Assessing MDG 6 in Sub-Saharan Africa: A Territorial Analysis Using a Synthetic Indicator

Evaluación del ODM 6 en el África Subsahariana: un análisis territorial, utilizando un indicador sintético

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Abstract

Sub-Saharan Africa has the most serious HIV and AIDS epidemic in the world. As a result, the epidemic has devastating, widespread social and economic consequences, particularly for vulnerable groups such as children under the age of five and pregnant women. Given this situation, it is important to analyse which countries have been able to improve in progress toward fulfilling Millennium Development Goal (MDG) 6: Combat HIV, AIDS and malaria in recent years. We analyse and quantify progress towards MDG 6 by comparing a large number of the variables defined in the UN Millennium Declaration in sub-Saharan African countries up to 2013. To construct the synthetic indicator from a multidimensional approach, we used the P_2 distance method.

Keywords: Epidemic; Millennium Goals; P_2 Distance Measure; Synthetic Indicators; Regional Disparities.

Resumen

El África Subsahariana padece la epidemia más grave de VIH y SIDA en el mundo. Como resultado, la epidemia tiene consecuencias sociales y económicas devastadoras y generalizadas, especialmente para los grupos más vulnerables como los niños menores de cinco años y las mujeres embarazadas. Ante esta situación, es importante analizar que países han podido mejorar en progreso hacia el cumplimiento del Objetivo de Desarrollo del Milenio (ODM) 6: Combatir el VIH, el SIDA y la malaria en los últimos años. Con este objetivo, analizamos y cuantificamos el progreso hacia el ODM 6, comparando un gran número de variables definidas en la Declaración del Milenio de la ONU, en los países del África Subsahariana, hasta 2013. Para construir el indicador sintético, a partir de un enfoque multidimensional, utilizamos el método de distancia P_2.

Palabras clave: Disparidades Regionales; Epidemia; Indicadores Sintéticos; Objetivos del Milenio; Método de Distancia P_2.

Jel Classification: I10, R11, R58.

1. INTRODUCTION

This paper uses a spatial approach to analyse progress towards Millennium Development Goal (MDG) 6: Combat HIV/AIDS and malaria in the sub-Saharan African (SSA) countries suffering worst from the global HIV and AIDS epidemic (UNAIDS, 2014). Using the most recent data available, we compare the countries' progressing meeting MDG 6 to determine the extent to which progress towards this goal in the region until 2013, which is the latest year for which data is available.

Because the index also controls for the new information contained in each variable by weights created from the coefficient of discrimination, it represents a policy-relevant proxy for MDG 6 progress. The study does not include the island territories of Sao Tome and Principe, Cape Verde, Seychelles and Comoros, due to lack of current data.

To analyse and quantify progress towards MDG 6 in these countries, we compare a large number of the variables defined in the UN Millennium Declaration, which is the latest year for which data is available. Given the difficulties in finding updated statistics on Goals 4 and 5, particularly for these countries, the construction of this indicator is in itself a contribution.

In our study, the index includes information on different variables from various development domains established under the MDGs by virtue of the detailed statistical information contained in the report on MDGs (UN, several years) (Table 1). The index enables classification of the countries, as well as examination of the impact of each individual indicator, to determine country disparities in fulfilment of MDG 6.

When several countries gathered in New York at the beginning of this century to articulate a new development agenda, one of their most momentous steps was to elevate the importance of health on the global development agenda (UN, 2001). From a 1998 baseline, HIV-specific MDGs aimed to reduce sexual and parental HIV transmission by 50%, eliminate mother-to-child transmission (MTCT), reduce tuberculosis (TB) deaths among HIV-infected people by 50% and deliver antiretroviral therapy (ART) to 15 million people by 2015 (UN, 2014).

Although ART has substantially changed the face of human immunodeficiency virus (HIV) (Mutevedzil and Newell, 2014), implementation of programmes for the prevention of MTCT has not been sufficiently effective to eliminate vertically-acquired HIV (Abrams and Myer 2013). Globally, an esti-

mated 35.3 (32.2–38.8) million people were living with HIV in 2012 (UNAIDS, 2013a), an increase over previous years, as more people are receiving life-saving ART (UNAIDS, 2014).

Over the past several decades, the HIV/AIDS epidemic has dramatically altered patterns of morbidity and mortality in SSA (Fortson, 2011). In 2012, roughly 25 million people in SSA were living with HIV, accounting for nearly 70% of the global total (UNAIDS, 2012). In that same year, an estimated 1.6 million new HIV infections occurred, and 1.2 million AIDS-related deaths (WHO, 2013), and the vast majority of MTCT is in this region (Wilson, 2015). In 2012, 1.6 million (1.4–1.8 m) new HIV cases were reported in SSA (UNAIDS, 2011; 2013b).

These statistics show that SSA has the largest burden of paediatric HIV in the world (Ubesie, 2012). There is clearly a need for more investment in health sector initiatives to encourage voluntary HIV disclosure and partner testing, including initiatives that provide guidance and training to HIV counsellors and that support individuals diagnosed with HIV (Bott and Makhlouf, 2013).

The reported coverage of antiretroviral prophylactic therapy for prevention of mother-to-child transmission (PMTCT) of HIV has increased in SSA in recent years (Larsson et al., 2015). Coverage of PMTCT services in many low-income countries is subject to overestimation, however, since it only considers enrolment in the programme, not whether the individual PMTCT components are fulfilled (UNAIDS, 2010).

The shortcomings of health systems in this region—such as poor referral systems for HIV testing, inadequate PMTCT counselling and programme dropouts—hamper the effectiveness of PMTCT services (Larsson et al., 2012). Effective PMTCT interventions are therefore critical in reducing the HIV/AIDS burden in SSA (Ladner et al., 2015).

The global community strongly agrees on the need for coordinated action in the response to AIDS and on the opportunity to increase results by focusing on populations at increased risk of HIV/AIDS (Sidibé et al., 2014). MDG 6 thus focused on combating HIV/AIDS, tuberculosis and malaria. MDG 6 emerged from the extraordinary success achieved at that time in developed countries, where the advent of combination ART was reducing MTCT and HIV-related mortality and transforming HIV from a rapidly fatal infection to a long-term chronic disease (Prendergast et al., 2015).

Access to evidence-informed HIV prevention, testing, counselling, treatment and care services in low-and middle-income countries has expanded. This progress demonstrates how countries can surmount seemingly intractable health and development challenges through commitment, investment and collective action (UNICEF 2010). So, because a significant proportion of disease burden is in sub-Saharan Africa, global well-being demands that we understand and control disease spread in African slums as a major international health priority (Oppong, Mayer and Oren, 2015).

The highest incidence of HIV/AIDS and malaria is found in geographic regions of SSA, where parasitic co-infections are also widespread (Hotez, 2013). Beneficial behaviours include use of methods such as abstinence or delaying sexual debut, condoms, safe sex, monogamy, reduction in number of partners, voluntary counselling and testing, among others (Ramjee and Daniels, 2013). With the post-2015 agenda on the horizon, now is a good time to reflect on the progress that has been made towards reaching these goals, particularly with regard to MDG 6 in SSA.

2. Method

2.1. Model

This study uses the Pena P_2 (DP_2) distance method (1977). The synthetic indicator DP_2 is a measure initially devised to gauge well-being in a set of territorial units at a given moment in time (Cuenca *et al.*, 2010; Blancas *et al.*, 2011; Rodríguez, 2011; Lozano-Oyola *et al.*, 2012; Zarzosa and Somarriba, 2013; Rodríguez, 2014; Rodríguez *et al.*, 2015a; Somarriba *et al.*, 2015). As we will see below, the DP_2 indicator belongs to a group of measures based on axiomatic derivations created to meet a series of requirements deemed necessary to achieve the stated goal (Rodríguez *et al.*, 2012).

The DP_2 synthetic indicator fulfils a number of properties (see Zarzosa 1996; Pena 1977; 2009; Zarzosa and Somarriba 2013; Rodríguez, 2014; Rodríguez, *et al.*, 2015b; among others), expressed as follows: existence and determination, monotony, uniqueness quantification, invariance, grade one homogeneity, transitivity and non-arbitrariness in the importance attached to the simple indicators, or neutrality (a property introduced by Zarzosa, 1996), as well as completeness, exhaustiveness, additivity and invariance compared to the baseline.

This indicator has the advantage of being able to solve a large number of problems, such as aggregation of variables expressed in different units, arbitrary weighting and information duplicity (Somarriba, 2008). To obtain synthetic indicators, Somarriba and Pena (2009) compare the DP_2 indicator to other methods, such as principal component analysis and data envelopment analysis (DEA).

So, DEA has some limitations. It involves subjectivity in choice of the partial indicators (Perez *et al.*, 2009), does not fulfil the principle of uniqueness and monotony, and does not maintain the variance with changes of origin and/or scale in the units of measure (Rodríguez *et al.*, 2015c). Nor does it consider the interdependence of the indicators, as does the DP_2 method (Pena, 2009).

The principal component analysis also fails to fulfil some mathematical properties, not only of uniqueness and monotony but also and especially of neutrality, properties verified in the DP_2 method (Zarzosa *et al.*, 2015). Further,

the numerical results of the principal components method lack the quantitative interpretation of the DP_2 (Pena, 1977).

Zarzosa (1996) and Zarzosa and Somarriba (2013) provide a detailed study of the DP_2 indicator. A summary of the technique is given below. The input order in the DP_2 of the partial indicators governing the relative weight of each variable (Table 1) is determined by an algorithm that reaches convergence and stabilizes to verify the condition of conformity with a non-random, neutral classification method (Escobar 2006; Somarriba and Pena, 2009; Rodríguez *et al.*, 2015c; Zarzosa *et al.*, 2015).

The variables are arranged in descending order, according to the correlation with this indicator. Once the DP_2 has been calculated, the variables are re-ordered in accordance with the value registered, until convergence is obtained at a specific value of the indicator, known as the stop criterion.

The process ends when the distance between the new indicator and the indicator from the previous step is of negligible magnitude (Pena, 1977; Cuenca *et al.*, 2010).

The first difficulties that arose in the construction of synthetic indicators involved refining the weighting assigned to each observable variable and the size effect in the synthetic index. The DP_2 distance method used here synthesises the information contained in a series of social indicators by weighting the differences between the indicators and their reference values by the percentage of new information that each variable provides when it is included in the overall average.

This procedure eliminates the information provided by the i-th indicator, which is already contained in the preceding i-1 indicators and is considered as an exhaustive synthetic indicator because it is not based on reduced information. This property enables inclusion of a great number of variables, since all redundant variance is removed by the process itself (Montero *et al.*, 2010).

In other words, this correcting mechanism enables us to retain only the new information that each variable contributes, thus employing the useful information and avoiding duplication (Merino *et al.*, 2012). The first DP_2 partial indicator to be incorporated would therefore be the one that contributes most information, and so on.

When measuring size effect, in general, the larger the country the higher the values of the observable variables. To relativize the observed values, it is thus sufficient to express the variables as a function of the population or the surface area, according to whether their respective values increase with the population or the surface area (Somarriba and Pena 2009; Cuenca and Rodríguez 2010).

Dividing the property of the indicator by a standard deviation solves the problem of heterogeneity of the variables' measuring units by expressing all partial indicators (quotients involved in the expression) in abstract units (Zarzosa, 1996; Merino *et al.*, 2012).

The P_2 distance from country j is defined as follows (Pena, 1977):

$$DP_2 = \sum_{i=1}^{n} \left\{ (d_i/\sigma_j)(1 - R^2_{i,i-1,\dots,1}) \right\} \qquad (1)$$

with $R^2_1 = 0$, where $d_i = d_i(r^*) = |x_{ri} - x_{*i}|$ with the baseline. $\qquad$ (2)

$X_* = (x_{*1}, x_{*2}, \dots, x_{*n})$, where n is the number of variables that incorporate information on level of fulfilment of MDG 6; x_{ri} is the value of variable i in country r; σ_i is the standard deviation of variable i; and $R^2_{i,i-1,\dots,1}$ is the coefficient of determination in the regression of X_i over X_{i-1}, $X_{i-2},\dots,X_1$, which is already included.

Thus defined, the synthetic indicator measures the distance, relative to the object studied, between each country and a fictitious baseline in order to obtain the minimum value in the set of MDG 6 variables. In this instance, the baseline comprises the results from an imaginary country that reflects the worst possible scenario for all simple indicators and would therefore be attributed a value of zero in the synthetic indicator (Zarzosa and Somarriba, 2013).

A higher value of DP_2 therefore expresses a higher level of MDG 6, as it represents a greater distance from the "least desired" theoretical situation. The correction factor $(1-R^2_{i,i-1,\dots,1})$ also avoids duplication of information, since it eliminates the information contained in the preceding indicators from the partial indicators (Pena, 2009).

The indicator can also be used as a baseline for the situation in an imaginary country with a better situation. That is, the synthetic distance indicator defined to compare the countries should be invariant with respect to the baseline taken for each country, such that it would be the same for all (Zarzosa, 1996). In this study, we apply the DP_2 to SSA.

2.2. Data

This indicator permits comparisons to be made for SSA in 2013, using as a reference the information contained in a set of social indicators set out under the MDGs by the UN and UNAIDS (several years) (Table 1).

We have included all variables considered by the UN to measure the progress of countries toward MDG 6. These statistics are jointly compiled from the work of the Inter-agency and Expert Group (IAEG) on MDG Indicators coordinated by the United Nations Statistics Division, using the UN's latest data available on the MDGs (2014).

The year of analysis is 2013, but for those variables where information was not available for that date, the nearest year was taken as an alternative.

TABLE 1: VARIABLES OF MDG 6: COMBAT HIV AND AIDS AND MALARIA THROUGH THE UN ACCESS ORDER OF DP2 OF THE VARIABLES (1-17)

Indicators to measure progress
1) People living with HIV, 15-49 years old, percentage
2) ART coverage among people with advanced HIV infection, percentage
3) HIV prevalence rate, men 15-49 years old, in nationally-based surveys
4) HIV prevalence rate, women 15-49 years old, in nationally-based surveys
5) Proportion of condom use to overall contraceptive use among currently married women 15-49 years old, percentage
6) AIDS orphans as proportion of SSA population (one or both parents)
7) School attendance rate of orphans aged 10-14
8) Men 15-24 years old with comprehensive correct knowledge of HIV/AIDS, percentage
9) Women 15-24 years old with comprehensive correct knowledge of HIV/AIDS, percentage
10) Condom use at last high-risk sex, 15-24 years old, women, percentage
11) Condom use at last high-risk sex, 15-24 years old, men, percentage
12) Proportion of pregnant women who participated in PMTCT programmes
13) Budget allocations to programmes on HIV/AIDS, percentage
14) Proportion of child population under 14 years of age living with HIV/AIDS
15) Children under 5 sleeping under insecticide-treated bed nets, percentage
16) Children under 5 with fever being treated with anti-malarial drugs, percentage
17) Malaria death rate per 100,000 population, ages 0-4

Source: Author based on UN (2014) and UNAIDS (several years) data.

The value of the DP_2 indicator for each country was calculated as described above (Table 2).

2.3. AMOUNT OF INFORMATION OF THE VARIABLES

Finally, distances in inter-country MDG 6 are also highly influenced by the discriminant capacity of each variable within the set of countries as a whole. A variable with high discriminant capacity will thus significantly impact the DP_2 results. To gauge the impact of each variable on the results in terms of country

disparities in sub-Saharan Africa, we applied the "Global Information Quantity" method (Zarzosa, 1996).

The most accurate procedure is to select the indicator that provides the most information (Ivanovic, 1974; Somarriba *et al.*, 2015) and obtain the Ivanovic discrimination coefficient (DC) (Table 3). This coefficient quantifies the discriminatory or informative power of each variable (Ivanovic, 1974; Zarzosa, 1994).

This measure, analysed by Zarzosa (1996), ranges from 0 to 2, where 0 and 2 correspond to the two extreme theoretical cases of discriminant power (Zarzosa and Somarriba, 2013). If a variable takes the same value for all countries, the DC equals zero, indicating that this variable holds zero discriminant power and does not have a major impact on the distances between these countries.

By contrast, if a variable has a value other than zero for one country only, its information is relevant for evaluating relative levels of MDG 6 fulfilment (Table 4).

3. MDG 6 in SSA in 2013: DP_2 Country Classification

As mentioned above, our method aims to construct a synthetic indicator of MDG 6 to permit comparison among countries in SSA. The results shown in Table 2 were obtained for 2013 using Pena's DP_2 method for the variables in Table 1.

Given the above-mentioned properties of the DP_2 method, we can interpret the cardinal distance between countries (Somarriba *et al.*, 2015). For example, in 2013, Somalia, which shows the lowest value of the MDG 6 synthetic indicator, is at a distance of 7.59 units from the undesirable fictitious country (null value in the synthetic indicator), and at a distance of 13.89 (spread) from the best situated country, Namibia (21.48) (Table 2). All distances between countries can thus be measured. Namibia was followed in the ranking by Swaziland (19.79) and Botswana (19.77) (Table 2).

In 2013, Namibia, Swaziland and Botswana reported early infant diagnosis (EID) coverage above 50% (Prendergast, Essajee and Penazzato, 2015). However, coverage in countries like Chad and Democratic Republic of Congo, with low positions in our classification, (Table 2) remains below 6% (UNAIDS, 2013a).

Swaziland has the highest adult prevalence rate, 26.5%, followed by South Africa, Namibia and Mozambique at 17.9%, 13.3% and 11.1%, respectively (UNAIDS 2013b). Transmission is mainly through heterosexual sex, with women disproportionately infected compared to their male counterparts (Ramjee and Daniels, 2013).

South Africa (ranked 14th in our classification) and Nigeria (only 33rd) are the countries with the highest number of people living with HIV in the region—3.2 and 6.3 million, respectively (UNAIDS, 2012) (Table 2). There are, however, large disparities among two countries. Access to treatment covers 20% of the

infected people in Nigeria and 42% in South Africa (UN, 2014). These findings stress the urgent need to implement aggressive HIV prevention programmes (Mutevedzil and Newell, 2014).

Table 2: Synthetic Indicator ff MDG 6 in Sub-Saharan Africa. 2013 Countries in Order of Relative DP2

Country	DP2 Indicator 2013 Mean: 14.37	Ranking 2013
Namibia	21.48	1
Swaziland	19.79	2
Botswana	19.77	3
Gabon	19.40	4
Malawi	18.32	5
Rwanda	17.83	6
United Republic of Tanzania	17.38	7
Kenya	17.32	8
Lesotho	17.29	9
Zimbabwe	17.13	10
Cameroon	16.20	11
Zambia	15.96	12
Burundi	15.90	13
South Africa	15.89	14
Togo	15.85	15
Congo	15.51	16
Burkina Faso	15.37	17
Liberia	15.26	18
Equatorial Guinea	15.21	19
Ghana	15.16	20
Guinea-Bissau	14.97	21
Uganda	14.79	22
Benin	14.44	23
Senegal	14.25	24
Angola	14.05	25
Gambia	14.01	26
Eritrea	13.90	27

Mauritius	13.79	28
Mozambique	13.67	29
Central African Republic	13.11	30
Sierra Leone	12.95	31
Ethiopia	12.66	32
Nigeria	12.52	33
Guinea	12.09	34
Côte d˜Ivoire	11.62	35
Madagascar	11.47	36
Mali	11.12	37
Democratic Republic of the Congo	10.93	38
Djibouti	10.41	39
Mauritania	10.08	40
Niger	9.17	41
Chad	8.44	42
Sudan	8.12	43
Somalia	7.59	44

Source: Author based on UN (2014) and UNAIDS (several years) data.

If we compare the values for the countries in 2013 with those of the 2007 variables of MDG 6 (Rodríguez *et al*., 2012), it is generally the case that SSA countries showed higher values for MDG 6 variables.

This improvement highlights the relative advance of countries in the lowest positions in the ranking, such as Somalia, Niger, Mauritania and Madagascar (Table 2), a finding that follows the conclusions of other studies, such as Ben-david *et al.* (2012). The changes discussed above allow us to analyse the individual performance of each country during the study period.

Nigeria, a country which accounts for 18% of the total population in the region, shows a positive value for the MDG 6 synthetic indicator in 2007 and 2013 (Table 2). That is, the values of the UN millennium goal variables improved in Nigeria during this period.

According to the openness coefficient (the ratio between the maximum and minimum DP_2 value a country reaches (Zarzosa, 1996), the territorial differences in fulfilment of MDG 6 have been reduced significantly in the study period. They show a coefficient of 9.03 in 2007, as compared to 2.83 in 2013, in the areas studied. These results provide further evidence that the SSA countries have improved with regard to the values of the variables associated with MDG 6

4. Regional Distribution of Progress of MDG 6

There are also treatment differentials between countries. Children and men are less likely than adults and women to undergo treatment. It is of serious concern that millions children are infected of the region, in addition to other vulnerable groups such as young people and those affected by conflicts, disaster or displacement. Young people also lack access to education, health services and social protection, circumstances likely to undermine this population's ability to protect itself against HIV and to access ART when they become adults (UNAIDS, 2014).

The vulnerability of children, youth and pregnant mothers is evident. Indeed, as the variables' values have shown, and in line with the findings of other recent reports by international organisations with similar objectives (UN, 2014; UNAIDS, 2014), very little progress has been made regarding this population's accurate knowledge of HIV and condom use during high-risk sex.

To facilitate study of this group of countries' fulfilment of MDG 6, we determined the territorial distribution of progress towards MDG 6 in SSA based on the values of the indicator in 2013 (Table 2).

The countries were divided into four groups to display the range of regional distribution of progress towards MDG 6 in four similar categories. The countries shown in green comprise a group in which the values of the synthetic indicator fall within the range of the first quartile of the ranking. These SSA countries have been most successful in achieving MDG 6 in relative terms. The countries shown in red obtained the worst results in the synthetic indicator in 2013 (last quartile), as reflected in the legend of Table 2.

As can be seen in Table 2, 11 countries formed part of the first group, those that made the greatest progress towards the MDG 6 indicator up to 2013. In the past 10 years, efforts by national governments and development partners to halt the spread of the AIDS epidemic have borne fruit: new infections among adults have decreased by more than 50% in Botswana, Malawi, Namibia, Rwanda, Zambia and Zimbabwe; and by more than 25% in Swaziland (UNAIDS, 2013a).

In a parallel manner, 11 countries included in the fourth cluster of countries in 2007 (Rodríguez *et al.*, 2012), those that made least progress towards MDG 6, decreased to 4, a value less than 10, in 2013. They are Niger, Chad, Sudan and Somalia (Table 3), with relatively low populations (Table 2). While efforts to treat and prevent HIV such as ART and PMTCT expand in SSA, their coverage is still unacceptably low in the most countries in this region, according to the World Health Organization (2013).

For many pregnant women living with HIV, such treatment remains out of reach, especially for those living in rural areas and those fearful of stigma and discrimination if they test positive. Of the 960,000 pregnant women living with HIV in 2011, over 90% lived in just 9 countries—South Africa, Mozambique, Uganda, Tanzania, Kenya, Zambia, Zimbabwe, Malawi and Ethiopia (UNAIDS, 2013b).

In short, the countries included in the first two groups of the ranking account for approximately 36.5% of the total population of SSA, with the best relative results for the 2013 MDG 6 indicator according to the value obtained in the variables (Table 2).

5. Discriminatory Power of the Variables to Combat HIV/AIDS and Malaria (MDG 6)

The Pena method used in this study to analyse progress towards MDG 6 in SSA also allows us to determine the influence that each individual variable in the set has on the final results of the indicator discussed above. In using this method as defined by Zarzosa and Somarriba (2013), we can extract the most important factors to explain progress towards MDG 6 in the region.

In this section, the results of the Ivanovic Discrimination Coefficient (Ivanovic 1974) are applied to the progress towards MDG 6, analysed in depth by Zarzosa (1994, 1996). Table 3 shows the coefficient values corresponding to the variables.

This coefficient takes values between 0 and 2, coinciding with the two theoretical cases of the power of information. That a variable possesses a near-0 value for one territory in the coefficient does not mean that it does not contribute information, but that its information is already incorporated into all previous variables (Somarriba, Zarzosa and Pena, 2015).

We will begin by discussing the results obtained for the countries.

In 2013, the two most discriminating MDG 6 variables—those that head the ranking with coefficient values greater than 0.4 and thus have relatively high discriminatory power—are related to AIDS and HIV: "People living with HIV, 15-49 years old, percentage" and "AIDS orphans as a proportion of the SSA population (one or both parents)" (Table 3).

Table 3. Amount of Information Contributed by the Variables on MDG 6: Combat HIV/AIDS and Malaria in Sub-Saharan Africa. 2013

Ivanovic Discrimination Coefficient 2013	Variable
0.51	AIDS orphans as proportion of sub-Saharan Africa population (one or both parents)
0.44	People living with HIV, 15-49 years old, percentage
0.36	Proportion of child population under 14 years of age living with HIV/AIDS
0.32	HIV prevalence rate, women 15-49 years old, in nationally-based surveys
0.25	Budget allocations to programmes on HIV/AIDS, percentage

0.22	HIV prevalence rate, men 15-49 years old, in nationally-based surveys
0.16	Children under 5 sleeping under insecticide-treated bed nets, percentage
0.14	Men 15-24 years old with comprehensive correct knowledge of HIV/AIDS, percentage
0.11	Proportion of condom use to overall contraceptive use among currently married women 15-49 years old, percentage
0.10	Children under 5 with fever being treated with anti-malarial drugs, percentage
0.08	Condom use at last high-risk sex, 15-24 years old, men, percentage
0.07	Malaria death rate per 100,000 population, ages 0-4
0.05	Condom use at last high-risk sex, 15-24 years old, women, percentage
0.05	Antiretroviral therapy coverage among people with advanced HIV infection, percentage
0.03	Proportion of pregnant women who participated in the prevention of mother-to-child transmission (PMTCT)
0.02	School attendance rate of orphans aged 10-14
0.01	Women 15-24 years old with comprehensive correct knowledge of HIV/AIDS, percentage

Source: Author based on UN (2014) and UNAIDS (several years) data.

As shown in Table 3, almost all variables showed discrimination coefficients below 0.4 in 2013. "AIDS orphans as proportion of SSA population" is the only variable with a value greater than 0.5, indicating that it gained greater discriminatory power. Another variable with stronger discriminatory power in this period is "HIV prevalence rate, women 15-49 years old, in nationally-based surveys".

These variables have had strong relative importance in the outcome of the DP_2 synthetic indicator and are decisive in the progress towards MDG 6 in the group of countries in SSA. As can be seen, striking differences in the value of the variables in different areas play a key role in achieving MDG 6 across countries, among them several variables directly related to the MDG target to halt and begin to reverse the spread of HIV/AIDS by post-2015.

In contrast, the variables "Budget allocations to programmes on HIV/AIDS, percentage" and "HIV prevalence rate, men 15-49 years old, in nationally-based surveys" show values ranging from 0.2 to 0.3, indicating that they achieve substantial discriminatory power in 2013.

Additionally, the importance of the variables "Men 15-24 years old with comprehensive correct knowledge of HIV/AIDS, percentage", "Children under 5 with fever being treated with anti-malarial drugs, percentage" and "Proportion of condom use to overall contraceptive use among currently married women 15-49 years old, percentage" obtained coefficient values above 0.10 in the year of the study (Table 3).

Finally, the variables "ART coverage among people with advanced HIV infection, percentage", "Proportion of pregnant women who participated in the PMTCT", and "Women 15-24 years old with comprehensive correct knowledge of HIV/AIDS, percentage" showed coefficient values below 0.05 and have almost null discriminatory power in 2013.

6. Conclusion and Reflections on the Path Forward

With a view to the upcoming post-2015 horizon for the final assessment of progress towards the MDGs, this study has investigated achievement of MDG 6: Combat HIV, AIDS and malaria in 44 countries of SSA in the year 2013 from two approaches.

In the first phase, we applied the Pena distance method to compare each country individually, as well as to determine the relative situation of each country in the context of SSA. We then examined the impact of each MDG variable on the final outcome of the synthetic indicator and the discriminatory power or relevance of each variable.

We will now summarise the general study conclusions.

Overall, until 2013, progress towards MDG 6 was slightly uneven among SSA countries. With respect to the results of other, prior studies with similar objectives (Rodríguez *et al*. 2012), these countries have made relative progress toward MDG 6 during the period 2007-2013, as indicated by the higher average indicator in 2013 compared to 2007 (14.36 and 10.04, respectively).

Smaller territorial disparities in the indicator values are also observed among the countries, as shown by the opening coefficient for 2013 (2.83).

By country, Nigeria, by far the most populated country in the region, achieves a relatively low ranking in 2013 (Table 2). South Africa, another heavily populated country, also fails to rank in the first quartile. Perhaps the most striking finding is that two of the countries with the highest number of inhabitants, Nigeria and South Africa, suffered setbacks in their relative progress towards MDG 6, in the overall SSA context.

These results can be explained by the fact that Nigeria and South Africa have largely borne the burden of the epidemic in SSA, with an enormous impact on the children and young women in these territories (UN, 2014; UN-AIDS, 2010). There is urgent need to address the specific problems of the most vulnerable segments of the population suffering from the spread of HIV through concrete objectives targeted at Nigeria and South Africa. We must actively combat all types of discrimination in these populated areas in an equal framework of prevention, access and ART among the people most at risk of infection.

As to the discriminatory power of the MDG 6 variables during the study year, the following considerations can be drawn:

The synthetic indicator variables in 2013 with the greatest discriminatory power in the final indicator are those most closely related to Target 6a

– halt and begin to reverse the spread of HIV/AIDS among children, especially orphans, as well as low-income pregnant women and young mothers. These variables show the great relevance of the indicator and its high impact on the outcome.

In line with the findings of recent studies on this subject (Stangl and Grossman, 2013), the prevention of high-risk sex among younger women in both behavioural and medical terms—taking into consideration their economic, social, cultural and biological environment—should be a priority of the future strategy to combat the HIV/AIDS epidemic in SSA.

In short, our results reveal that it is necessary not only to maintain but also to increase international aid to combat the HIV epidemic and other infectious diseases in SSA on the 2030 horizon through greater investment in financial, human and technical resources. Special attention must be paid to individual countries such as Nigeria and South Africa which, in the general framework for improving the fight against HIV/AIDS and other diseases, in addition, to implementing programmes to increase knowledge of the disease among vulnerable segments of the population.

The United Nations should take this fact more seriously into account when designing programmes to raise standards for reaching MDG 6 in these countries, whose populations constitute a large percentage of the region's population at risk, particularly with regard to pregnant women and orphans and PMTCT.

Finally, we would like to emphasise that our ultimate goal is to use the latest data available to provide new information that sheds a little more light on the progress made towards MDG 6 in SSA and on the most relevant factors in the fight against HIV/AIDS and other diseases, which continue to have devastating consequences for much of the population in the region.

Our aim is to further these countries' progress in achieving MDG 6. Based on the most discriminant variables (Table 2), we indicate the most relevant issues and those with the greatest impact. These variables contribute to a greater extent to the countries' progress toward reaching MDG 6 in the coming years, in key areas such as social protection of child orphans, education in prevention, and health habits for mothers and pregnant women, through measures such as HIV testing and treatment linked to antenatal services, early infant diagnosis and paediatric treatment.

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