Center for Demographic and Health Research (CIDS) UNAN-León, Nicaragua.
Department of Public Health and Clinical Medicine, Umeå University, Sweden.

Comparison of diarrhea episodes in different seasons in León, Nicaragua, 2001-2002.

MSc. In Epidemiology.

Author: Magdaly Torres, MD.

Tutor: Mercedes Cáceres. MD, Ph.D

Asesor: Rodolfo Peña, MD, Ph.D

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ABSTRACT

Diarrhea diseases are a major public health problem among children in developing countries and underprivileged areas of the world, these contribute to high morbidity and mortality rates in these regions. In Nicaragua, diarrhea is cause of infant mortality and responsible of many deaths annually. Moreover, several diarrhea studies demonstrated that most of diarrhea cases are treated at home and therefore not captured by hospital-based surveillance systems. This demonstrates the importance of community based surveillance systems to monitoring and compares diarrhea episodes in different seasons in León city. Therefore the purpose of the present thesis is to describe the epidemiological patterns of diarrhea diseases among children under five years old based on an ongoing community-based surveillance system in the municipality of León, Nicaragua.

A questionnaire with V sections were carried out with mothers or caretakers in dry and rainy season belonging to 414 households selected randomly with the presence of children under five years of age in each one.

Most of the children involved in this study were 3-5 years of age with a similar proportion by sex in both seasons. The caretakers were 20-30 years (58%) and 44% of the households were living in poverty. Caretakers were unemployed to a great extent (62%) and their education was found to be no formal in 20%, indicating when the caretakers are young girls they lack knowledge and skills of how to take care of the children adequately.

The proportion of children who got diarrhea episodes in rainy season was more than double (40%) than the proportion in dry season (17%), being the highest proportion in the group 1-2 years of age in both seasons.

The data also had shown a potential for an association between diarrhea episodes and rainy season, pointing to the risk of acquiring diarrhea in this season and indicating the importance of use of health services and Oral Rehydration Therapy (ORT) in home. Thus it is important to monitor diarrhea occurrence on population level, and the existing epidemiological surveillance system in León provides an interesting tool to take guide immediate actions and planning of prevention programs and control of this disease.

Key words: Diarrhea/epidemiology; child; developing countries; longitudinal studies; surveillance system; caretakers; seasons.

RESUMEN

Las enfermedades diarreicas son unos de los mayores problemas de salud en los niños de los países sub-desarrollados del mundo. Estas contribuyen a altas tasas de morbilidad y mortalidad en estas regiones. En Nicaragua, la diarrea es causa de mortalidad infantil y responsable de muchas muertes anualmente. Sin embargo varios estudios de diarrea han demostrado que la mayoría de los casos son tratados en casa y por lo tanto no son detectados por los sistemas de vigilancias basados en hospitales. Esto demuestra la importancia de un sistema de vigilancia basado en la comunidad que monitoree y compare los episodios de diarrea en las diferentes estaciones del año en la ciudad de León. Por lo tanto el propósito de la presente tesis es describir los patrones epidemiológicos de las enfermedades diarreicas en los niños menores de 5 años utilizando un sistema de vigilancia basado en la comunidad en el municipio de León, Nicaragua.

Un cuestionario con 5 secciones fue aplicado a madres o responsables de las niños/as, en ambas épocas del año quienes habitaron en las 414 viviendas seleccionadas aleatoriamente y que tenían la presencia de niños/as menores de 5 años habitando en la vivienda.

La mayoría de los niños/as involucrados/as en el estudio tenían edades de 3-5 años y la proporción de niños/as participando por sexo fue similar en ambas estaciones. Las personas encargadas de cuidar a los niños/as tuvieron edades comprendidas entre los 20-30 años en el 58% de los casos y 44% de las viviendas se encontraban viviendo en pobreza. Las encargadas de los niños/as estuvieron en desempleo en una amplia proporción (62%) y su educación fue encontrada ser no formal en el 20% de ellas, indicando que cuando la encargada de cuidar a los niños/as es una mujer joven hay falta de conocimientos y habilidades de cómo cuidar niños/as adecuadamente.

La proporción de niños/as quienes tuvieron episodios diarreicos en la época lluviosa fue del 40%, más del doble que la proporción encontrada en la época seca (17%); teniendo los niños de 1-2 años de edad la proporción más alta de episodios diarreicos en ambas épocas del año.

Los datos muestran una tendencia de asociación entre los episodios diarreicos y la época lluviosa, resaltando el riesgo de adquirir diarrea en esta época e indicando la importancia del uso de los servicios de salud y las sales de rehidratación oral en el hogar. A si que es importante monitorear la ocurrencia de los episodios de diarrea a nivel de población, y la presencia de un sistema de vigilancia epidemiológico en León, que proporcione valiosa información para la toma de acciones inmediatas y la planificación de programas para prevenir y controlar ésta mortal enfermedad.

Palabras claves: *Diarrea, epidemiología, niños/as, países sub-desarrollados, estudios longitudinales, sistemas de vigilancia, responsables del cuidar a los niño/as, estaciones del año.*

1. INTRODUCTION

Diarrhea is one of the principal causes of morbidity and mortality among children in the developing world. In 1982, on the basis of a review of active surveillance data from studies conducted in the 1950s, 1960s and 1970s, it was estimated that 4.6 million children died annually from diarrhea [1]. In 1992, a review of studies conducted in the 1980s suggested that diarrhea mortality had declined to approximately 3.3 million annually. Both reviews estimated that children in the developing world experienced a median of between two and three episodes of diarrhea every year [2].

The number of deaths can be dramatically reduced through critical therapies such as prevention and treatment of dehydration with Oral Rehydration Salts (ORS) and fluids available at home, breastfeeding, continued feeding, selective use of antibiotics and zinc supplementation for 10-14 days. It is estimated that in the 1990s, more than 1 million deaths related to diarrhea may have been prevented each year by the promotion and use of appropriate home therapies to successfully manage diarrhea, including Oral Rehydration Therapy (ORT) [3].

The goals by UNICEF and WHO (United Nations Millennium Development Goals) is to reduce by one half the deaths due to diarrhea among children under five by 2010 compared to 2000 and reduce by two thirds the mortality rate among children under five by 2015 compared to 1990 [3].

Ingestion of unsafe water, inadequate availability of water for hygiene, and lack of access to sanitation contribute to 88% of the deaths from diarrhea globally. Furthermore, these highly prevalent illnesses have been found to be major determinants of growth retardation and malnutrition [4]. Diarrhea disease cause a heavy economic burden on health service as well, because up to a third of total pediatric admission are due to diarrhea diseases and up to 17% of all deaths of ward pediatric patients are diarrhea related [5].

A review of 22 longitudinal community-based studies in Asia and Latin America found an overall incidence of 3.9 episodes of diarrhea in children less than 12 months of age and 2.1 episodes per year in children 1-4 years of age [6]. Moreover, a meta-analysis of several diarrhea studies demonstrated that approximately 90% of diarrhea cases are treated at home and therefore not captured by hospital-based surveillance systems [7].

This demonstrates the importance of community-based surveillance systems to assess the real incidence of diarrhea in the general population. Analyses used to detect enteropathogen are generally performed in

order to identify specific causes of diarrhea. However patients are rarely followed to evaluate important individual and community risk factors such as re-infection and host resistance. Prevalence of diarrhea and related risk factors are important indicators of health development and are thus necessary to monitor in order to target and evaluate intervention and prevention measures [6].

Infant mortality rates from intestinal infections in 1984 varied from 2.3 per 100,000 in West Germany to 1,623 per 100,000 in Paraguay. Even in the United States, diarrhea is common, although mortality is low. In the first years of life, children in the United States have on average one to two episodes per year.

In a recent study of more than 400 Swedish children with diarrhea, bacterial agents were demonstrated in 14 per cent. The most common organism was *Campylobacter jejuni*, found in 4.8% of these children. In developing countries, the proportion of bacterial agents is much higher, up to 45% [3].

Acute diarrhea continues to exact a high toll on children in developing countries (fig.1). Success in reducing death and illness due to diarrhea depends on acceptance of the scientific basis and benefits of these therapies by governments and the medical community. It also depends on reinforcing family knowledge of prevention and treatment of diarrhea, and providing information and support to underserved families [3].

Accompanying general improvement of the quality of life, the World Health Organization-guided local programs of diarrhea disease control were instituted, including promotion of breastfeeding, oral rehydration therapy, and specific health education. A gradual decrease in the prevalence of these diseases was registered, especially after 1980, thus helping to diminish the global infant death rate, which at present approaches a figure of 15 per 1,000 [8,9].

In Nicaragua one of the two poorest countries in the Western Hemisphere [10], with a population of 5 million inhabitants (2002); approximately half of the population is poor and about 17% lives in extreme poverty. The poverty in Nicaragua is more profound in the rural areas where 70% of the population is poor in contrast to 30% being poor in the urban area [11].

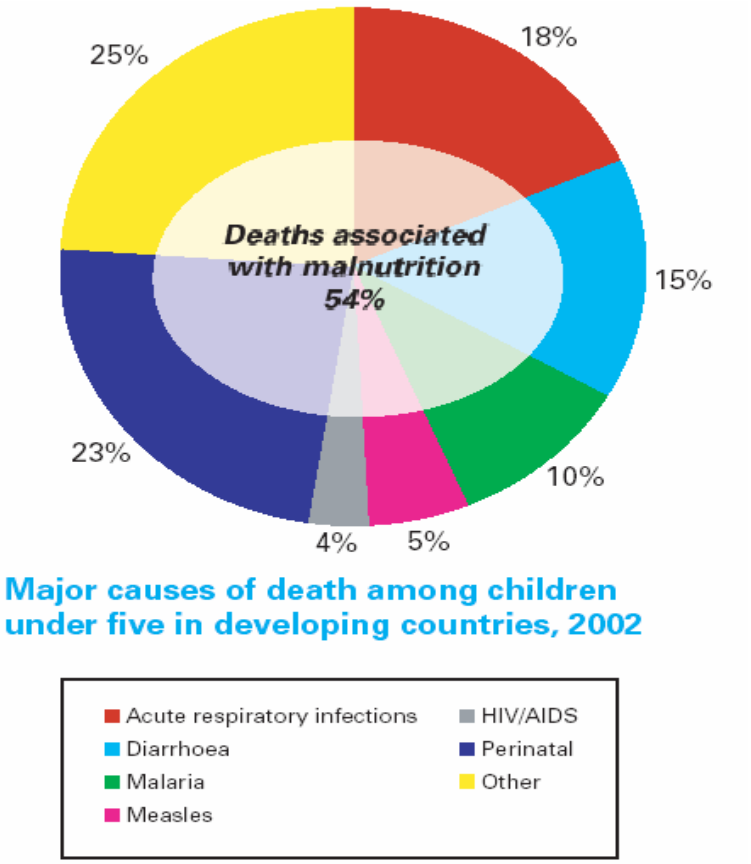

Fig. 1 WHO/UNICEF [2]

The principal cause of infant mortality is diarrhea, which is responsible for 40% of these deaths annually. This statistic reflects the low usage of health services and oral rehydration therapy (ORT). In an effort to improve the situation, several studies were carried out in Villa Carlos Fonseca municipio, one of this epidemiologic studies included 391 mothers over 14 years of age with one or more children under age 5 years, of whom 215 had had diarrhea in the two weeks preceding the survey to determine the incidence of diarrheas according to the diagnosis made by the mothers. The limited use of health services and ORT, although it was observed that in certain cases traditional treatments were used in combination with those of western medicine. There was a direct but nonsignificant correlation between the level of schooling of the mothers and the frequency with which they visited the health center [12].

A prospective study in León show than rotavirus infections are acquired very early in infants and the breast milk appears to confer partial protection against rotavirus infection, probably mediated by specific IgA antibodies [13].

Surveillance System

Public health surveillance is the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity and mortality and to improve health. Data disseminated by a public health surveillance system can be used for immediate public health action, program planning and evaluation, and formulating research hypotheses. For example, data from a public health surveillance system can be used to:

- guide immediate action for cases of public health importance;
- measure the burden of a disease (or other health-related event), including changes in related factors, the identification of populations at high risk, and the identification of new or emerging health concerns;
- monitor trends in the burden of a disease (or other health-related event), including the detection of epidemics (outbreaks) and pandemics;
- guide the planning, implementation, and evaluation of programs to prevent and control disease, injury, or adverse exposure;
- evaluate public policy;
- detect changes in health practices and the effects of these changes;
- prioritize the allocation of health resources;
- describe the clinical course of disease; and
- Provide a basis for epidemiologic research [14].

The identification of new cases of a potentially epidemic disease like diarrhea disease may be achieved by a *surveillance* system, where cases systematically are identified and reported, or by a *sentinel* health information system, where a limited number of health care systematically report new cases identified in their practice [15].

2. OBJECTIVES

2.1 General

To describe the epidemiological patterns of diarrhea diseases among children under five years old based on an ongoing community-based surveillance system in the municipality of León, Nicaragua.

2.2 Specifics

* To report prevalence of diarrhea among children under five years of age.

* To calculate the proportions of diarrhea in different season.

3. SUBJECTS AND METHODS

3.1 Study area

This study was performed in the municipality of León, Nicaragua from December 2000 to November 2002.

The municipality of Leon has an area of 820 km^2 of which 215 km^2 are covered by a demographic surveillance system in both the urban and the rural areas and approximately 195,000 inhabitants. It lies at a distance of 93 kilometers from the capital. The mean temperature is 28° C and the yearly amount of rain is 2000 mm. There are two seasons, rain season - winter (May to October) and dry season – summer (November to April).

The population covered by the surveillance system is 55 000 (11 000 households) which represents 24% of the municipality. According to the survey in 1993 is 3% children under 1 year of age, 15% is children under 5 years of age and 25% are women in reproductive age (15-49 years). Twenty five percent of the rural population does not know how to read and write compared to 8% in the city.

In the 15 to 60 years of age, 38% has a stable source of income (domestic workers, industrial workers, farmers, professionals, businessmen, office clerks, teachers and health workers). The mean number of children per woman in the rural area is 9 compared to 5 per women in the urban area. The major religion is catholic and the native language is Spanish [16].

There are an average 5.7 persons per household. According to official data, 60-65% of people within working age are unemployed, and 50% of those have a monthly salary that does not cover the cost of basic foodstuffs [17-18].

3.2 Study population

We initiated a longitudinal prospective community-based study in the municipality of León with approximately 55,000 people. This system included a database of households formed in 1993 and 1996. The surveillance system involves 11,000 households (at the 2002 survey). Thus, the sample size for this study represents around 22% of the total population of Leon municipality was selected in 1993, thought a cluster-sampling technique, Approximately eight thousand households were included in the sample, consisting a population of 45,000 people. The population of these clusters was updated in 2002.

The sample size was calculated based on estimates of incidence of diarrhea and prevalence of risk factors captured from the literature. With a 95% confidence interval, 80% power and an expected frequency of disease of 3-5 episodes per year we determined a sample of 581 children. Due to an expected rate of drop outs we added 59 children to reach a final sample size of 640 children. The sample size was calculated in Epi-info 6.04 and the data were captured and stored in Access 97 Microsoft program, cleaned and analyzed in the software Statistical Package of Social Science (SPSS) version. 10.0. The differences between the seasons were analyzed using the difference of proportions method, and Logistic regression of risk factors were performed using a 95% confidence interval and a 5% level of significance.

We randomly selected 414 households from the 1996 survey in the municipality of León (*see appendix-figure 2*). A first interview was made to identify households with children under five years of age. If there were no children under five, living in a household, they were excluded and we then randomly selected another household from the database. Households where the family had migrated or the child had aged out of the study population were also excluded from the database.

3.3 Questionnaire.

The questionnaire was pilot tested and necessary adjustments made. The information was obtained using a questionnaire containing five sections as follows:

I**.** Household characteristics, II. Family structure, III. History of breastfeeding, IV. Diarrhea list of children in the household subject of surveillance V. Diarrhea episodes and their characteristic.

3.4 Data collection.

The data collection was performed during two seasons. The first period was during the *dry season* (December 2000 to March 2001) and the second period was during the *rainy season* (July to November 2002). Each selected households were plotted on a map and distributed to field workers for organization of home visits and personal interviews. Specially trained female interviewers visited and interviewed every two weeks each selected household. The interviews were performed with the mother of the child or the child's caretaker, caretakers were asked about any cases of diarrhea that had occurred in the previous 14 days. For each case of diarrhea, the field worker asked about the time and duration of the diarrhea episode, the frequency of diarrhea, the color and consistency of feces, as well as the presence of blood in the feces.

If the diarrhea was ongoing at the time of the visit, the field worker asked the mother to take a stool sample to the hospital.

For diarrhea episodes occurring between the field worker visits, oral and written instructions were given to the mothers or caretakers on how to take stool samples. The equivalent of $0.40 was provided to the mother to cover travel expenses to the hospital.

One of the field workers acted as the field supervisor and she organized systematic and random check-ups of the forms and at least 3 random visits to each of the field workers during the study period.

3.5 Ethical aspects

Contact was maintained with local health services so that the participants could get help and remedies for problems encountered. In order to maintain privacy of the participant, all data collected were treated with confidence and access to this information will not be given to others than the restricted team of researchers. The study was approved by the research ethics committee at León University.

3.6 Definitions

Diarrhea was defined as an over all change in the child's normal stool pattern, characterized by an increase in the frequency (to at least four stools per 24-hours period) and a decrease in the consistency of stools to an unformed state.

An episode of diarrhea was considered when the child had 4 or more times with diarrhea per day in each visit performed by the interviewer.

Demographic surveillance system: In a defined geographical site monitor, collect, analyze, interpret, disseminate and reuse the systematic demographic information in order to develop actions and plan interventions for a specific population [16].

Household: A place where a group of individuals (residents) live, share food and sleeps.

Poverty index: To estimate the socio-economic status, an index of the Unsatisfied Basic Needs Assessment (UBNA) was used [18]. This measure was previously used in the same setting of Leon Nicaragua by Zelaya et.al, [19] and Peña et. al., 1999 [20]. It included four indicators:

1. Housing was considered inadequate if the house had a dirt floor or if the walls had been constructed with other materials than cement.
2. Low school enrolment was determinated if the educative level of the parents was two levels lower than the expected level.
3. A highly dependent economy was defined as a child in school age without education in the household.
4. Sanitary conditions were considered inadequate if no piped water was available inside or outside the house or if there was no flush toilet.

Finally these four indicators were added to build the *Poverty Index* from 0 to 4; 0-1 was interpreted as non-poor household and 2-4 as poor household.

Education: was estimated as literacy of the children's caretaker according to the highest achieved level and further divided into two groups: Women were classified as having no formal education if they were either illiterate or had not completed primary school. Women with formal education were further classified according to whether they had completed primary high school or secondary or higher level of education.

Occupation: An activity that serves as one's regular source of livelihood.

4. RESULTS

4.1 The majority of children that we studied in both periods were 3-5 years of age with a similar proportion of children by sex but in the rainy season we found less children than in the dry season because some children had aged out of the study population, they were excluded secondary to frame to met inclusion criteria and the total number changed from 721 in dry season to 610 in rainy season in the analysis.

Table 1. Characteristics of children are under study in each season.

Dry season	Levels	Female N= 351 n (%)	Male N= 370 n (%)	Total N= 721 n (%)
Age group (years)	< 1	131 (37.3)	112 (30.3)	243 (33.7)
	1-2	67 (19.1)	74 (20.0)	141 (19.6)
	3-5	153 (43.6)	184 (49.7)	337 (46.7)
Rainy season		N= 299 n (%)	N= 311 n (%)	N= 610 n (%)
Age group (years)	< 1	37 (12.4)	29 (9.3)	66 (10.8)
	1-2	125 (41.8)	118 (37.9)	243 (39.8)
	3-5	137 (45.8)	164 (52.7)	301 (49.3)

4.2 The study included 664 caretakers over 15 years of age with one or more children and the majority of them were between 20-30 years (58%). In 44% of the households the families live in poverty and 20% of the caretakers do not have any formal education, 62% were unemployed.

Table 2**.** Characteristics of children's caretakers

Characteristic	%
Age	
<20 yrs	14.4
20-30 yrs	58.0
31-40 yrs	19.5
>40 yrs	8.1
Education	
No formal education	19.5
Formal education	80.5
Poverty	
Poor	44.3
No poor	55.7
Occupation	
Unemployed	61.9
Employed	38.1

4.3. Characteristics of households.

During December 2000 to November 2002 interviewers met with a total of 414 households, 4 households were excluded secondary to frame to met inclusion criteria (e.g. there were no children under five years of age living in the household, incomplete information in quality control step or migration) four hundred and ten households were included in the analysis. The main walls were brick/cement (85 %) as well as the floor (53%). The availability to sanitary services (water supply and type of toilet) was found to be; tap inside (96%) and the sewage was latrine in 51%, followed by water toilet in 49% (table 3).

Table 3: Characteristics of households

Category		**n**	**%**
Walls	Brick/cement	350	85.4
	Dried mud	30	7.3
	Wood	11	2.7
	Palm leaves	19	4.6
Floor	Brick/cement	212	51.7
	Tiled	99	24.1
	Mud	4	1.0
	Soil	95	23.2
Sewage	Water Toilet	201	49.0
	Latrine	207	50.5
	Toilet/latrine	2	0.5
Water Supply	Tap inside	392	95.6
	Tap outside	8	2.0
	Well	6	1.5
	Others	4	1.0
TOTAL		410	100

4.4 Distribution of children with diarrhea episodes by period of data collection.

In a total of 721 children included in the study we identified 216 children with diarrhea during both periods of observation. The total number of children with diarrhea, total number of diarrhea episodes, and the total number of days with diarrhea all increased significantly during the rainy season, the latter more than doubling (Table 4).

Table 4: The total number of children with diarrhea, total number of diarrhea episodes, and the total number of days with diarrhea

Characteristics	Dry season n= 601 n (%), mean	Rainy season n= 487 n (%),	P-value
Total no. of children having diarrhea	83 (14)	133 (27.3)	0.0000
Total no. of diarrhea episodes	101 (mean=0.16)	194 (mean= 0.40)	0.000
Total days with diarrhea	304	693	-

4.5 The proportion of children who got diarrhea episodes in rainy season was more than double (40%) than the proportion in dry season (17%), the proportion is highest for the age group 1-2 years of age in both season (table 5).The proportion for all age groups increased during the rainy season.

Table 5: Proportion of diarrhea episodes by age of child and period of data collection

SEASON	Dry season N=601 children			Rainy season N= 487 children		
Age group	No. of children with diarrhea episodes	(%)	I.C. 95%	No. of children with diarrhea episodes	(%)	I.C. 95%
<1 YEAR	28	4.7	(2.97 – 6.3)	29	6	(3.9 – 8.1)
1-2 YEARS	61	10.2	(7.7 – 12.6)	105	21.6	(17.9 – 25.2)
3-5 YEARS	12	1.9	(0.88 – 3.1)	60	12.4	(9.4 – 15.2)
TOTAL	101	16.8	(13.8 – 19.8)	194	40	(35.5 – 44.2)

5. DISCUSSION

The study was performed on a representative sample of children under five years of age from the urban area of the municipality of Leon, Nicaragua. This area is typical of the pacific coast of Nicaragua; although unemployment after the break-down of cotton production is higher than in many other areas of the country [20]. This background of poverty is very important for the spectra of risk factor, which are direct causes of diarrhea diseases the children. This study confirms that the conditions of the households were similar to other studies made with the similar sample size [21]. It involved 664 caretakers and the majority of them were 20-30 years of age (58%) (table 2), an outcome similar to a study made in Nicaragua in 1990 where the most of the mothers were 28 years of age [12].

We identified 294 episodes during both periods of observation (table 4). A distinct difference in the proportion of diarrhea between the two seasons was found with the higher proportion the rainy season (table 5) and the proportion of children with diarrhea was 16% in dry season and 40% in rainy season. There was a tendency to acquire the diarrhea diseases more than double as often in the rainy season as in the dry season, the proportion is highest for the age group 1-2 years of age in both seasons. The proportion for all age groups increased during the rainy season. Comparable results have not been found as most reports are on prevalence like the Minister of Health (MINSA) reports.

As the risks of acquiring diarrhea are different, in different seasons of the year, we carried out this study and used a surveillance system for diarrhea diseases in 601 children during dry season and 487 of the same children during rainy season. The first period was thirteen weeks during the dry season and the second period were twenty weeks during the rainy season. The collection of data by means of interviews every two weeks should give valid data on the episodes of diarrhea. Also the control of data collection and transfer of data to computers should be of value for the validity. The sample is giving information enough for the results to be inferred for the whole city of León.

Most of reports from Leon, by the Hospital, Minister of Health (MINSA) and Local Systems for Integral Health Care (SILAIS) about diarrhea diseases prevalence are random as there is no surveillance system that reports the risk to get the diarrhea. Thus, there is a need to develop adequate prevention strategies and improve the prevention program of infant diarrhea disease in the health services mainly in rainy season. This could be one of the entry-points for the prevention of infant diarrhea, take care with children mainly less than 2 years of age and policies to reduce the diseases in this risk group in the municipality of Leon.

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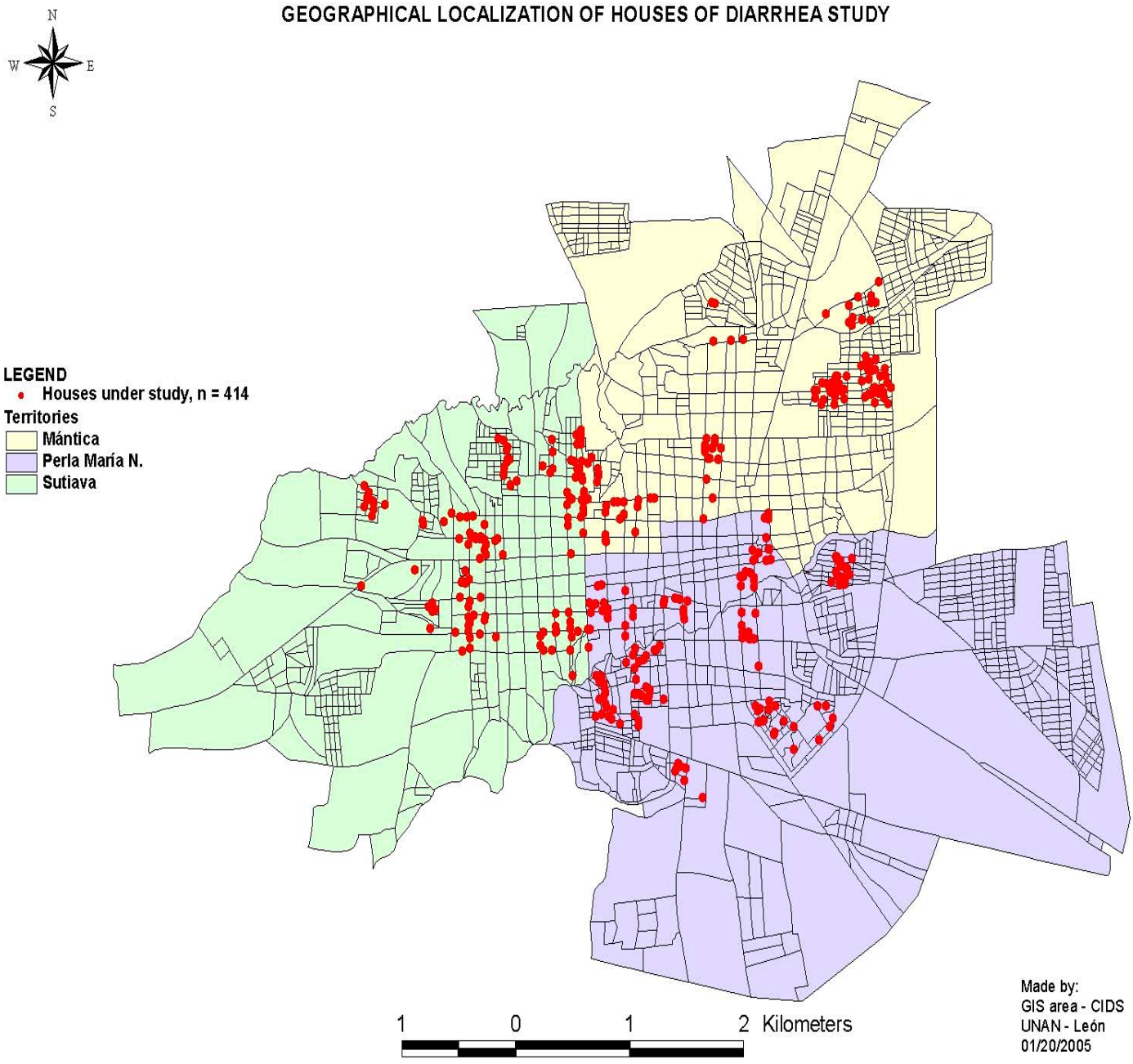
APPENDIX

Figure 2


GEOGRAPHICAL LOCALIZATION OF HOUSES OF DIARRHEA STUDY
N
W
E
S
LEGEND
Houses under study, n = 414
Territories
Mántica
Perla María N.
Sutiava
1 0 1 2 Kilometers
Made by:
GIS area - CIDS
UNAN - León
01/20/2005