The paradoxical under-five diarrhea prevalence decline in the DRC. What can we learn from decomposition analysis?

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Background

Diarrheal diseases remain the second leading causes of death among children under five globally. About 22 percent of childhood deaths in developing countries are attributable to diarrhea (Black, Morris, & Bryce, 2003; UNICEF, 2008; UNICEF & WHO, 2009). It kills more young children than AIDS, malaria and measles combined (UNICEF & WHO, 2009).

Number of studies have shown that diarrheal diseases are associated with poverty and unhygienic environment (Daniels, Cousens, Makoae, & Feachem, 1990; MacDougall & McGahey, 2003). It is understandable that more than 80 percent of deaths due to diarrhea occur in South Asia and sub-Saharan Africa (SSA) (UNICEF & WHO, 2009). Nearly three quarters of child deaths due to diarrhea occur in 15 countries among which 14 countries from SSA.

With 89,900 annual child deaths due to diarrhea, the Democratic Republic of Congo (DRC) is the third country with highest diarrheal morbidity among under-five children worldwide. Three factors may explain this situation: the humanitarian crisis, environmental degradation and population poverty. First, since 1996, the DRC has been hit by conflict, which has devastated and destabilized the country. People continue to live in crisis conditions in many parts of the country. The eastern provinces (Orientale, Katanga, Maniema, Nord Kivu and Sud Kivu), and more recently the province of Equateur, are afflicted by violence. Second, the majority of people do not have access to clean drinking water (54 percent) and hygienic toilet (77 percent). The large amounts of faecal waste are discharged to the environment without adequate treatment (WHO & UNICEF, 2010). Last, the DRC‟s 2010 Human Development Index (HDI) is estimated at 0.239, which gives the country a rank of 168 out of 169 countries with comparable data despite numerous natural resources (UNDP, 2010).

However, the DRC childhood demography is less documented. Analysis of the DRC national surveys[1] shows that diarrhea prevalence declined from 22 percent in 1995 to 16 percent in 2007 (Zaïre, 1996 ; Congo ; UNICEF & USAID, 2002; Congo, 2008). This trend in diarrhea prevalence contrasts with stall in under-five child mortality (about 200 deaths per 1,000 live births) (UNICEF, 2008) as well as HDI degradation. Why is the DRC diarrhea prevalence declining over time? Is it due to improve in population living conditions or to change in the under-five children composition by age, province of residence or living conditions? This study aims to identify sources of diarrhea prevalence variation in DRC by child age, province of residence and by household living conditions. We use data from the three nationally representative surveys: 1995 and 2001 MICS data, and the 2007 DHS data.

[1] 1995 and 2001 Multiple Indicator Clusters Surveys (MICS) and 2007 Demographic and Health Survey (DHS).

1. Theoretical considerations

Though some diarrheas are due to errors of metabolism, chemical irritation or organic disturbance, the vast majority are caused by infectious pathogens (Curtis, Cairncross, & Yonli, 2000). Human faeces are the primary source of diarrheal pathogens. The pathogen agents (viruses, bacteria, protozoa and parasitic worms) pass through environment to reach new hosts. For small children, the principal victims of diarrheal disease, „the environment" is likely to be the home and its immediate vicinity. Figure 1 schematizes the routes that faecal pathogens take through the environment to reach a new host.

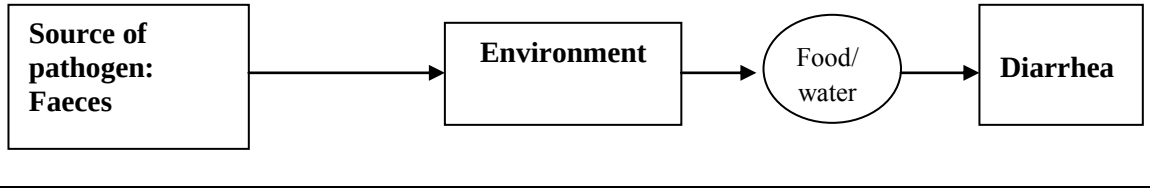


Figure 1 – Diarrhea transmission routes

Most pathogens that cause diarrhea share a similar mode of transmission – from the stool of one person to the mouth of another. This is known as faecal-oral transmission. Excreta can contaminate water sources, and contaminated water can be drunk directly or used in food preparation (Curtis, Cairncross, & Yonli, 2000). Some pathogens may get onto fingers, into food or fluids and some of these may reach a new host. Flies landing on excreta can carry pathogens to foods or surfaces that are used for food preparation or eating. Human or animal feet that tread in faecal material deposited in the open bring pathogens into the domestic environment, and children playing with, or eating, faecally contaminated earth can ingest pathogens.

Therefore, most transmission occurs in the domestic domain, which is the child"s principal habitat. Exposure to diarrhea-causing agents is frequently related to the use of contaminated water and to unhygienic practices in food preparation and disposal of excreta. Poor sanitation, lack of access to clean water, and inadequate personal hygiene are responsible for an estimated 90 percent of childhood diarrhea (UNICEF & WHO, 2009; WHO & UNICEF, 2010).

Against this background, the conceptual framework that guides our analysis of children"s diarrhea prevalence identifies three variables that directly or indirectly determine child health: child" age, access to clean water and safe sanitation. Large body of empirical work has shown association between these variables and prevalence of diarrhea among under-five children (Mosley & Chen, 1984; Esrey & Habicht, 1986; Esrey, Potash, Roberts, & Shiff, 1991; Curtis, Cairncross, & Yonli, 2000; Fewtrell, Kaufmann, Kay, Enanoria, Haller, & Colford, 2005; Kandala N-B. , Emina, Nzita, & Cappuccio, 2009; UNICEF & WHO, 2009; WHO & UNICEF, 2010).

Child age and diarrhea

Bulk of studies showed significant association between diarrheal diseases and child"s age (Lal, Joshi, & Bhattacharya, 1993; Mock, Sellers, Abdoh, & Franklin, 1993 ; Kandala N-B. , Emina, Nzita, & Cappuccio, 2009; Avachat, Phalke, Phalke, Syed, & Kalakoti, 2011). Depending on the context, scholars found that prevalence of diarrhea is higher among children aged 6-12 months, 10-25 months or 12 - 36 months. In the DRC, Kandala N-B. , Emina, Nzita, & Cappuccio (2009) found positive association between child age and prevalence of diarrhea until 15 months and negative after. Child age influence diarrhea through feeding practices, time to weaning, time to complementary food and sanitary conditions. Further children of crawling and walking age are vulnerable because they are more likely to play with, or to eat, faecally contaminated earth. Thus, changes in the distribution of under-five children may affect variation of diarrhea prevalence over time.

Access to clean water and sanitation

Improved household sanitation and water supply are expected to be the key factors associated with the decline of diarrheal disease in the long term. Sanitation and water supply have a direct effect in reducing exposure to pathogens. Previous studies have found that certain aspects of sanitation and water supply, such as the quantity of water available and whether the water was supplied inside or away from the home, are more important than other aspects, such as water quality (Esrey & Habicht, 1986; Esrey, Potash, Roberts, & Shiff, 1991; UNICEF & WHO, 2009; WHO & UNICEF, 2010). Indirect effects may occur as the increased diffusion of sanitation and water supply in a community changes standard household hygienic practices. Consequently change in proportion of children with access to clean water and hygienic sanitation influences diarrhea prevalence between two dates.

We define clean water or drinking water as water of sufficiently high quality that can be consumed or used with low risk of immediate or long term harm. It is from tap (in the residence, in the plot, public tap…). Following methods are considered as developed sanitation services: public sewer , septic tank, pour-flush latrine, pit latrine with slab, ventilated improved pit, ecological sanitation (Huuhtanen & Laukkanen, 2006). The MICS and DHS surveys collect these information.

Province of residence

Province is important factor in the DRC context. There is significant provincial differences in access to clean water and hygienic sanitation. Furthermore, the humanitarian crisis due to 1996-2003 affected differently provinces. Kandala, Emina, Nzita, & Cappuccio (2009) observed low prevalence of childhood diarrheal diseases in the western provinces (Kinshasa, Bas-Congo and Bandundu), and a relatively higher prevalence in the south-eastern provinces (Sud-Kivu and Katanga). Consequently changes in province share could affect diarrhea prevalence.

2. Data and Methods

2.1 Data

This study uses data from the 1995 and 2001 MICS and the 2007 DHS. These surveys were carried out during three important periods of the DRC political history: Mobutu transition (1990-1997), the war conflict and 1(president) + 4 (vice-presidents) period (1996-2003) and after the 2006 "democratic election". These survey are nationally representative investigation on children‟s and women‟s health. They offer opportunity to analyze change in diarrhea prevalence in DRC. The three datasets have comparable information on households characteristics and child health diarrhea at the time of the survey.

The samples covered all provinces, urban and rural areas. Furthermore, the three surveys use multistage cluster-sampling. At the first stage, a stratified sample of enumeration areas (villages/communities) is taken; at the second stage, a sample of households within the selected communities is taken; and finally, at the third stage, all women respondents (aged 15-49 years) in the sample households are included. Cluster sampling is a cost-saving measure, without the need to list all the households. In total the 1995 MICS covers 4,574 households. The 2001 MICS covers a total of 8,600, whereas the 2007 DHS sample size is estimated at 8,886 households.

Table 1 presents the distribution of children by sex, age, place of residence and province in each survey.

Table 1 – Background characteristics of under-five children in DRC (1995, 2001 and 2007)

	1995 MICS		2001 MICS		2007 DHS	
	Percent	Number	Percent	Number	Percent	Number
Child sex						
Male	51.1	2,506	50.0	5,129	49.8	4,476
Female	48.9	2,397	50.0	5,125	50.2	4,516
Child age in months						
0-5 months	11.9	585	10.7	1,087	10.9	979
6-11 months	12.2	596	11.0	1,118	10.4	931
12-23 months	21.3	1,042	21.9	2,224	20.4	1,838
24-35 months	20.3	996	19.3	1,964	19.7	1,771
36-47 months	17.8	872	18.1	1,846	19.5	1,757
48-59 months	16.6	812	19.1	1,939	19.1	1,716
Place of residence						
Urban	31.8	1,558	36.0	3,695	39.8	3,575
Rural	68.2	3,345	64.0	6,559	60.2	5,417
Province of residence						
Kinshasa	4.4	215	14.4	1,473	10.2	914
Bas-Congo	10.3	504	5.3	542	7.3	659
Bandundu	11.4	557	11.7	1,198	9.1	819
Equateur	21.8	1,068	11.3	1,160	10.0	900
Orientale	8.8	432	10.2	1,041	7.2	644
Nord – Kivu	3.8	184	7.2	740	8.3	750
Maniema	10.8	531	2.6	262	9.5	855
Sud-Kivu	5.5	269	6.0	617	9.0	806
Katanga	2.5	123	11.2	1,149	9.8	878
Kasai Oriental	5.3	262	10.9	1,114	10.6	950
Kasai Occidental	15.5	758	9.3	958	9.1	817
Total	100.0	4,903	100.0	10,254	100.0	8,992

Data contains information on 4,903 children from the 1995 MICS, 10,254 children from the 2001 MICS and 8,992 children from the 2007 DHS. The distribution of under-five children by sex shows a generally similar pattern. Males and females are equally represented in the 3 surveys. With reference to the distribution by age, proportion of children age less than 6 months seems to be similar (about 11 percent) in the three surveys, whereas small variations are observed in other age groups.

Proportion of children in urban areas increased from 32 percent in 1995 to 40 percent in 2007. Within the 11 provinces in DRC, the largest proportion of under-five children varies across surveys. In 1995, Equateur province was over represented with 21 percent, whereas in 2001 the largest proportion of children is from Kinshasa (14 percent). The distribution of children by province in the 2007 DHS is more balanced.

2.2 Statistical methods

This study relies on two complementary methods: descriptive analysis of trends and decomposition analysis. This method is based on comparison of diarrhea prevalence by exposure variables (child‟ age, province of residence, household living conditions) over time. It allows reporting trends in diarrhea prevalence from 1995 to 2007 by child‟ age, province of residence and household living conditions.

The decomposition approach divides the trends in child‟ diarrhea prevalence into change in population composition and change in public health (Eloundou-Enyengue & Giroux, 2010 ; Romo, 2003). Formula 1 presents the simple or basic decomposition .

$$\Delta D = \sum \overline{d}_j * \Delta w_j + \sum \overline{w}_j * \Delta d_j \quad (1)$$

Total change = effect of composition + effect of performance

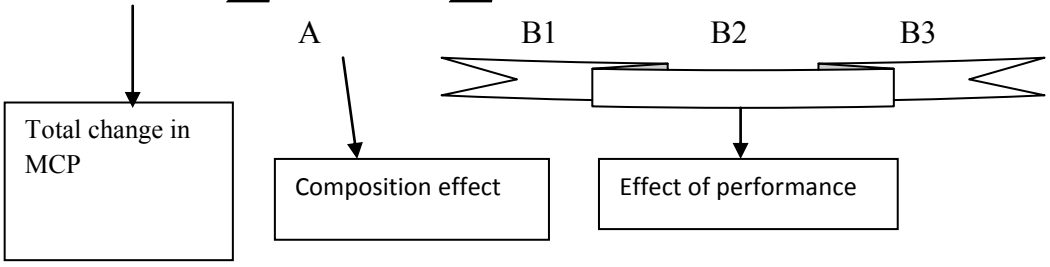
- Change in composition or composition effect represents the extent of change due to variation in the size of different groups of exposure variables (child‟ age, province of residence, household living conditions).
- The effect of behavior represents the percentage of variation attributable to change in public health.

Therefore, decomposition analysis will allow us to express the overall diarrhea prevalence as a population weighted average of the diarrhea prevalence for different groups of exposure variables. The change in the overall *diarrhea prevalence (ΔD)* is represented by the change in the proportion of diarrhea prevalence for each group (weighted by the group's recent period population proportion) and by the change in the population proportion of each group (weighted by the group's previous period diarrhea prevalence). Therefore, an increase in a

group's diarrhea prevalence or in a group's population proportion will increase the overall diarrhea prevalence among under-five children.

In order to have more details, we proceed to the advanced decomposition of the performance effect. We present below the advanced decomposition formula.

$$\Delta C = [\sum \bar{d}_j * \Delta w_j] + [\sum \bar{w}_j * \Delta \alpha] + [w_j * x\Delta\beta] + [w_j * x\Delta\mu] \quad (2)$$



Formula 2 encompasses four components among which the composition effect (A) and three performance component effects (B1-B3):

- The basic effect or improvement of basic public health (B1). α is the regression intercept when x=0 ;
- Effect of differential in diarrhea prevalence by category of exposure variables (B2). β is the increased in MCP associated with a unit increase in women education, and
- B3 represents the effect of other variables not considered (residual factors). μ is the error term.

Four reasons justify the choice of the decomposition analysis: (1) the paper aims to analyze diarrhea prevalence change in the DRC; (2) the outcome variable (proportion of children who have suffered from diarrhea two weeks prior to the survey) is numerical ; (3) the exposure variables (age, living conditions, province of residence) are ordinal level variables. It is important to clarify that provinces of residence are ranged according to their human development index (See Table A1 in annex); and (4) analyses are performed at aggregated/ cluster level (child age, household living conditions, province of residence). Furthermore, the decomposition method is simple, easy to apply and to interpret results. In this way, we are able to describe trends in diarrhea prevalence by exposure variables and clearly identify the source of changes in diarrhea prevalence.

3 Results

3.1 Trends in diarrhea prevalence in the DRC

Table 2 describes trends in diarrhea prevalence in the DRC from 1995 to 2007. In general, the prevalence of diarrhea in the DRC declined by 27 percent from 22 percent in 1995 and 2001 to 16 percent in 2007. There is no change in diarrhea prevalence between 1995 and 2001. However, analysis by child age, household living conditions and province of residence reveals diverse patterns of diarrhea prevalence trends in the DRC.

Table 2 – Prevalence of diarrhea among under-five children in DRC, 1995-2007

	Year			Percentage changes		
	1995	2001	2007	1995-2001	2001-2007	1995-2007
	1	2	3	4	5	6
Age in months						
0-5	12.7	15.3	10.5	20.7	-31.4	-17.2
6-11	33.4	36.0	28.6	7.7	-20.4	-14.3
12-23	33.9	34.7	26.1	2.4	-24.8	-23.0
24-35	22.4	21.7	17.1	-3.1	-21.3	-23.7
36-47	15.4	14.6	10.0	-5.2	-31.2	-34.7
48-59	11.6	10.7	6.8	-7.3	-36.3	-41.0
Living conditions						
No clean water or hygienic toilet	22.8	22.7	16.7	-0.1	-26.8	-26.8
One (hygienic toilet or water)	22.6	20.8	15.2	-8.0	-27.0	-32.8
Hygienic toilet and clean water	15.2	17.2	17.4	13.3	1.1	14.6
Province						
Kinshasa	13.5	20.9	13.4	54.9	-35.9	-0.7
Bas-Congo	12.5	19.4	10.9	55.2	-43.8	-12.7
Bandundu	17.7	14.6	11.4	-17.5	-22.1	-35.8
Equateur	26.4	27.3	14.1	3.4	-48.5	-46.7
Orientale	22.0	21.5	15.6	-2.3	-27.3	-29.0
Nord-Kivu	12.0	18.8	17.8	57.2	-5.4	48.7
Maniema	36.0	22.9	16.6	-36.3	-27.7	-54.0
Sud-Kivu	16.0	24.1	16.6	50.7	-31.0	4.1
Katanga	27.9	24.3	15.4	-12.9	-36.5	-44.7
Kasai-Oriental	13.4	27.2	23.2	103.6	-14.7	73.7
Kasai-Occidental	26.9	29.6	24.0	10.0	-19.1	-11.0
Total (DRC)	22.2	22.2	16.4	0.0	-26.1	-26.1

Source : 1995 DRC-MICS ; 2001DRC- MICS ; 2007 DRC-DHS

With reference to child age differences in diarrhea prevalence trends, there are two patterns.

- 0-23 months: Proportion of children who suffered from diarrhea increased between 1995 and 2001, and declined from 2001 to 2007 for children aged less than 24 months. This is a reversed U patterns.
- 24-59 months: Prevalence of diarrhea is declining. The magnitude of change is higher from 2001 to 2007 regardless of child age.

Moreover, prevalence of diarrhea is higher among children age 6-11 months and 12-23 months than those belonging to other age groups.

Considering the household living conditions, trends in diarrhea prevalence could be divided into three groups.

- No change in diarrhea prevalence from 1995 and 2001 contrasts with 27 percent decrease in diarrhea prevalence among children living in precarious conditions (no clean water and no hygienic sanitation).
- The preceding pattern contrasts with that of children living in the most equipped households (clean water and modern toilet). Proportion of children with diarrhea increased by 13.3 percent from 15.2 percent in 1995 to 17.2 percent in 2001. There are no significant difference between the prevalence of diarrhea between 1995 (17.2 percent) and 2007 (17.4 percent) in this category.
- Furthermore, Table 2 shows also continuous decline in diarrhea prevalence among children living in households with clean water or hygienic sanitation.

While in 1995 and 2001, proportion of children with diarrhea is low among those living in more equipped households, the opposite pattern is observed in 2007.

Review of diarrhea prevalence trends by province of residence reports two patterns like analysis by child age.

- In 7 provinces including Kinshasa the city capital, Equateur (the poorer province) and Sud-Kivu (conflict related province), diarrhea prevalence increased from 1995 and 2001, and declined from 2001 to 2007.
- In the remaining 4 provinces among which mining provinces (Katanga and the two Kasai) and conflict related provinces (Nord-Kivu, Maniema and province Orientale).

To sum up, trends in diarrhea prevalence in the DRC from 1995 to 2007 present mixed patterns and inconsistencies. Depending of demographic, socioeconomic or geographic category, proportion of children with diarrhea two weeks preceding the survey decreases, increases or follow U pattern.

3.2 Decomposition of diarrhea prevalence changes in the DRC

In this section, we decompose changes in diarrhea prevalence by the three independent variables. This may contribute to understand whether the observed changes are due to variation in surveys population structure or to changes in health behavior. Table 3 presents results of simple and advance decomposition for the 1995-2007 period.

Table 3 : Decomposition of trends in diarrhea prevalence in the DRC 1995-2007

Age in months	Performance effect				Effect of Composition	Category Contribution
	Base	Differentiation	Error	Total		
	B1	B2	B3	B	A	C
0-5	-0.474	0.000	0.227	-0.248	-0.120	6.2%
6-11	-0.468	-0.039	-0.030	-1.624	-0.561	18.6%
12-23	-0.866	-0.144	-0.613	-1.062	-0.243	31.6%
24-35	-0.831	-0.208	-0.023	-0.846	-0.120	20.0%
36-47	-0.776	-0.259	0.038	-0.537	0.222	13.1%
48-59	-0.741	-0.309	0.203	-0.997	0.232	10.4%
Overall	70.4%	16.2%	3.4%	90.0%	10.0%	100.0%
Province						
Equateur	-1.526	0.137	-0.724	-2.113	-1.880	66.8%
Orientale	-0.898	0.161	0.093	-0.643	0.480	2.7%
Sud-Kivu	-0.455	0.123	0.366	0.033	-0.122	1.5%
Nord-Kivu	-0.346	0.124	0.449	0.226	0.042	-4.5%
Maniema	-0.628	0.282	-1.023	-1.369	-1.985	56.2%
Bandundu	-1.219	0.656	-0.303	-0.866	0.676	3.2%
Kasai-Occidental	-1.169	0.734	0.048	-0.387	-1.185	26.3%
Katanga	-0.546	0.392	-0.610	-0.764	1.569	-13.5%
Kasai-Oriental	-0.835	0.674	1.085	0.924	1.477	-40.2%
Bas-Congo	-0.636	0.570	-0.048	-0.114	-0.735	14.2%
Kinshasa	-0.646	0.638	0.002	-0.007	0.772	-12.8%
Overall	149.1%	-75.2%	11.1%	85.1%	14.9%	100.0%
Sanitation						
None	-6.031	0.000	1.386	-4.644	0.059	79.0%
Toilet or water	-1.447	0.759	-0.665	-1.354	0.403	16.4%
Toilet and water	-0.456	0.478	0.105	0.127	-0.396	4.6%
Overall	136.7%	-21.3%	-14.2%	101.2%	-1.2%	100%

Source : 1995 DRC-MICS ; 2007 DRC-DHS

In general, decomposition results indicate that changes in health behavior is the principal source of change in diarrhea prevalence between 1995 and 2007 regardless of the exposure variable (Column B). Analysis of performance effect (columns B1 – B3) reveals the importance of the base effect. In other words, the observed changes are common to the entire population. The differentiation effect, the error terms and the composition effect are negligible.

Table 3 (Column C) shows also that decline in diarrhea prevalence observed in 2007 compared to 1995 is mainly due to depression of diarrhea prevalence among:

- children aged 12-23 months,
- those living in Equateur and Maniema province, and
- children living in poor conditions (no clean water and hygienic sanitation).

By contrast, children living in Katanga, Kasai Oriental and Kinshasa contributed in the opposite direction.

Table 4 displays decomposition analysis findings for period between 2001 and 2007. Like for the 1995-2007 period, the 2001-2007 decreases in diarrhea prevalence is attributable the change in health behavior. Overall the likelihood of having diarrhea decreased in DRC regardless of child age, province of residence or the household living conditions.

Table 4: Decomposition of trends in diarrhea prevalence in the DRC 2001-2007

	Performance effect				Effect of	
Age in months	Base	Differentiation	Error	Total	Composition	Contribution
0-5	-0.737	0.000	0.221	-0.517	0.027	8.2%
6-11	-0.729	0.051	-0.105	-1.823	-0.203	16.5%
12-23	-1.446	0.204	-0.581	-0.899	-0.429	37.7%
24-35	-1.333	0.282	0.153	-0.744	0.078	13.8%
36-47	-1.288	0.363	0.070	-0.783	0.172	11.4%
48-59	-1.304	0.459	0.101	-0.855	0.003	12.4%
Overall	114.5%	-22.8%	2.4%	94.1%	5.9%	100.0%
Province						
Equateur	-0.540	0.009	-0.454	-0.985	2.087	-18.3%
Orientale	-0.895	0.031	0.139	-0.725	-0.360	18.0%
Sud-Kivu	-0.441	0.023	-0.035	-0.453	-0.542	16.5%
Nord-Kivu	-0.422	0.029	0.334	-0.059	-0.653	11.8%
Maniema	-0.220	0.019	0.009	-0.193	0.093	1.7%
Bandundu	-1.064	0.109	0.481	-0.473	0.352	2.0%
Kasai-Occidental	-0.784	0.094	0.081	-0.609	0.000	10.1%
Katanga	-0.916	0.125	-0.329	-1.120	-1.142	37.5%
Kasai-Oriental	-0.857	0.132	0.254	-0.471	0.812	-5.6%
Bas-Congo	-0.396	0.068	-0.135	-0.463	-0.439	14.9%
Kinshasa	-0.723	0.136	-0.160	-0.747	0.057	11.4%
Overall	120.3%	-12.8%	-3.1%	104.4%	-4.4%	100.0%
Sanitation						
None	-5.590	0.000	0.711	-4.879	-1.560	110.7%
Toilet or clean water	-1.026	0.462	-0.261	-0.825	1.658	-14.3%
Toilet and water	-0.361	0.325	0.046	0.010	-0.223	3.7%
Overall	119.9%	-13.5%	-8.5%	97.9%	2.1%	100.0%

Source : 2001DRC- MICS ; 2007 DRC-DHS

Children aged 12-23 months, those living in Katanga province and children living in poorer conditions contributed more in the diarrhea prevalence decline. The opposite contribution is observed for children living in Equateur province and in Kasai Oriental.

Discussion and Conclusion

This study had twofold objectives. First, to describe trends in diarrhea prevalence in the DRC by child age, province of residence and the household living conditions. Last but not least, to identify sources of diarrhea prevalence changes. We use data from the DRC three nationally representative surveys: 1995 and 2001 MICS data, and the 2007 DHS data. We rely on descriptive and decomposition analyses.

In general proportion of under-five children who had suffered from diarrhea decreased by 27 percent from 22.2 percent in 1995 and 2001 to 16.4 percent in 2007. However, analyses by child age, household living conditions and province of residence present different patterns.

- No change in diarrhea prevalence between 1995 and 2001 contrasts with decrease in diarrhea prevalence from 2001 to 2007 for some categories regardless of the independent variables;
- Proportion of children with diarrhea increased between 1995 and 2001 contrasting with stagnation observed between 2001 and 2007 in certain groups of children;
- Reversed U pattern in diarrhea prevalence is observed among some children;
- Some children experienced continuous decline in diarrhea prevalence.

Findings from decomposition analyses (simple and advanced) suggested that decrease in diarrhea prevalence in DRC between 1995 and 2007 or between 2001 and 2007 is general. It is largely due to the changes in health behavior (performance effect). The effect of composition is negligible.

However, decline in diarrhea prevalence contrasts with increase in proportion of children living in households without access to safe water and sanitation. In fact, proportion of children living in household with access to clean water and hygienic sanitation diminished from 10.1 percent in 1995 to 5.9 percent in 2007 through 7.5 percent in 2001. What could explain this contrast (decrease in diarrhea prevalence in the deterioration of living conditions)? There are two hypotheses.

First, there is progress in population health education and hygiene promotion programmes: use of boil drinking water, use of safe disposal of faecal material and the adequate washing of hands after contact with adult and child stools. Unfortunately according to WHO and UNICEF, in DRC the large amounts of faecal waste are discharged to the environment without adequate treatment (WHO & UNICEF, 2010).

Second, the seasonal pattern of diarrheal disease give a hint of pathogen multiplication in food. The peak of bacterial diarrheal disease in the hottest and rainy season. One explanation for this could be that pathogenic bacteria can multiply more readily on stored food in warmer temperatures and rainy season. The DRC 1995 and 2001 MICS were carried out during the hot and rainy season (March-May) when diarrhea prevalence is higher; whereas the 2007 DHS data were collected during the dry season (June-August). Therefore decrease in diarrhea prevalence in DRC is likely due to the seasonality of diarrheal diseases than public health policy.

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Annex

Table A1: The DRC : Human Development Index by province in 2001

Rank	Province	HDI
1	Equateur	0.3090
2	Orientale	0.3520
3	Sud-Kivu	0.3730
4	Nord-Kivu	0.3800
5	Maniema	0.4190
6	Bandundu	0.4230
7	Kasai-Occidental	0.4290
8	Katanga	0.4350
9	Kasai-Oriental	0.4560
10	Bas-Congo	0.4650
11	Kinshasa	0.6200
Source : Congo, R. D., & USAID, U. &. (2002)		