Socioeconomic factors associated with dysentery in children under-five years from developing countries

Short title: Socioeconomic factors and dysentery in developing countries

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Abbreviations: ADD, Acute diarrheal disease; WHO, World Health Organization; DHS, Demographic and Health Survey; WB, World Bank; GDP Gross Domestic Product; United Nations, UN.

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38 **Socioeconomic factors associated with dysentery in children under-five**
39 **years from developing countries**
40

41 ## Abstract

42 **Objective:** Dysentery represents 10% of all causes of acute diarrhea in the world
43 and recognizing the implied proximal and distal social factors at different levels would
44 impact on every related outcome. Our purpose is to identify mother, household and
45 country characteristics that favor the presence of dysentery in children under 5 years
46 old. **Methods:** We conducted a multilevel analysis of data from phase V of the
47 Demographic and Health Survey and the World Bank, which included 38,762
48 children from 33 countries. **Results:** Prevalence of dysentery was 14.74%. GDP per-
49 capita was negative associated (OR= 0.75; 95% CI 0.71-0.78) and Gini index was
50 positive associated (OR= 1.23; 95% CI 1.19-1.28). Additionally, child age (OR=
51 0.99; 95% CI 0.99-1.00), mother age (OR= 1.01; 95% CI 1.00-1.01), employed
52 mother (OR= 1.11; 95% CI 1.02-1.20), and number of household members (OR=
53 1.02; 95% CI 1.01-1.03) have significant positive associations with the presence of
54 dysentery, while complete immunization schedule (OR= 0.88; 95% CI 0.81-0.96),
55 duration of breastfeeding (OR= 0.81; 95% CI 0.75-0.89), and type of residence (OR=
56 0.87; 95% CI 0.79-0.97) have significant negative associations with having the
57 illness. Finally, each of the categories of wealth index showed a significant
58 association with dysentery (p-value < 0.001). **Conclusions:** Lower per capita GDP
59 and higher Gini coefficient are associated with the development of dysentery,
60 regardless of characteristics of children, their mother, and household. Future and

present public health programs should address these issues in order to impact on the occurrence of this illness.

Author summary

Dysentery represents 10% of all causes of acute diarrheal disease. Diarrhea is the fifth cause of worldwide death in children under five years old. It is particularly important to assess and prevent this condition because the early years of life are critical since it is the period when the brain develops most rapidly and has a high capacity for change. Complications associated with dysentery such as malnutrition and convulsive episodes could have a negative effect in this aspect.

Our purpose is to identify the country proximal and distal socioeconomic factors that favor the presence of dysentery in children under five years old from low and middle-income developing countries in order to impact on the occurrence of this illness and its related outcomes. Studying associated factors with developing dysentery during an episode of acute diarrhea could be the base upon which we can diminish mortality from this illness through national policies to impact on national, community and household aspects.

Introduction

Acute diarrheal disease (ADD) is defined as the presence of three or more abnormally loose or watery stools in 24 hours. It is the second cause of death in children under five years old [1,2], with a worldwide prevalence of about 8% [3]. This illness is caused usually by the presence of microorganisms in contaminated food or drinking water [4], most of the times by rotavirus, which accounts 527,000 deaths annually. Eighty-two percent of these deaths occur in the poorest countries [5]. The second leading cause of ADD is related to a bacterial infection, in which *E. coli enteropathogenic* is the most important involved microorganism [6].

Dysentery is an intestinal inflammation that can lead to severe diarrhea with mucus or blood in the stools. It is a particularly worrying presentation of ADD [1] usually accompanied by fever, abdominal pain and impaired general conditions. Hence, it is defined as the presence of macroscopic blood and mucus in the stools [1,4]

According to the World Health Organization (WHO), dysentery represents 10% of all causes of ADD and accounts for 15% of all deaths from this cause. It is also the fifth cause of death worldwide in children under five years old [7]. In developing countries, shigellosis is the most frequent cause of dysentery in children, with 99% of all cases in comparison to developed countries whose main etiology is seasonal virus [4,6,8]. Complications associated with dysentery goes from dehydration, malnutrition, and cognitive impairment to severe outcomes as convulsive episodes, uremic syndrome and death [8]. It is worth recognizing, that children are at higher risk to acquire this mentioned infection, not only because they

have more contact with soil, but also because their immune system is still immature for establishing an appropriate response to any microorganism [2].

In a recent study, we evaluated the relationship between some characteristics of developing countries and the occurrence of diarrheal disease. We concluded that residents of nations with higher inequality and lower incomes have greater probabilities of having diarrhea, especially when there is a lack of household wealth and mother's education [9].

Other factors that showed strong positive association with diarrhea were female sex of the child, younger age of the child, incomplete immunization status, birth weight, lack of education of the mother and an unemployed mother [9].

Recognizing dysentery risk factors would reduce not only mortality rates in children under five years old but also would impact in every outcome related to this disease. The aim of this article is to identify mother, household and country characteristics that favor the presence or absence of dysentery in children under five years old by analyzing the Demographic and Health Survey (DHS) phase V in 33 nations.

Methods

This is a cross-sectional, transnational and multilevel study. We used level-1 data (child, mother and household characteristics) from the Demographic and Health Survey (DHS) phase-V [10] and level-2 data (country characteristics) from the World Bank (WB) country data [11].

The DHS phase-V collected data from 41 developing countries from 2004 to 2010. A nationally representative, probabilistic sample including rural and urban areas was collected from each participating country. Respondents were selected through a multistage, stratified sampling procedure of households. Between 5,000 and 30,000 households were surveyed per country. Data was gathered for the countries included in Attachment 1. We excluded Ukraine from the analysis because this country did not apply the child health module of the survey. Information from the remaining 40 countries was merged to create a single dataset, which included 395,485 households with children. The dataset was further limited to biological mothers answering the survey to assure comparability (384,662), living children (359,527), permanent household residents (349,849) and cases with complete information in variable diarrhea (348,706). Afterward, the database was limited to cases that reported diarrhea during the two weeks before the interview (49,065) in order to know how many of them had dysentery. Then, the database was finally limited to cases with complete information in the variable dysentery (38,762). Finally, we have information from 33 countries because Bangladesh, Benin, Congo, Democratic Republic of the Congo, Indonesia, Mali, and Niger did not have information about dysentery [10].

After careful analysis, we concluded that the WB country data was the best source of level-2 data in this study because of its country comparability and robustness when compared to data from other sources. These data included the 2010 indicators: per capita gross domestic product (GDP), Gini-coefficient, and health expenditure as a percentage of GDP.

Outcome Variable

Dysentery: the presence of bloody diarrhea (as defined by the respondent, the child's mother). Dysentery was asked by DHS to the mothers whether there was any blood in the stools of those children who had diarrhea at any time during the two weeks preceding the interview (0 = no; 1 = yes).

Independent Variables

We divided the variables according to the data source: level-1 variables included the child, mother and household characteristics, and level-2 variables included country data. At first, we considered three levels of analysis –child, household, and country- but most households had only one child under the age of five, so it was decided to include only one child per household, the youngest, and conduct a two-level analysis.

Level-1 data, children: age of the child in months, sex, possession of the health card, immunization defined as the completeness of WHO schedule, duration of breath feeding in months, birthweight, twin pregnancy, cesarean section, bottle feeding with a nipple. Even though it is not ideal to include a birthweight-missing

177 indicator, taking into consideration that 46% of the children did not have this
178 information, imputation was ruled out.
179
180 **Level −1 data, mother**: age in years, education o educational attainment,
181 current employment, marital status, total children and partner age
182
183 **Level -1 data, mother's pregnancy**: planned pregnancy, antenatal visits.
184
185 **Level −1 data, household**: household members defined as the number of
186 people living in the same home, place of residence, the age of household head, main
187 floor material, years living at the house, sanitation score based upon water source
188 and waste disposal and wealth index calculated by the DHS considering income,
189 possessions, and quality of life [12].
190
191 **Level-2 data, country**: Country wealth coded as a set of dummy variables:
192 Low income (1 = gross domestic product per capita (GDPpc) of US$1,025 or less),
193 Lower middle income (1 = GDPpc between US$1,026 and US$4,035), Upper middle
194 income (1 = GDPpc between $4,036 and $12,475), and High income (1 = GDPpc of
195 $12,476 or more) [15]. Inequality based on the Gini coefficient (1 = top 25 % unequal
196 countries and 0 = more equal countries) and health expenditure coded as a set of
197 dummy variables based on the percentage of GDP expended on health. Low health
198 expenditure (1 = 5 % or less), Middle health expenditure (1 = between 5.1 and 10
199 %), High health expenditure (1 = more than 10 %). We considered in the initial
200 models country homicide rates and total country population, but these variables were

omitted in the final models because of their lack of association with dysentery and their negative effects on the model's validity, measured using residual files and reliability estimates.

Statistical Analysis

The analysis was conducted considering known factors associated with dysentery and the country characteristics studied. Multilevel analyses were preferred because the hierarchical nature of the data violated the principles of independence and homogeneity required for a single-level analysis [13].

The statistical analysis was performed using SPSS 20.0 (IBM) and HLM 7 (Scientific Software International, Inc.), as follows: 1) we merged the individual datasets of the 40 countries, 2) we filter out the database following the inclusion and exclusion criteria explained above obtaining information from 33 countries, 3) we calculated descriptive statistics for categorical (proportions) and numerical variables (mean, standard deviation, minimum and maximum values), 4) we obtained bivariate odds ratios using hierarchical linear modeling logistic regressions of dysentery in all of the studied variables, and 5) we generated multivariable models for dysentery using hierarchical linear modeling. Stepwise multilevel logistic regression equations were estimated. Individual, family and household factors were included as possible predictors of dysentery, and differences were deemed to be significant with P-value less than 0.05. The large sample size allowed us to find small differences with narrow 95% confidence intervals. Finally, multilevel modeling was used to explore the association of country characteristics with dysentery (between countries associations) adjusting for individual, family and household predictors of the

condition (within countries associations) [14,15]. Full maximum likelihood was used to fit the models. Random effects were estimated only for indicators with variations between groups that could be explained by the studied variables, allowing the coefficients to vary across groups. Those level-1 indicators were centered on the country mean to avoid the problem of co-linearity. All other variables, as well as the neighborhood variables, were centered on the grand mean and we constrained their variance. Level 2 country data variables were dichotomized and analyzed into 50% higher and 50% lower. The final model can be seen in Table 4. We have calculated median odd ratios (MORs) and intra-class correlations (ICC) for the models, as well as 80% interval odds ratios (IORs) for the country level variables [16,17].

We tested bivariate interactions by multiplying duration of breastfeeding and maternal education, duration of breastfeeding and maternal employment, immunization and maternal education, and wealth index and immunization to determine if an interaction was present.

Within countries, weights provided by the DHS for children under 5 years old were employed in the analysis for the level-1 data. They were adjusted to the survey design. Post-stratification was incorporated as a weight adjustment. The adjusted weights were used in all of the analyses. For level-2 data, between countries, weights were created and used in the analysis for each country accounting for their population.

Regression analyses considering the DHS year of survey were performed to assure that the results were not biased by the different time lapses the surveys took place at each country.

248 Macro International provided the datasets from the 41 countries included in
249 this study. The study was based on secondary sources without identifying
250 information about individual participants. It was given approval by the institutional
251 review board, Comité de Ética en Investigación, Universidad del Rosario.

252

253 ## Results

254 The sample comprised 38,762 children under 5 years from 33 developing
255 countries, who presented diarrhea during the last two weeks before the interview,
256 according to the mother´s report. The descriptive features of the evaluated
257 population are shown in Table 1. They are separated from children who did and did
258 not present dysentery in their last episode of diarrhea.

259

Table 1. Descriptive statistics from children under five years old from 33 countries, 2004–2010 who reported diarrhea. Proportions for categorical variables and median/interquartile range for numerical variables.

Variables	NO Dysentery	Dysentery
Children		
Dysentery *% (n)*	85.25 (33,048)	14.74 (5,714)
Age in months *median (IQR)*	19 (22)	24 (22)
Female sex *% (n)*	47.32 (15,639)	47.67 (2,724)
Possession of health card *% (n)*	87.82 (29,026)	85.35 (4,877)
Complete immunization schedule *% (n)*	63.72 (21,060)	55.98 (3,199)
Planned pregnancy *% (n)*	57.17 (18,895)	53.02 (3,030)
Antenatal visits *% (n)*		
None	9.47 (3,131)	11.06 (632)
1-2	10.02 (3,312)	9.53 (545)
3-10	59.77 (19,753)	56.09 (3,205)
More than 10	4.16 (1,376)	2.55 (146)
Missing information	16.56 (5,476)	20.75 (1,186)
Birth weight *% (n)*		
Low	6.25 (2,066)	5.19 (297)
Normal	48.17 (15,921)	40.47 (2,313)
Not weighed or not remember	45.057(15,061)	54.32 (3,104)
Cesarean delivery *% (n)*	11.08 (3,665)	8.76 (501)
Duration of breastfeeding (months) *median (IQR)*	13 (10)	15 (10)
Still breastfeeding *% (n)*	62.07 (20,514)	56.10 (3,206)
Drinking from a bottle with a nipple *% (n)*	22.44 (7,418)	17.72 (1,013)
Twin pregnancy *% (n)*	1.99 (659)	1.90 (109)
Mother		

Age (years) *median (IQR)*	27 (10)	28 (11)
Educational attainment *% (n)*		
No education	24.23 (8,010)	30.36 (1,735)
Elementary	39.38 (13,017)	44.50 (2,543)
High school	30.24 (9,995)	21.92 (1,253)
Superior	6.12 (2,025)	3.18 (182)
Mother's Employment *% (n)*	47.76 (15,787)	57.47 (3,284)
Marital status *% (n)*		
Single	4.27 (1,669)	4.48 (256)
Married	88.34 (29,195)	87.73 (5,013)
Divorced separated or widow	7.38 (2,440)	7.78 (445)
Total children ever born *median (IQR)*	3 (3)	3 (3)
Partner age (years) *% (n)*		
Under 20	0.58 (193)	0.36 (21)
Between 20 and 40	70.77 (23,391)	65.68 (3,753)
Above 40	16.43 (5,430)	20.86 (1,192)
Missing information	12.20 (4,034)	13.09 (748)
Household		
Number of household members *median (IQR)*	6 (4)	6 (3)
Male-headed households *% (n)*	82.17 (27,157)	80.71 (4,612)
Age of head of household *median (IQR)*	36 (18)	37 (17)
Who is the head of household *% (n)*		
Mother	9.61 (3,179)	11.37 (650)
Husband	64.64 (21365)	66.22 (3,784)
Other relative	25.73 (8,504)	22.40 (1,280)
Urban residence *% (n)*	65.20 (21,548)	73.90 (4,223)
Floor material *% (n)*		
Soil or sand	44.65 (14,758)	56.72 (3,241)
Wood	11.51 (3,804)	11.95 (683)
Finished floor	43.83 (14,486)	31.32 (1,790)
Years living at house *% (n)*		
Under one	4.03 (1,333)	3.85 (220)
Between one and five	22.64 (7,485)	21.21 (1,212)
More than five	62.34 (20,604)	66.13 (3,779)
Missing information	10.97 (3,626)	8.80 (503)
Inadequate sanitation score *% (n)*	16.70 (5,520)	23.27 (1,330)
Wealth index *% (n)*		
Poorest	27.78 (9,182)	37.45 (2,140)
Poorer	22.82 (7,543)	25.28 (1,445)
Middle	20.42 (6,749)	18.34 (1,048)
Richer	16.75 (5,537)	12.58 (719)
Richest	12.21 (4,037)	6.33 (362)

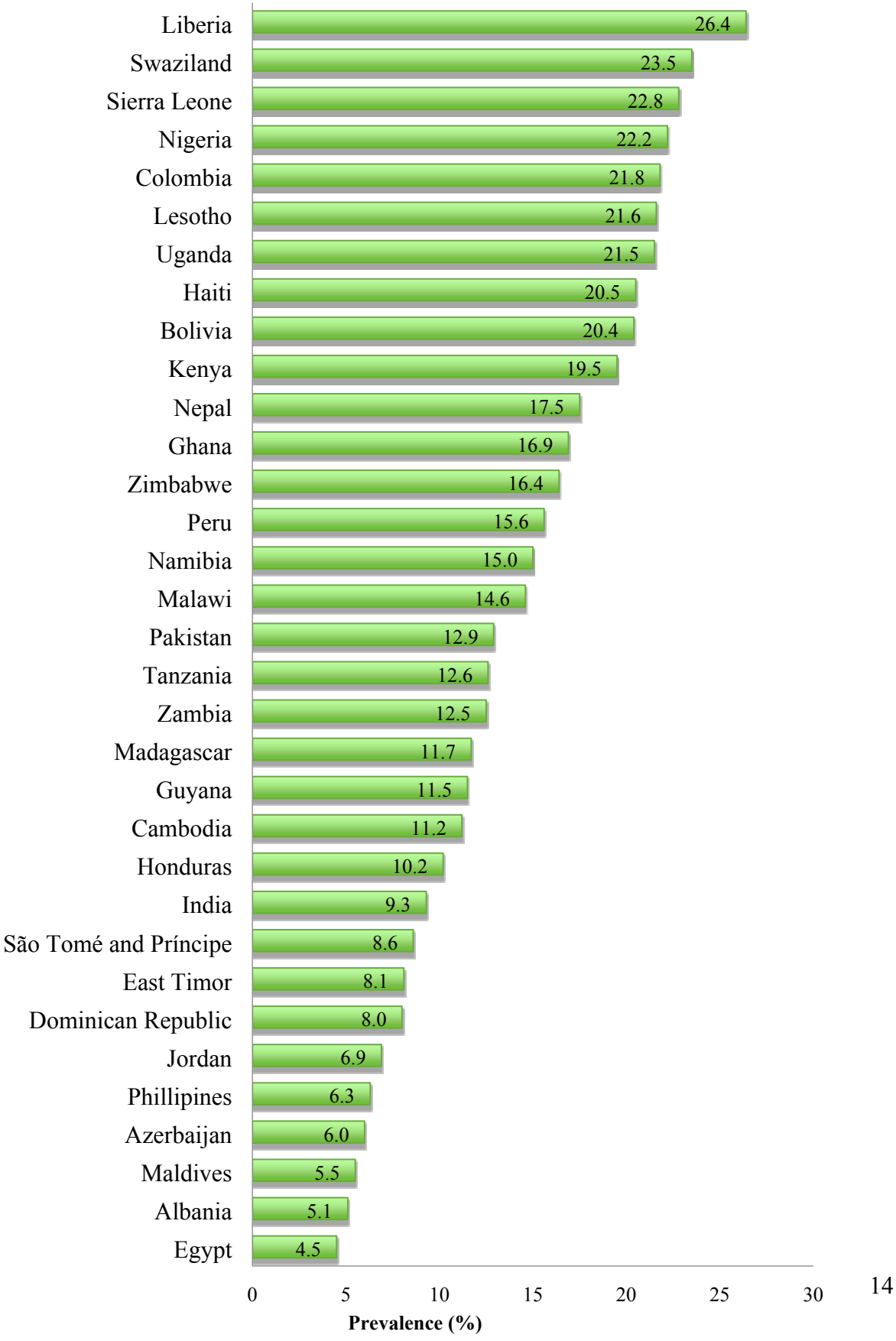
The prevalence of dysentery was 14.74%. The median age of the children who had dysentery was 24 months, and the median age among the children who did not present it was 19 months. In addition, only 56% of the children who had dysentery had their immunization schedule completed, in contrast with children who did not present dysentery who accounted for 63%, approximately.

Nearly half of the children who did not have dysentery had normal weight (48%). However, this percentage was lower among the group of children who did present the illness (41%). Moreover, this last group of children was breastfed a median of 15 months, in comparison with the group of children who did not present dysentery and was breastfed a median of 13 months.

Approximately, 24% of the mothers did not have any level of education in the group of children who had present dysentery. Nevertheless, this value was higher in the group of the mothers of children who did present dysentery (30%). Additionally, more than half of this last group of mothers was employed (57%). Finally, the higher the wealth index was, the lower its percentage became in both groups of children.

Furthermore, the prevalence of dysentery in each of the evaluated countries is shown in Figure 1. The Republic of Liberia presented the highest prevalence of dysentery in the whole group of countries, and Colombia had the highest one among the evaluated Latin-American countries.

Figure 1. Prevalence of dysentery in evaluated countries



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The characteristics of diarrhea in both groups of children are shown in Table 2. Approximately, 58% of children who had dysentery also had fever. Likewise, this group of children received almost 55% and 27% of oral rehydration and antibiotic therapy, respectively. However, they did receive lower amounts of liquids and solids during illness (61% and 38%, respectively), than the group of children who did not present dysentery (67% and 43%, respectively).

Table 2. Signs, symptoms and characteristics related to dysentery from children under five years from 33 countries, 2004–2010.

Variables	NO Dysentery	Dysentery
Fever *% (n)*	45.66 (15,090)	58.54 (3,347)
Heard or used oral rehydration salts *% (n)*	83.85 (27,712)	83.40 (4,766)
Visited an appropriate place for medical treatment *% (n)*	51.27 (16,947)	58.69 (3,354)
Received oral rehydration solutions *% (n)*	47.34 (15,645)	54.91 (3,138)
Received antibiotic treatment *% (n)*	20.99 (6,937)	26.96 (1,541)
Offered adequate amount of liquids during illness *% (n)*	67.55 (22,327)	61.46 (3,512)
Offered adequate amount of solids during illness *% (n)*	43.86 (14,497)	38.08 (2,176)

Table 3 shows the results of the bivariate regressions among dysentery and each one of the others included variables.

Table 3. Bivariate regressions of dysentery on independent variables

Variables	OR	P- value
Children		
Age (months)	1.01	0.000
Female sex	1.01	0.624
Possession of health card	0.81	0.000
Complete immunization schedule	0.72	0.000
Planned pregnancy	0.85	0.000
None antenatal visit	1.19	0.000
1-2 antenatal visits	0.95	0.259
3-10 antenatal visits	0.86	0.000
More than 10 antenatal visits	0.60	0.000
Missing information about antenatal visits	1.32	0.000
Low weight at birth	0.82	0.002
Normal weight at birth	0.73	0.000
Not weighted at birth or not remember	1.42	0.000
Cesarean delivery	0.77	0.000
Duration of breastfeeding (months)	1.03	0.000
Still breastfeeding	0.78	0.000
Drinking from a bottle with a nipple	0.75	0.000
Twin pregnancy	0.96	0.665
Mother		
Age (years)	1.02	0.000
No education	1.36	0.000
Elementary	1.23	0.000

High school	0.65	0.000
Superior	0.50	0.000
Employed	1.48	0.000
Single	1.50	0.482
Married	0.94	0.187
Divorced	1.06	0.282
Total children ever born	1.10	0.000
Partner under 20 years old	0.63	0.041
Partner between 20 and 40 years old	0.79	0.000
Partner above 40 years old	1.34	0.000
Missing information about partner age	1.08	0.061
Household		
Number of household members	1.03	0.000
Female household head	1.10	0.008
Age of head of household	1.00	0.760
Mother household head	1.21	0.000
Husband household head	1.07	0.021
Other relative household head	0.83	0.000
Rural residence	0.66	0.000
Soil or sand	1.62	0.000
Wood	1.04	0.334
Finish floor	0.59	0.000
Poorest	1.56	0.000
Poorer	1.15	0.000
Middle wealth index	0.88	0.000
Richer	0.72	0.000
Richest	0.49	0.000
Adequate sanitation score	0.66	0.000
Illness		
Fever	1.68	0.000
Heard or used oral rehydration salts	0.97	0.400
Visited an appropriate place for medical treatment	1.35	0.000
Received oral rehydration solutions during illness	1.36	0.000
Received antibiotic treatment during illness	1.39	0.000
Offered adequate amount of liquids during illness	0.77	0.000
Offered adequate amount of solids during illness	0.79	0.000

Results of logistic regression among dysentery and the country level characteristics are shown in Table 4. After controlling for each of the child, mother, house and country level variables, we found that related to dysentery, GDP per-capita and health expenditure were negatively associated, and GINI index was positively associated.

Table 4. Multivariate multilevel logistic regressions for dysentery and country level characteristics.

Variables	Final model		
	OR	CI	p-value
Child sex	1.03	(0.96-1.11)	0.337

Child age	0.99	(0.99-1.00)	<0.001
Vaccination	0.88	(0.81-0.96)	0.003
Normal weight at born	0.95	(0.87-1.04)	0.276
Duration of breastfeeding	0.81	(0.75-0.89)	<0.001
Mother's age	1.01	(1.00-1.01)	0.002
Mother's education			
No education	1.25	(1.84-1.60)	0.049
Elementary level education	1.24	(0.98-1.57)	0.065
High school level education	1.03	(0.82-1.29)	0.798
Superior level education	Comparison category		
Employed mother	1.11	(1.02-1.20)	0.009
Married	1.07	(0.95-1.20)	0.242
Number household members	1.02	(1.01-1.03)	<0.001
Type of residence urban	0.87	(0.79-0.97)	0.015
Household wealth			
Poorest	2.07	(1.72-2.49)	<0.001
Poorer	1.78	(1.49-2.13)	<0.001
Middle	1.49	(1.25-1.78)	<0.001
Richer	1.38	(1.16-1.65)	<0.001
Richest	Comparison category		
INTERCEPT	0.14	(0.12-0.16)	<0.001
GDP per capita	0.75	(0.71-0.78)	0.003
Gini index	1.23	(1.19-1.28)	<0.001
Health expenditure	0.85	(0.80-0.89)	<0.001
Random effects Intercept	***Standard deviation***	***Variance component***	***p-value***
	0.34	0.12	<0.001
Reliability Intercept	87.8%		

At the same time, this last model showed that child age, mother age, employed mother, and the number of household members have significant positive associations with having dysentery (p-value less than 0.05). On the other hand, complete immunization schedule, duration of breastfeeding, and the type of residence have significant negative associations with having the illness (p-value less than 0.05).

Simultaneously, each one of the categories of wealth index showed a significant association with dysentery (p-value less than 0.001). And it is possible to appreciate that the richer a person is, the lower its odds ratios becomes

Discussion

In this study, 14.7%, of the 38,762 children under-five years who suffered from diarrhea, had dysentery. This is consistent with the following data found. Diarrheal diseases remain among the most common causes of mortality and morbidity in children, particularly in low and middle-income countries. In 2013, of the 6.3 million children worldwide who died before their fifth birthday about 7.94% died from diarrhea (18). In a study in North Ethiopia with 241 participants, the overall prevalence was 13.3% (19).

Similar to previous studies, we observed a positive correlation between dysentery and mother's age, no education of the mother, employed mother, the number of household members and poverty [21- 23], as well as a negative correlation between dysentery and child age, vaccination, duration of breastfeeding and urban residence [24,25].

It is worth mentioning that the household wealth showed a gradient of association with dysentery that changed depending on the wealth category. This confirms what was found by Chompook et al. in Thailand, [26] the poorer you are, the more likely to get dysentery.

The country characteristics studied showed association with dysentery. A negative correlation of GDP per capita and child dysentery was observed, which means that the lack of economic production is associated with the health of children at the country level. This finding is consistent with other epidemiological studies, which present how the lack of economic resources at the country level is associated

356 with the decrease and absence of opportunities and in turn with impaired health of
357 the population [27,28].

358 The Gini index showed a positive correlation with dysentery. The degree of
359 inequality in the distribution of income is related to the health of children at the
360 country level. Inequalities create the sense of unfairness and feelings of injustice
361 and discrimination in the disadvantaged group, due to the difference in the
362 opportunities offered [29]. These feelings have the potential to undermine the
363 wellbeing of children and their families.

364 Health expenditure also showed a positive correlation to dysentery. It is likely
365 that when a country invests their money in health, it is giving its children the potential
366 to be healthier [30].

367

368 ## Limitations

369 Even though DHS has significant and well-known advantages related to
370 quality, comparability, and representativeness of the information, our study presents
371 some significant limitations.

372 First, due to its cross-sectional nature, it is not possible to establish any causal
373 relationship among studied variables. Second, as data was collected exclusively
374 from mothers, who are supposed to be the best relators about their child' s history,
375 related bias are likely to be found. Third, while DHS questionnaires are not executed
376 simultaneously in every country and social conditions tend to change over time,
377 some differences could be expected. However, our results did not change after
378 controlling for year of survey. Fourth, the variable definitions are limited by the

379 established methodology of the DHS team. Finally, the resulting large sample size
380 contributes to an over-power analysis that could detect minimal effect sizes, and
381 these could mean slight biases in the sampling process.

382 ## Conclusion

383 This study explored, by using a multilevel analysis, the association between
384 per capita GDP, income inequalities (Gini coefficient), health expenditure and
385 dysentery, in a multinational population adjusted by individual, maternal and
386 household characteristics. We found that some factors like older age of the child and
387 their mother, an unemployed mother, lower number of household members, higher
388 wealth index, and higher Gini index are protective factors against dysentery; while,
389 lower GDP per-capita, incomplete immunization schedule, lower duration of
390 breastfeeding and rural residence are risk factors against the same illness.

391
392 Additionally, as in a previous study, health expenditure does not appear to
393 take part in developing dysentery. However, per capita GDP and Gini coefficient
394 keep showing an important involvement with progressing from acute diarrhea to
395 dysentery. Due to this, and in order to diminish the consequences of this morbid
396 presentation of acute diarrhea, countries weigh up ways of improving their per capita
397 GDP and diminishing inequalities. Studying associated factors with developing
398 dysentery during an episode of acute diarrhea could be the base upon which we can
399 diminish mortality from this illness.

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Supporting Information

S1 Fig. Prevalence of dysentery in evaluated countries.

S1 Table. Descriptive statistics from children under five years from 33 countries, 2004–2010 who reported diarrhea. Proportions for categorical variables and median/interquartile range for numerical variables.

S2 Table. Signs, symptoms and characteristics related to dysentery from children under five years from 33 countries, 2004–2010.

S3 Table. Bivariate regressions of dysentery on independent variables

S4 Table. Multivariate multilevel logistic regressions for dysentery and country level characteristics.

Attachment # 1

Country	Year	Country	Year
Albania	2008–2009	Malawi	2010
Azerbaijan	2006	Maldives	2009
Bangladesh	2007	Mali	2006
Benin	2006	Namibia	2006–2007
Bolivia	2008	Nepal	2006
Cambodia	2010	Niger	2006

Colombia	2010	Nigeria	2008
Congo	2005	Pakistan	2006–2007
Egypt	2005–2006	Peru	2004–2008
Philippines	2008	Democratic Republic of Congo	2007
Ghana	2008	Dominican Republic	2007
Guyana	2009	São Tomé é Príncipe	2008–2009
Haiti	2005–2006	Sierra Leone	2008
Honduras	2005–2006	Swaziland	2006– 2007
India	2005-2006	Tanzania	2010
Indonesia	2007	East Timor	2009–2010
Jordan	2007	Ukraine	2007
Kenya	2008–2009	Uganda	2006
Lesotho	2009	Zambia	2007
Liberia	2007	Zimbabwe	2005–2006
Madagascar	2008–2009		

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