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## Chapter 2.

## Methodology

## 2.1

### The Human Opportunity Index

The Human Opportunity Index (HOI) is an aggregate measure that summarises the equitable availability of services. The endowment is the percentage of a population with access to a health service or with a health outcome that is necessary to progress in life. Unlike standard indices, such as coverage rate, to capture access to a particular service, the HOI also takes into account the (in) equitable access to the service among different groups of the population. The HOI is best understood as a coverage rate discounted for inequality of access. The HOI was developed by the World Bank Group (WBG) with external researchers and first presented in 2009 (Barros et al. 2009)<sup>1</sup>.

The simplest way to express the HOI ( $H$ ) for a particular opportunity is to take the average coverage rate for this opportunity ( $\bar{C}$ ) and apply a discount ( $P$ ) due to inequality in coverage between population groups with different circumstances:

$$H = \bar{C} - P \quad (1)$$

Alternatively, the HOI can be expressed as:

$$H = \bar{C} \left( 1 - \frac{P}{\bar{C}} \right) = \bar{C} (1 - D) \quad (2)$$

Notice that from equation (2), the HOI is equal to the average coverage rate ( $H$  equals  $\bar{C}$ ) if access to the opportunity is independent of the circumstances (that is  $D=0$ ).  $D$  is usually referred to as the dissimilarity index (D-index), and can be interpreted as the share of the total number of opportunities (that is, places available in a service) that needs to be reallocated between circumstance groups to ensure equality of opportunities.  $P$  is the penalty that the coverage ( $\bar{C}$ ) suffers due to inequality and it depends on the D-index ( $D$ ) and on the coverage ( $\bar{C}$ ). For each circumstance group  $k$ ,  $D$  can be computed as follows:

$$D = \frac{1}{2\bar{C}} \sum_{k=1}^m a_k |\bar{C} - C_k| \quad (3)$$

where  $k$  is a group with a specific set of circumstances,  $C_k$  the coverage rate of group  $k$ ,  $a_k$  the share of group  $k$  in total population; and  $m$  the number of groups defined by circumstances.

When analysing household survey data, the procedure consists of running a logistic regression model to estimate, at an individual level, the relationship between the access to a particular opportunity (binary dependent variable) and the circumstances of an individual (independent variables), on the full sample for which the HOI measure will be constructed. The estimated coefficients of the regression are used to obtain for each individual his/her predicted probability of access to the opportunity, which is then used to estimate the D-index, the coverage rate



and the HOI<sup>1</sup>. Detailed information regarding construction, properties and limitations of the HOI has been described elsewhere<sup>1</sup>.

## 2.2

### Shapley decomposition

The Shapley decomposition is the decomposition of the D-index according to the Shapley value concept, first described by Shorrocks in 2012<sup>2</sup>. The Shapley decomposition estimates the relative contribution of each circumstance to the inequality index so that the contributions add up to the value of the D-index, when it is computed with all the available circumstances in the data<sup>3</sup>.

The D-index can change according to the set of circumstances used to define groups. In particular, it can only increase or remain constant when more circumstances are added to any existing set of circumstances. This in turn implies that the measured D-index is always a lower limit of the actual inequality that would be estimated if one were to use the set of all relevant circumstance variables. This property also allows defining the contribution of each circumstance to inequality as the increase in D-index due to the addition of a circumstance, or the marginal value added by a “new” circumstance to the D-index. Circumstances that add higher marginal value (in terms of the Shapley values) to the D-index are interpreted as “contributing” a larger share of the inequality between groups<sup>3</sup>. Detailed information regarding construction, properties and limitations of the Shapley decomposition and Shapley value has been described elsewhere<sup>1,4</sup>.

## 2.3

### Study population

The study population is comprised of women of reproductive age, between 15 and 49 years old. Three subgroups of this population are used to analyse certain indicators (Table 2.2) that are only relevant for a specific subgroup, taking into account the data available from the data sources (i.e. the Demographic Health Surveys (DHS)):

- Older adolescent girls between 15 and 19 years old, for whom the indicators of interest are those related to reproductive health and educational attainment.
- Women who had children in the last few years (five or two years, depending on the indicator) before the interview, for whom indicators related to pregnancy and infants' health are analysed.
- Women who had a child within six months of the survey, used for the analysis of exclusive breastfeeding.

The analysis of “met need for family planning” is done for two non-overlapping subgroups: older adolescents (15 to 19 years) and women of reproductive age (20 to 49 years)<sup>1</sup>. Importantly, while it would have been relevant to analyse some of the indicators among younger adolescent girls between 10 and 14 years old, there is no data source. In fact, almost all studies on reproductive health among younger adolescent girls are conducted using data from retrospective questions addressed to adult women and older adolescent girls. The lack of information among this particular age group is one of the existing knowledge gaps for which it is necessary to generate reliable and timely data. Breaking the data gap to break the gender gap is highlighted in the new agenda of the Sustainable Development Goals (SDGs) era.

## 2.4

### Data sources and country inclusion criteria

**Table 2.1** List of countries and DHS surveys

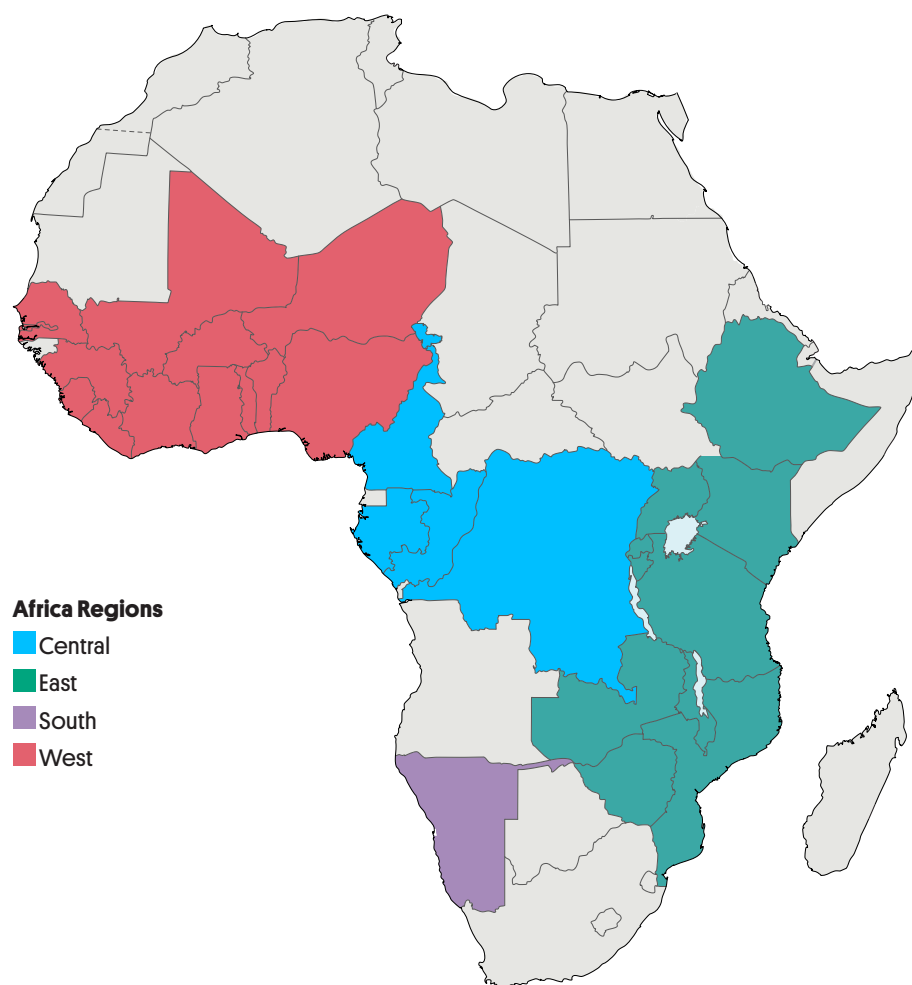
	Country	Survey year	African UN region		Country	Survey year	African UN region
1	Benin	2011-2012	Western	16	Malawi	2010	Eastern
2	Burkina Faso	2010	Western	17	Mali	2012-2013	Western
3	Burundi	2010	Eastern	18	Mozambique	2011	Eastern
4	Cameroon	2011	Central	19	Namibia	2013	Southern
5	Comoros	2012	Eastern	20	Niger	2012	Western
6	Congo Rep.	2011-2012	Central	21	Nigeria	2013	Western
7	Congo DR	2013-2014	Central	22	Rwanda	2014-2015	Eastern
8	Côte d'Ivoire	2011-2012	Western	23	Senegal	2014	Western
9	Ethiopia	2011	Eastern	24	Sierra Leone	2013	Western
10	Gabon	2012	Central	25	Tanzania	2010	Eastern
11	The Gambia	2013	Western	26	Togo	2013-2014	Western
12	Ghana	2014	Western	27	Uganda	2011	Eastern
13	Guinea	2012	Western	28	Zambia	2013-2014	Eastern
14	Kenya	2014	Eastern	29	Zimbabwe	2010-2011	Eastern
15	Liberia	2013	Western				

**Note:** Congo DR = Congo Democratic Republic, Congo Rep. = Congo Republic, UN = United Nations. Research undertaken in March 2016.

The data source for this study is the DHS financed by United States Agency for International Development (USAID)<sup>5</sup>. The DHS are community level, household surveys carried out in developing countries, including 33 sub-Saharan African (SSA) countries. They contain hundreds of questions related to household characteristics and household members, women of reproductive age and their children and men of reproductive age. The questionnaires administered to women of reproductive age provide useful information about maternal and reproductive health that makes the DHS the ideal data source for this report. The high degree of consistency in DHS questionnaires and sampling methodology across countries also make it particularly suitable for a multi-country study, as it allows for cross-country comparisons and/or aggregations of results.

The countries included in the analysis were those having at least one available standard and complete DHS conducted between 2010 and 2015. The most recent dataset of each country was selected for the study (see Table 2.1 and Figure 2.1).

**Figure 2.1 Map of the countries included in the analysis**



## 2.5

### Selecting and defining opportunities

This report focuses on the study of health opportunities for women of reproductive age. The final selected indicators include health outcomes and the use or knowledge of certain health services (Table 2.2). Although most of these indicators can be influenced by individuals' decisions, following the reasoning previously explained, in this report they will be treated as health opportunities for women.

Health is only one dimension of women's needs, but it becomes particularly salient during their reproductive age due to the elevated risk of death that they face<sup>6</sup> (see also Chapter 1). The opportunities selected for this study can be interpreted as a necessary and minimum set of conditions to be met for a woman during her reproductive years from the perspective of her own and her children's well-being. These include a number of variables measuring access to specific health services, as well as two "outcome" variables related to anaemia and adequate body mass index (BMI) that represent key aspects of maternal health associated with lower risks of mortality. For the specific study of older adolescents, education has also been selected as an opportunity because it is linked to adolescents' reproductive health, early marriages and high-risk pregnancies<sup>7,8</sup>. Table 2.2 provides the list of the opportunities and the baseline population analysed in each case.

**Table 2.2** List of opportunities and baseline population for whom they have been analysed

Opportunity	Description
Not having anaemia	Women without anaemia <b>Baseline population:</b> all women of reproductive age [15-49]
Having the recommended BMI	Women with a BMI between 18.5 and 24.99 <b>Baseline population:</b> all women of reproductive age [15-49]
Met need for family planning	Women currently using contraceptive methods <b>Baseline population:</b> women of reproductive age [20-49] or older adolescent girls [15-19] with a need for family planning
Knowledge of a place where to get an HIV test	Women who know where to get an HIV test <b>Baseline population:</b> all women of reproductive age [15-49]
Four antenatal care visits attended by skilled personnel	Women who received at least four antenatal care visits attended by skilled personnel <b>Baseline population:</b> all women with newborns in the five years preceding the interview date
Delivery attended by a skilled attendant	Women who had a delivery attended by a doctor, nurse, midwife or auxiliary midwife <b>Baseline population:</b> all women with newborns in the five years preceding the interview date
Mother's checkup after delivery	Women who had a checkup after delivery <b>Baseline population:</b> all women with newborns in the two/five years preceding the interview date

*table continues next page*

**Table 2.2** List of opportunities and baseline population for whom they have been analysed (continued)

Maternity care package	Women who attended at least four antenatal care visits, had a delivery attended by skilled personnel AND had a checkup after delivery <b>Baseline population:</b> all women with newborns in the five years preceding the interview date
Malaria prophylaxis during pregnancy	Women who took at least one dose of IPTp (SP) <b>Baseline population:</b> all women with newborns in the five years prior to interview and received at least one antenatal care visit
Being offered an HIV test during antenatal care	Women who were offered an HIV test during antenatal care visits <b>Base population:</b> all women with newborns in the two years prior to interview and received at least one antenatal care visit
Infant checkup within two months after delivery	Women whose last child had a checkup within two months after delivery <b>Base population:</b> all women with newborns in the two/five years prior to the interview date and the child survived
Six months of exclusive breastfeeding	Women who are breastfeeding and are not giving the children any other type of food or beverage <b>Base population:</b> all women with newborns in the six months prior to the interview date and the child survived
Having never been pregnant	Women who have never had a child, a stillbirth or an abortion, and are not currently pregnant <b>Base population:</b> Older adolescent girls (15-19)
Currently attending school	Women who are currently attending school (or university) <b>Base population:</b> Older adolescent girls (15-19)

**Note:** HIV = Human Immunodeficiency Virus, IPTp = Intermittent Preventive Treatment of malaria in Pregnancy, SP = Sulfadoxine-Pyrimethamine.

Notably, seven of the 13 opportunities are related to the health indicators listed in the recommendations of the World Health Organization (WHO) Commission on Information and Accountability for Women's and Children's Health. "Met need for family planning", "antenatal care coverage with at least four visits during pregnancy", "deliveries attended by skilled personnel", "postnatal care visits" for mothers and newborns after delivery, and "six months of exclusive breastfeeding" are some of the reproductive and maternal health indicators used by the WHO to monitor progress on maternal and child health, and are used by other organisations and ongoing initiatives as well<sup>9,10</sup>. While "postnatal checkups" for mothers and newborns indicators are recommended within hours after delivery, this report will use a different time period for each indicator – two months for infant checkups and undetermined for mothers – because of the number of missing values for the recommended indicators in some of the datasets.

The definition of all opportunities is the same across countries to allow comparisons. In general, DHS interviewers ask questions to all women who meet the criteria for a given question. In a few cases only, the baseline population is not the same because of the country-specific characteristics of the surveys<sup>11</sup>.

<sup>11</sup>For example, all women who had a childbirth in the last five years answered questions regarding pregnancy, but for some countries and indicators, DHS program selected women who had their child during the last two years before the survey instead of five years, or randomly asked certain questions to a half or a third of the sample.

### **The composite HOI – an essential maternity care package**

A “composite HOI” that reflects access to multiple services for pregnant women has been defined, recognizing that none of these services are substitutes for each other, and underscoring that having access to all of them is critical for maternal health. Since the three key stages of pregnancy are the gestation months, the child-birth and the postpartum period, the three opportunities related to these stages constitute an essential maternity care package. For this analysis, “opportunity” refers to a woman attending at least four antenatal care visits, having a delivery attended by skilled personnel, and having a checkup after delivery. The calculation of the HOI then follows the methodology described earlier. The interpretation of this composite HOI is intuitive: it reflects the extent to which women who had a newborn were covered by an essential maternity care package. The package that has been considered is not the ideal, because a woman’s checkup should be within hours after delivery, but it can be interpreted as meeting a minimum standard.

## **2.6**

### **Defining a set of circumstances**

Circumstances can be defined as the exogenous characteristics of women that, in absence of inequalities, should not be associated with having access to a service or having a particular health outcome (opportunities); contrarily, circumstances and opportunities are associated in the presence of inequalities. Some of the characteristics selected for this analysis such as education level, occupation and marital status can present the problem that they may be influenced by individual behaviour rather than being circumstances that are pre-determined at birth. For the purpose of this analysis, we favour this inclusive definition over a strict interpretation of circumstances for two main reasons. First, we are interested in seeing how access to opportunities varies by characteristics that differentiate groups of women – which is more important for policymaking purposes than finding differences in access by birth circumstances only. Second, characteristics like occupation and education are key contributors to the socio-economic situation of a woman of reproductive age, are extremely difficult to change and therefore exogenous for most practical purposes to a woman (or adolescent girl) at that point of time. Therefore, in assessing inequalities across groups, it seems important to take these characteristics into account, even though they do not conform to the standard definition of circumstances. In the rest of this report, these characteristics will be often referred to as circumstances to be consistent with how inequality of opportunities is typically presented. However, they must be understood as characteristics that are essentially beyond the control of a woman of reproductive age (or an older adolescent girl), rather than as circumstances determined purely at birth.



**Table 2.3** List of circumstances

	Women of reproductive age	Pregnant women	Older adolescent girls
<b>Women's characteristics</b>	Age	Age at delivery	-
	Marital status	Marital status	Marital status
	Number of children	Number of children	-
<b>Household head characteristics</b>	Sex of the household head	Sex of the household head	Sex of the household head
<b>Socio-cultural background</b>	Religion	Religion	Religion
	Educational level	Educational level	-
	-	-	Occupational status
<b>Location</b>	Area (urban/rural)	Area (urban/rural)	Area (urban/rural)
<b>Household status</b>	Wealth index (quintiles)	Wealth index (quintiles)	Wealth index (quintiles)

**Note:** The set of circumstances for Niger and Tanzania does not include religion, and the one for Mali and Senegal does not include occupational status, because these data were not available.

The circumstances that matter for women's health opportunities could be slightly different across countries, but a common set is selected to allow cross-country comparisons. The list of selected circumstances can be categorised into five groups: women's characteristics, socio-cultural background, household head characteristics, location and household status. Table 2.3 shows the complete list of circumstances. The codification of each variable (circumstance) is detailed in the Appendix A. The majority of the circumstances are used in the analysis of all women of reproductive age, but age is substituted by age at delivery for the analysis of maternity related opportunities. The reason for this change is the fact that age at delivery could condition certain aspects of maternity while age at the moment of the interview does not have any relationship with the time of pregnancy. For the analysis of adolescents' opportunities, the list varies because education is considered an opportunity, age is taken into account in the selection of the group (age 15-19) and the inclusion of the number of children does not make sense when analysing whether adolescents have ever been pregnant. In the analysis of women of reproductive age, occupation of the woman appears to be highly correlated with wealth index and thus does not contribute significantly to the D-index and the HOI. Hence, occupation has been excluded from the analysis for women of reproductive age. But in the case of adolescents, occupation has been included as a circumstance because it is less correlated with wealth and could matter for the likelihood of older adolescent girls going to school, having more children or having their family planning needs met.

Additionally, other identified circumstances relevant for women and girls' health opportunities in the SSA region and thus potentially included in the analysis are

domestic violence and migration status. With a 36.6 percent prevalence, Africa ranks among the worst affected regions for intimate partner violence, the type of violence against women for which more data are available<sup>III</sup>. For combined intimate partner and non-partner sexual violence among all women of 15 years or older, estimated prevalence rate is 45.6 percent<sup>11</sup>. Migration has a complex effect on health, and women migrants may face adverse health conditions, such as poorer pregnancy outcomes and perinatal health indicators, or higher risk of sexually transmitted diseases, including HIV, resulting from voluntary and forced migration<sup>12</sup>. However, these factors were not included because of lack of data related to domestic violence in a third of the countries in this study, and the inclusion of migration questions in only three of these countries<sup>5</sup>.

As mentioned earlier, the list of circumstances selected for constructing the HOI for an opportunity matters a great deal for the measure. Given this, all results that follow in the next chapters are subject to the limitation that the HOI is estimated for a specified list of circumstances and therefore subject to change if this list changes. However, while the HOI for an opportunity is not unique and depends on the number of circumstances considered, it cannot be higher if more circumstances are added to the existing set. In other words, the measure of the HOI used in this report will represent an upper boundary to the “true” HOI that would consider all circumstance groups (and a lower limit of the true D-index). Notably, the estimates always carry an error that could cause misleading comparisons between country HOIs, being a minor limitation to the analysis<sup>13</sup>.

Having a common set of circumstances for a given opportunity across all countries also implies that certain circumstances important for inequality in a particular country are absent from the list. This could lead to the HOI (D-index) estimated for that country to be over-(under) estimated and not reflect the “true” inequality of opportunity in a specific country. Given this potential issue, the results throughout this report should be interpreted as the upper and lower boundaries of the HOI and D-index, respectively, for an opportunity in any particular country, computed for a set of circumstances common to all countries. Country-specificity is sacrificed to enable comparability of results across countries.

Finally, it is important to take into account that all potential interactions between circumstances have been excluded from the analysis. The simplified specification is essential for the analysis to be tractable, and implies that the HOI (D-index) should be interpreted as the upper (lower) boundary of what the estimates would be if interactions were included.

<sup>III</sup>Based on aggregated data from: Botswana, Cameroon, Democratic Republic of Congo, Ethiopia, Kenya, Lesotho, Liberia, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Uganda, United Republic of Tanzania, Zambia and Zimbabwe.

## 2.7

### Data management

The country-level analyses were weighted using the sample weights available in the DHS programme datasets. These sample weights are expansion factors applied to adjust for differences in probability of selection across observations in the sample<sup>14</sup>. However, these country specific sample weights cannot be applied to the cross-country analysis when all study countries are pooled. An adjustment to the country specific sample weights needs to be performed to make country samples representative of women's population in each country. Thus, more weight is given to those women belonging to a more populous country than those residing in smaller ones. The recalibration of the sample weights was performed by dividing each weight in a particular survey by the sum of the original sample weights and multiplying the result by the total number of women of reproductive age in the country<sup>15</sup>. No other data treatment has been applied to the data analysis.

**Figure 2.2 Summary of opportunities, circumstances and groups of women included in the analysis**

#### Women of reproductive age

	Pregnant women	Older adolescent girls	
<ul style="list-style-type: none"> <li>■ Not having anaemia</li> <li>■ BMI between 18.5 and 24.99</li> <li>■ Met need for family planning</li> <li>■ Knowledge of where to get an HIV test</li> </ul>	<ul style="list-style-type: none"> <li>■ Four antenatal care visits</li> <li>■ Delivery attended by skilled personnel</li> <li>■ Postnatal checkup</li> <li>■ Maternity care package</li> <li>■ Malaria prophylaxis during pregnancy</li> <li>■ HIV test offered during pregnancy</li> <li>■ Infant checkup after delivery</li> <li>■ Six months of exclusive breastfeeding</li> </ul>	<ul style="list-style-type: none"> <li>■ Met need for family planning</li> <li>■ Having never been pregnant</li> <li>■ Currently attending school</li> </ul>	Opportunities
<ul style="list-style-type: none"> <li>■ Age</li> <li>■ Marital status</li> <li>■ Number of children</li> <li>■ Sex of the household head</li> <li>■ Religion</li> <li>■ Education level</li> <li>■ Area</li> <li>■ Wealth index</li> </ul>	<ul style="list-style-type: none"> <li>■ Age at delivery</li> <li>■ Marital status</li> <li>■ Number of children</li> <li>■ Sex of the household head</li> <li>■ Religion</li> <li>■ Educational level</li> <li>■ Area</li> <li>■ Wealth index</li> </ul>	<ul style="list-style-type: none"> <li>■ Marital status</li> <li>■ Sex of the household head</li> <li>■ Religion</li> <li>■ Area</li> <li>■ Wealth index</li> <li>■ Occupational status</li> </ul>	Circumstances

**Note:** Women of reproductive age = 15-49 years old, except for met need for family planning [20-49 years old]. Pregnant women = newborns born two/five years or six months prior to the interview date. Older adolescents = 15-19 years old.

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