest isolation frequency was *S. epidermidis*. Mats and toys, along with bathrooms, were the surfaces with the lowest number of isolations (22%) belonging to 23 genera; the largest number of bacteria were Gram-positive (66%) and the most frequently isolated bacteria was *S. hom hominis*.

The genera of the bacteria isolated at each sampled site were classified into three categories:

Category 1: normal skin and mucous flora (*Alloiococcus*, *Dermacoccus*, *Enterococcus*, *Granulicatella*, *Kocuria*, *Micrococcus*, *Moraxella*, *Staphylococcus* and *Streptococcus*).

Category 2: opportunistic bacteria in food and water (*Acinetobacter*, *Aerococcus*, *Aeromona*, *Achromobacter*, *Brevundimona*, *Chryseobacteria*, *Citrobacter*, *Enterobacter*, *Escherichia coli*, *Ewingella*, *Klebsiella*, *Kluyvera*, *Lactococcus*, *Leclercia*, *Leuconostoc*, *Myroides*, *Pantoea*, *Proteus*, *Providencia*, *Pseudomona*, *Serratia*, *Sphingobacterium*, *Sphingomona*, *Rahnella*, *Raoultella*, *Vibrio* and *Yersinia*).

Category 3: zoonotic and floor bacteria (*Bordetella bronchiseptica*, *Brucella*, *Erysipelothrix rhusiopathiae*, *Francisella*, *Methylobacterium*, *Pastereulla*, *Rhizobium*, *Shewanella*, *Staphylococcus arlettae*, *S. equorum*, *S. intermedius*, *S. lentus*, *S. sciuri*, *S. xylosus* and *Streptococcus thuraltensis*).

Figure 2 shows the distribution of the bacteria identified at each of the sampling sites and categorized according to the previous description.

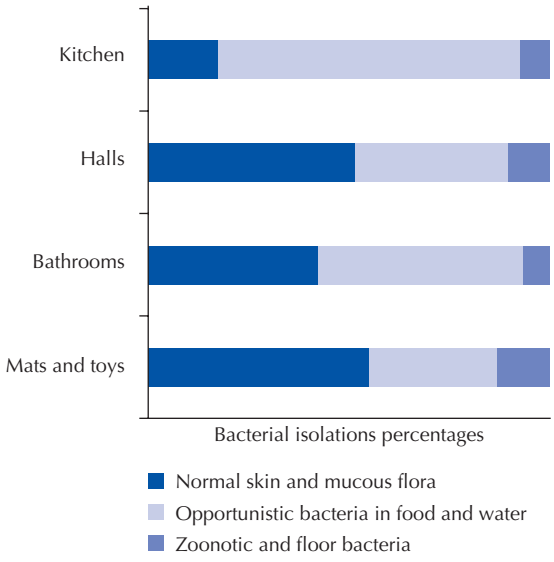

Figure 2 – Percentages of isolation of bacteria on surfaces in children's care homes – Bogotá, Colombia, 2015.

Table 2 shows the state of cleanliness, infrastructure, and the number of isolations of bacteria in the sampling sites. The place with the highest percentage of isolated bacteria was the kitchen, even though the score given to the state of cleanliness and infrastructure was over 70%.

Table 2 – State of cleanliness, infrastructure and number of bacterial isolations in children's care homes – Bogotá, Colombia, 2015.

Site evaluated	Cleaning (%)	Adequate infrastructure (%)	Isolations (%)
Halls	85.4	83.6	22
Mats and toys	83.9	43.8	20
Kitchen	82.6	71.1	36
Bathrooms	76.8	58.7	22

DISCUSSION

The results of this research, along with studies that have associated the development of diseases in children due to environmental factors[1-2], suggest the importance of identifying healthy habits and classifying microorganisms as the basis for carrying out interventions that will have an impact on health care during early childhood. Children's care homes and their hygiene practices permit exposure to and transmission of microorganisms[5-6]. It is recognized that children, in comparison with adults, do not have strong hygiene habits, making them more liable to contract and transmit primary pathogens or opportunistic pathogens[7].

A relevant finding of the present study was the low percentage of children that carry out the hand hygiene protocol at the three basic times. This result is important since many infections are acquired through direct contact with sick individuals or via surfaces contaminated with microorganisms that become temporarily lodged in the epidermis and are removed through hand hygiene[8]. Insufficient hand hygiene in children is linked with the presence of bacteria and parasites with pathogen potential[8-10]. A significant association was found between the presence of *Blastocystis hominis* and the absence of hand hygiene prior to food consumption[10].

Although a large proportion of the caregivers said they knew the 10 hand hygiene steps established by the WHO, in the observation only 2.8% performed them at the five recommended times. This finding, together with the children's hand hygiene results, may be due to behavior reported in previous studies[11]: if adults do not have good hand hygiene habits, it is unlikely they will be encouraged in children. This observation may also be related to the higher proportion of Gram-negative bacteria in areas handled more by caregivers, such as kitchens. The microbiological results from kitchens may be associated with the failure to use personal protection items, to keep one's nails cut, clean and without nail polish, and compliance with food handler certificates. Other factors identified in the study, such as inadequate food storage, handling of meat, fruit and vegetables with the same kitchen utensils, and the use of dirty dish towels, may also be associated with the loss of innocuousness of food through direct or cross-contamination[12].

Insufficient knowledge on the part of caregivers on the correct way to use sodium hypochlorite in cleaning and disinfection protocols was identified in the study as a critical health intervention aspect. The FDA (Food and Drug Administration) and National Ministry of Education of Colombia recommend sodium hypochlorite solutions of 5.25% for disinfecting fruits, vegetables, kitchen utensils and surfaces, because of its antimicrobial property and safety profile in comparison with other products used for the same purpose in homes[13]. It is important to review the existing regulations in each country regarding the dilution and exposure time of these solutions, since microbiota can vary among regions. Microbiological monitoring should also be performed after cleaning and disinfection protocols in order to adjust the regulations, in light of reports of bacterial resistance not only to antibiotics, but also to disinfectants[14]. There are reports in the literature of resistance of mesophilic aerobic germs on food surfaces to sodium hypochlorite solutions[15]. Excess concentrations of this disinfectant can also reduce the quality of the air children breathe, made worse by the fact that only 19% of the CCH had efficient ventilation systems. It has been demonstrated that ventilation strategies in buildings occupied by human populations have a direct influence on bacterial microbiota[16].

In the present study, 78% of the CCH had a water tank, and 64% of them cleaned it every six months or more; this is an indicator that should be worked on with caregivers, since poor cleaning and maintenance of water storage devices are responsible for a large number of outbreaks of gastrointestinal diseases[17].

A total of 699 bacteria were identified using automated methodologies. Although it is clear that environments inhabited by human beings are not free of microorganisms, their presence (mostly saprophytes) in soil, water, and air makes the environment a facilitator of transformation processes of organic matter by Gram-positive bacteria. Therefore, distinguishing between saprophytic microbiota that is normally found in biological systems and pathogens and their concentration that can affect health is more important than the number of bacterial isolations[18-19]. Although bacteria have various effects on human health, not only as a cause of infections but as part of the normal microbiota, their true importance has not been fully understood[20-21]. An example of this situation is the growing number of infections in populations outside of hospital environments by methicillin-resistant *Staphylococcus aureus*, which implies there are other reservoirs of this pathogen inside homes[22-23]. Despite the importance of characterizing the bacteria found in environments where vulnerable populations reside, there have been few reported studies. Therefore, this study makes a relevant contribution by providing a baseline of the bacterial communities present, taking into account that only 1% of the microorganisms present in closed environments are actually viable[24].

Both Gram-positive and Gram-negative bacteria are commonly isolated from the surfaces of community homes. This finding was also reported in a previous study where a similar proportion of gram-positive and gram-negative bacteria was found in the air of homes[21]. However, Gram-positive bacteria predominate in the microbiota in places with greater human contact, as was seen in the case of halls, toys, and mats, similar to studies where up to 75% of the bacteria present in the air may correspond to this type of microorganism[25-26]. In contrast, there was a higher percentage on kitchen surfaces of Gram-negative bacteria, which have high pathogen potential in communities[27].

Some studies have emphasized the importance of including molecular methods, such as microarrays and metagenomic approaches to characterize bacteria in these environments, since conventional methodologies with culture mediums only detect a fraction of the microbiota[18]. However, the protocols used in the present study were effective on the surfaces of the homes for bacteria considered opportunistic pathogens, such as *K. oxytoca, K. pneumoniae* and *S. epidermidis*. Although *Klebsiella* spp. is a microorganism normally found in environments, it is also associated as a pathogen in both clinical and community settings that causes various infectious diseases, such as urinary tract infections, pneumonia, septicemia, meningitis and wound infections[28-29]. The main reservoirs of this bacterium are the gastrointestinal tract of patients and the hands of health workers, which facilitates their transmission through direct contact[30]. Human beings are considered the main reservoirs of staphylococci. Therefore, their transmission can occur by direct contact with the hands or body fluids of infected individuals or by indirect contact with contaminated fomites[31-32]. Recommendations for future studies include monitoring the presence of these bacteria on caregivers' hands, as well as monitoring the absence of children due to infectious diseases, in order to determine the role that these bacteria may play and to characterize the risk of their presence on surfaces as primary or opportunistic agents in children.

CONCLUSION

The findings of the present study provide a foundation for making decisions on how to improve conditions related to infrastructure and equipment in children's care homes. These results also represent a contribution toward understanding the microbiological diversity of environments that shelter vulnerable populations, such as children, since few studies exist at the national or international level. The results justify the need for interdisciplinary health interventions aimed at caregivers and children, with an emphasis on promoting healthy hygiene habits and safe surroundings, proper food handling, and good cleaning and disinfection practices, in order to protect the health of children and families. The current trend of food consumption outside the family nucleus implies that children are fed in places adapted to their care; this situation requires that the entities in charge monitor and control compliance with good manufacturing practices (GMP) and the implementation of programs related to cleaning and disinfection, waste management, quality assurance and even microbiological sampling of sites where care is given to children.

RESUMEN

Objetivo: Identificar hábitos de higiene de niños y cuidadores para la prevención y el control de enfermedades infecciosas en lugares de atención en Bogotá, Colombia; asimismo, caracterizar las bacterias en las superficies de estos ambientes. **Método:** Se diseñaron, validaron y aplicaron dos instrumentos para evaluar hábitos saludables y se tomaron muestras de superficies en cocinas, baños, salones, colchonetas y juguetes de 230 lugares. Las bacterias aisladas fueron clasificadas por metodologías automatizadas. **Resultados**: Se aislaron 699 bacterias, donde el mayor porcentaje de crecimiento fue en cocinas (36%). Estos resultados contrastan con lo observado, donde se evidenció que la mayoría de las cocinas se encontraron limpias (80%). La encuesta reportó que 93% de los cuidadores reconocen lavarse las manos antes de manipular alimentos y 23% informó utilizar elementos de protección para la manipulación de alimentos. **Conclusión**: Se evidencia la necesidad de acompañar e intervenir los hábitos de higiene y de cuidado del ambiente en lugares de atención a población infantil.

DESCRIPTORES

Niño; Infecciones Bacterianas; Higiene; Control de Infecciones; Mortalidad Infantil; Enfermería Pediátrica.

RESUMO

Objetivo: Descrever os hábitos de higiene de crianças e seus cuidadores para a prevenção e o controle de doenças infecciosas em locais de atendimento em Bogotá, Colômbia; e identificar as bactérias nas superfícies desses ambientes. **Método:** Foram desenhados, validados e aplicados dois instrumentos para avaliar os hábitos saudáveis e coletadas amostras de superfícies em cozinhas, banheiros, salas de

aula, colchões e brinquedos de 230 locais. As bactérias isoladas foram classificadas por metodologias automatizadas. **Resultados:** Foram identificados 699 isolados, cuja maior porcentagem de crescimento foi em cozinhas (36%). Estes resultados contrastam com o observado, uma vez que foi evidenciado que a maioria das cozinhas estavam limpas (80%). A pesquisa reportou que 93% dos cuidadores reconhecem lavar suas mãos antes de manipular alimentos e 23% informou utilizar elementos de proteção para sua manipulação. **Conclusão:** Evidenciou-se a necessidade de intervir nos hábitos de higiene e nas práticas de cuidado do ambiente em locais de atenção à população infantil, através de estratégias de educação dirigidas às crianças e aos cuidadores.

DESCRITORES

Criança; Infecção Bacteriana; Higiene; Controle de Infecções; Mortalidade Infantil; Enfermagem Pediátrica.

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