Rethinking inequality in Arab countries
Technical annex
Inequalities in health, education, and living standards: Measuring status and trends in 12 Arab countries

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Economic and Social Commission for Western Asia

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ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية

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1. Data sources and indicators

Data from multiple indicator cluster surveys (MICS), demographic and health surveys (DHS), and the Pan Arab Project for Family Health (PAPFAM) do not provide information on consumption and expenditure, but they offer a wealth of data in the non-income space, including data on health, education, nutrition and, depending on the focus of the surveys, on economic activities of household members. The main focus of household surveys is to collect information about the health and nutrition status of women of reproductive age and children aged 0-4, and related socioeconomic characteristics of households.

The survey questionnaires are structured in such way that the 'household questionnaire' collects general information on the usual residents (and sometimes visitors) of a household and its characteristics, while separate questionnaires focus on the health outcomes of children under the age of 5 and (ever-married) women of reproductive age, among other topics of interest. One advantage of these types of surveys is that some indicators are collected on an individual level. The data can therefore also be used to investigate inequalities between the sexes.

Household survey data usually complements information on health or education with data on living standards and assets or durable goods in a household. This data can be used to construct a wealth index, which serves as a proxy for household wealth. The wealth index was introduced by DHS to determine a household's relative economic status in the absence of income and expenditure data. The index is generated through a principal component analysis, which utilizes information on household assets ownership, materials used for housing construction, and types of water access and sanitation facilities. The index places each individual household on a continuous scale of relative wealth. The breakdown of the suggested indicators by wealth index quintiles or deciles reveals differences between the very rich and the very poor (as measured by the wealth index) in relation to outcomes in health or education.

Given that the wealth index is a survey-specific measure in terms of both its calculation and the underlying concept of wealth it aims to proxy, it faces substantial limitations in cross-sectional and trend analysis of wealth. For inequality analysis, the implication of the comparison, across countries and time, of the gap in outcomes between rich and poor using the wealth index does not inform whether the difference is due to a genuine gap in the outcome examined or differences across surveys in the underlying wealth that the wealth index is trying to capture. Considering this limitation, the present report will perform analysis of inequality in outcomes by wealth for the most recent period, focusing on the relative gap between richest and poorest within countries.

The DHS, MICS, and PAPFAM surveys are collected on a regular basis. For the Arab region, 24 surveys between 2000 and 2015 are available. The surveys from the period 2000-2007 are considered baseline surveys, while the surveys between 2011 and 2015 are endline surveys. Table 1 provides an overview of the available surveys and their main characteristics such as sample size, and information on their statistical representativeness and special characteristics, including ever-married samples or the availability of the wealth index, for the 12 selected Arab countries and both points in time.

Most of the surveys have a complicated survey design. Therefore, if only means are to be calculated, it is sufficient to use the sample weights provided in the datasets. However, to get reliable estimates for the standard errors and to test the difference between groups, the exact survey design needs to be accounted for when producing the estimates. Table 2 presents the survey designs for the household surveys and technical information that are needed to produce reliable estimates for the standard errors. The standard errors were calculated using the svyset prefix in Stata.

Table 1. Characteristics of household surveys across 12 Arab countries

			Sample Size				Representativeness			Wealth index		Fieldwork	
Survey	Year	Country	Households	Children under 5	Women	Ever-married sample	National	Urban/ rural	States (number)	Wealth index quintile	Wealth score	From	To
M	2000	Comoros	3,678	4,870	5,242		Yes	Yes	NA	Yes	NO	10/2000	11/2000
M	2000	Iraq	13,011	14,676	22,994		Yes	Yes	NA	Yes	Yes	10/2000	12/2000
M	2000	Sudan (North)	25,183	23,296	22,949		Yes	Yes	Yes(16)	Yes	Yes	07/2000	08/2000
D	2000	Egypt	16,957	11467	15,573	Yes	Yes	Yes	Yes (6)	Yes	Yes	02/2000	04/2000
P	2001	Tunisia	6,055	NA	3,902	Yes	Yes	Yes	Yes (7)	NO	NO	06/2001	08/2001
P	2002	Algeria	19,233	6,329	15,156	Yes	Yes	Yes	NA	NO	NO	09/2002	11/2002
D	2002	Jordan	7,825	6,073	6,006	Yes	Yes	Yes	Yes(3)	Yes	Yes	07/2002	09/2002
P	2003	Yemen	12,665	10,860	11,292	Yes	Yes	Yes	NA	Yes	Yes	12/2002	06/2003
D	2003	Morocco	11,513	6,180	16,798	Yes	Yes	Yes	Yes	Yes	Yes	10/2003	02/2004
P	2006	State of Palestine	11,661	10,230	10,648	Yes	Yes	NA	NA	Yes	Yes	12/2006	01/2007
D	2007	Mauritania	10,361	8,672	12,549		Yes	Yes	Yes(13)	Yes	Yes	05/2007	09/2007
P	2007	Libya	18,629	12,550	11,920	Yes	Yes	NA	Yes (22)	Yes	NO	05/2007	10/2007
M	2011	Tunisia	9,171	2,899	10,215		Yes	Yes	Yes (6)	Yes	Yes	12/2011	1/2012
M	2011	Iraq	35,701	36,307	55,194		Yes	Yes	Yes (18)	Yes	Yes	02/2011	09/2011
P	2011	Morocco	15,343	7,162	11,069	Yes	Yes	Yes	Yes (14)	Yes	Yes	11/2011	02/2012
M	2012	Comoros	770	3149	865		Yes	Yes	Yes (4)	Yes	Yes	08/2012	12/2012
M	2012	Algeria	27,198	14,701	38,548		Yes	Yes	Yes (7)	Yes	Yes	10/2012	1/2013
D	2012	Yemen	17,351	16,093	16,656	Yes	Yes	Yes	Yes (21)	Yes	Yes	09/2013	11/2013
D	2012	Jordan	15,190	10360	11,352	Yes	Yes	Yes	Yes (12)	Yes	Yes	09/2012	12/2012
M	2014	Sudan	16,801	14,081	18,302		Yes	Yes	Yes (18)	Yes	Yes	09/2014	10/2014
M	2014	State of Palestine	10,182	7,816	13,367		Yes	Yes	NA	Yes	Yes	03/2014	04/2014
D	2014	Egypt	28,175	15848	21,762	Yes	Yes	Yes	Yes (6)	Yes	Yes	04/2014	06/2014
P	2014	Libya	18,579	13,486	11,067	Yes	Yes	Yes	NA	Yes	Yes	01/2014	03/2014
M	2015	Mauritania	11,765	10,663	14,342		Yes	Yes	Yes (13)	Yes	Yes	07/2015	11/2015

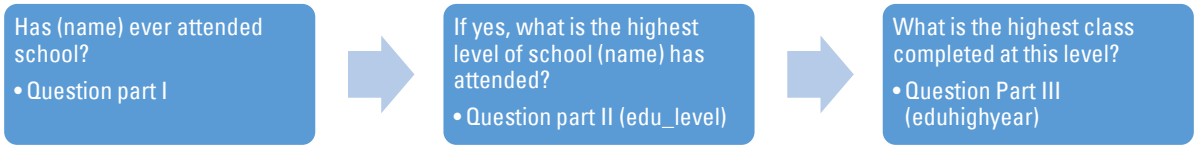
Table 2. Survey designs

Survey	Year	Country	Primary sampling units	Stratification	Stata coding for Strata variable	Description of survey design
PAPFAM	2002	Algeria	510 PSU	Rural/urban; regions	Variable for regions is missing	Survey report p. 7/8
MICS	2012	Algeria	1120 PSU	Rural/urban; regions (7)	Egen strata_rur= group(hh6 hh7)	Survey report p. 268
MICS	2012	Comoros	252 PSU	Rural/urban; regions (3+capital)	Available in dataset	Survey report p. 274
MICS	2000	Comoros	216 PSU	Rural/urban	Available in dataset	Survey report p.13
DHS	2000	Egypt	500 PSU	Rural/urban; regions (26)	Egen strata=group(hv023 hv025)	Survey report p. 221
DHS	2014	Egypt	883 PSU	Rural/urban; regions (25)	Available in dataset	Survey report p. 267
MICS	2000	Iraq	1321 Cluster	Three stages stratified random sampling method	Not available in dataset	Survey report p. 14
MICS	2011	Iraq	3658 PSU	Rural/urban; districts (118)	Available in dataset	Survey report appendix p.2
DHS	2002	Jordan	498 PSU	Rural/urban/major city; governorate (29)	Available in dataset	Survey report t p.155
DHS	2012	Jordan	806 PSU	Rural/urban; governorate (18), badia/camp/other	Egen strata=group(hv025 shgov shstratum)	Survey report p. 234
PAPFAM	2007	Libya	1065 PSU	District (22)	Clonevar strata=shabia	Survey report p.215
PAPFAM	2014	Libya	1100 PSU	District (21)	Clonevar strata=district	Survey report p.135
DHS	2007	Mauritania	440 PSU	Rural/urban; wilaya (13)	Egen strata=group(hh6aw hh6)	Survey report p. 134
MICS	2015	Mauritania	440 PSU	Rural/urban; wilaya (13)	Egen strata=group(hh6 hh7)	Survey report p.298
DHS	2003	Morocco	480 PSU	Rural/urban; regions (16)	Egen strata=group(hv024 hv025)	Survey report p. 207/208
PAPFAM	2011	Morocco	640 PSU	Rural/urban; regions (16)	Egen strata= group(qhregion qhmili)	Survey report p. 207
PAPFAM	2006	State of Palestine	not available	Not available	Not available	Not available
MICS	2014	State of Palestine	450 PSU	Rural/urban/camp; regions (17)	Egen strata=group(hh6 hh7a)	Survey report p. 204
MICS	2000	Sudan	720 PSU	Rural/urban/camp; regions (16)	Egen strata=group(hi7 hi6)	Survey report p.10
MICS	2014	Sudan	720 PSU	Rural/urban/camp; regions (16)	Egen strata=group(hh6 hh7)	Survey report p.254
PAPFAM	2001	Tunisia	349 PSU	Not available	Not available	Survey report p.208
MICS	2011	Tunisia	480 PSU	Rural/urban (central/peripherie); regions (9)	Egen strata=group(hh6a hh7)	Survey report p.135
PAPFAM	2003	Yemen	649 PSU	Not available	Not available	Survey report p.26
DHS	2012	Yemen	800 PSU	Rural/urban, governorates (21)	Egen strata= group (hv024 hv025); available in dataset	Survey report p.212

A. Education indicators

1. Years of education

The household questionnaire usually collects information on school attainment and attendance for all household members aged 5 and above. Given that education questions are linked to the line number of each household member, it is also possible to create variables for the highest education level or year of the parents, head of household, or other characteristics. In most surveys, the information on educational attainment is collected through a series of three questions:



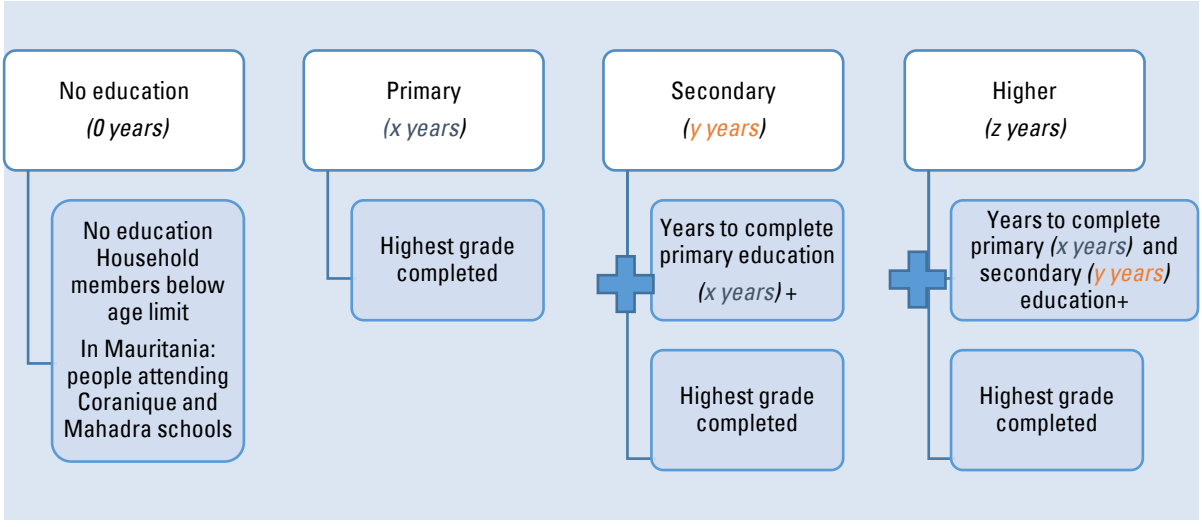
These three questions are the basis of the educational attainment indicators. It is important to disaggregate the questions on the highest class completed into three components: attendance, the highest level of schooling attended, and the highest grade completed at this level. Put in this way, the questions allow for the extraction of detailed information, not only on the highest class completed, but also on the highest level achieved. Thus, information on what percentage of the population has reached secondary schooling, for example, can be derived. All 24 household surveys include the first two questions. However, information on the highest class completed at this level was not collected in the following four surveys:

- PAPFAM Tunisia 2001;
- PAPFAM Yemen 2003;
- PAPFAM Libya 2007;
- PAPFAM Morocco 2011.

For the State of Palestine 2006, no primary sampling unit (PSU) variable is available from the dataset. Thus, the weighted years of education cannot be calculated.

Information on educational attainment is available for seven countries across two points in time. The information is utilized to generate the years of education completed for each household member aged 5 and above. The variable *edu_level* is coded to reflect the highest level of education that each household member attended, according to a country-specific classification. Members below the lower age limit for the education questions are coded with 0 years of education. Figure 1 shows the construction of the variable 'years of education' based on the information from the variables *edu_level* and *eduhighyear* and the information on the education system. As each country has its own specific categorization of education, table 3 gives an overview of the education systems of the countries at the time of the survey, as classified by the UNESCO Institute for Statistics (UIS) database and the number of years associated with each education level (primary==x; secondary==y and higher education==z).

Figure 1. Description of calculation of years of education



To calculate the years of education, some standard rules are applied in dealing with missing and inconsistent data, as follows:

1. If the highest grade achieved in one educational level is missing or unknown, it is assumed that the previous level has been completed and the highest possible grade from the previous level is assumed (i.e. six years of education is assumed if the level reported is intermediate education but the highest grade completed in intermediate is missing).
2. If the age of the household members is greater or equal to the years of education, years of education are considered missing.

Any modifications that go beyond these two standard rules are explained in table 3. In some countries, non-standard forms of education are present, as follows:

- In Mauritania, education in Coranique and Mahadra schools is a common phenomenon. However, this education is not considered formal education and is thus not considered in the calculation of the average years of education. Thus, the average years of schooling is also lower than, for example, reported in the Human Development Index (HDI) average years of schooling.
- In State of Palestine 2006, only the calculated years of education and level of schooling are available. Thus, the available years of education completed per person available from the dataset is used.

In general, non-standard curricula like in the Sudan are not considered part of formal education.

Table 3. Classification of national education systems into years of education

Survey	Year	Country	No education	Primary level	Secondary level (=years of primary education + highest grade of secondary level)	Highest level (=years of primary and secondary education+ highest grade of higher level)	Range eduyears
PAPFAM	2002	Algeria	• All household members below age 6; • All household members that never attended school.	Primaire	Six years of primary education + Moyen (0-3 grades) + Secondaire (0-3 grades)	12 years of secondary education + Superieure (0-14 grades)	0-26
			The educational levels Moyen and Secondaire have up to 4 grades, although only 3 grades are reported in the UNESCO system. However, four grades are accounted for HH members above the age of 14 (for Moyen)/17 (Secondaire), i.e. the age when they could have completed 4 grades in the respective level. If the highest grade achieved in one educational level is missing or unknown, the highest grade achieved in the previous level is assumed (i.e. 6 years for Moyen, 9 years for Secondaire and 12 years for Superieure.				
MICS	2012	Algeria	• All household members below age 5; • All household members that never attended school.	Primaire	Five years of primary education + Moyen (0-4 grades) + Secondaire (0-3 grades)	12 years of secondary education + Supérieur (0-12 grades)	0-24
			The educational level Primaire has up to seven grades. However, in line with the Multidimensional Poverty Index (MPI) calculations for years of education and the UNESCO system, grades 6/7 at the primary level are accounted as completed primary (i.e., five years of education).				
MICS	2000	Comoros	• All household members below age 6; • All household members that	Primaire	Six years of primary education + Secondaire (0-7 grades)	13 years of secondary education + Supérieur (0-4 grades)	0-17

Survey	Year	Country	No education	Primary level	Secondary level (=years of primary education + highest grade of secondary level)	Highest level (=years of primary and secondary education+ highest grade of higher level)	Range eduyears
			never attended school; • Programme non-formel.				
			All educational levels have up to eight grades. However, in line with the UNESCO system, the primary level considers only grades 1-6, secondary 0-7, and higher education 0-4.				
MICS	2012	Comoros	• All household members below age 4; • All household members that never attended school.	Primary	Five years of primary education + Secondary (0-7 grades)	12 years of secondary education + Higher (0-10 grades)	0-22
			Available from DHS Dataset. See DHS Recode Manual, p. 95 for information on the DHS methodology to calculate years of education.				
DHS	2000	Egypt	• All household members below age 6; • All household members that never attended school.	Primary	Six years of primary education + Secondary (0-8 grades)	12 years of secondary education + Higher (0-10 grades)	0-22
			Available from DHS Dataset. See DHS Recode Manual, p. 95 for information on the DHS methodology to calculate years of education.				
DHS	2014	Egypt	• All household members below age 6;	Primary	Six years of primary education + Secondary (0-8 grades)	12 years of secondary education + Higher (0-11 grades)	0-23

Survey	Year	Country	No education	Primary level	Secondary level (=years of primary education + highest grade of secondary level)	Highest level (=years of primary and secondary education+ highest grade of higher level)	Range eduyears
			• All household members that never attended school.				
			Available from DHS Dataset. See DHS Recode Manual, p. 95 for information on the DHS methodology to calculate years of education.				
MICS	2000	Iraq	• All household members below age 6; • All household members that never attended school; • Non-standard curriculum.	Primary	Six years of primary education + Secondary (0-6 grades)	12 years of secondary education + Higher (0-4 grades)	0-16
			The educational level 'Non- standard curriculum' (0-6 grades) is not considered formal education (following the methodology of MICS 2011). Grades 5/6 at the higher level are considered as completed higher education (i.e., 12 years of education).				
MICS	2011	Iraq	• All household members below age 5; • All household members that never attended school; • Non-standard curriculum.	Primary	Six years of primary education + Secondary (0-6 grades)	12 years of secondary education + Diploma (0-5 grades) + Bachelor (0-6 grades) and 16 years of higher education + Higher Studies (0-4 years)	0-20

Survey	Year	Country	No education	Primary level	Secondary level (=years of primary education + highest grade of secondary level)	Highest level (=years of primary and secondary education+ highest grade of higher level)	Range eduyears
			The educational level "Non- standard curriculum" (0-6 grades) is not considered as formal education (following the methodology of the MPI Calculations).				
DHS	2002	Jordan	• All household members below age 6; • All household members that never attended school.	Primary	Six years of primary education + Secondary (0-6 grades)	12 years of secondary education + Higher (0-8 grades)	0-20
			Available from DHS Dataset. See DHS Recode Manual, p. 95 for information on the DHS methodology to calculate years of education.				
DHS	2012	Jordan	• All household members below age 6; • All household members that never attended school.	Primary	Six years of primary education + Secondary (0-6 grades)	12 years of secondary education + Higher (0-8 grades)	0-20
			Available from DHS Dataset. See DHS Recode Manual, p. 95 for information on the DHS methodology to calculate years of education.				
PAPFAM	2007	Libya	Not available.				
PAPFAM	2014	Libya	• All household members below age 6; • All household members that	Basic	Nine years of basic education + Secondary (0-3 grades) + Secondary Technical (0-3 grades)	12 years of secondary education + Higher (0-7 grades)	0-19

Survey	Year	Country	No education	Primary level	Secondary level (=years of primary education + highest grade of secondary level)	Highest level (=years of primary and secondary education+ highest grade of higher level)	Range eduyears
			never attended school.				
			The mapping of national educational levels into corresponding ISCED levels was done according to the following Excel file. Thus, the basic level consists of primary (six years) and lower secondary (three years). The secondary level is split into two tracks: the secondary general and the secondary technical tracks. Higher education starts at age 18. Household members who classified their level as 'Don't know' are considered having 0 years of education.				
DHS	2007	Mauritania	• All household members below age 6; • All household members that never attended school; • Coranique and Mahadra schools.	Primary	Six years of primary education + Secondary (0-6 grades)	12 years of secondary education + Higher (0-8 grades)	0-20
			Coranique and Mahadra schools are not considered formal education.				
MICS	2015	Mauritania	• All household members below age 6; • All household members that never attended school; • Coranique and Mahadra schools.	Primary	Six years of primary education + Secondary (0-7 grades)	13 years of secondary education + Higher (0-8 grades)	0-21
			Coranique and Mahadra schools are not considered formal education. The secondary schooling system was changed from 3+3 years to 3+4 years after 2007 (See following excel file).				

Survey	Year	Country	No education	Primary level	Secondary level (=years of primary education + highest grade of secondary level)	Highest level (=years of primary and secondary education+ highest grade of higher level)	Range eduyears
DHS	2003	Morocco	• All household members below age 6; • All household members that never attended school.	Primary	Six years of primary education + Secondary (0-7 grades)	12 years of secondary education + Higher (0-15 grades)	0-27
			Available from DHS Dataset. See DHS Recode Manual, p. 95 for information on the DHS methodology to calculate years of education.				
PAPFAM	2011	Morocco	Not available				
PAPFAM	2006	State of Palestine	• All household members below age 5; • All household members that never attended school.	Primary	Six years of primary education + Secondary (0-7 grades)	12 years of secondary education + Higher (0-14 grades)	0-26
			Highest level of education and years of education are available in the PAPAFAM dataset. The variable highest grade achieved at each level is missing in the dataset.				
MICS	2014	Palestine	• All household members below age 5; • All household members that never attended school.	Primary	Six years of primary education + Secondary (0-6 grades)	12 years of secondary education + Higher (0-13 grades)	0-25
			Primary level consists of six years of schooling, secondary of 3+3, and higher education has 0-13 grades.				

Survey	Year	Country	No education	Primary level	Secondary level (=years of primary education + highest grade of secondary level)	Highest level (=years of primary and secondary education+ highest grade of higher level)	Range eduyears
MICS	2000	Sudan	• All household members below age 5; • All household members that never attended school; • Non-standard curriculum.	Primary	Eight years of primary education + Secondary (0-4 grades)	12 years of secondary education + Higher (0-6 grades)	0-18
			Non Standard Curriculum is not considered as part of formal education.				
MICS	2014	Sudan	• All household members below age 5; • All household members that never attended school.	Primary	Eight years of primary education + Secondary (0-3 grades)	11 years of secondary education + University (0-6 grades) and 15 years of higher education + Higher than university (0 grades)	0-17
			Primary level consists of the three levels: elementary, primary, and *assas*, which range from 0-8 grades. The levels vocational training, general secondary, intermediate, high secondary, secondary, and intermediate diploma are considered as upper secondary education, and consist of between 0-3 grades. Higher education includes the levels university and above university. Above university does not include grades, thus 15 years of education are assumed.				
PAPFAM	2001	Tunisia	Not available.				
MICS	2011	Tunisia	• All household members below age 6; • All household members that	Primary	Six years of primary education + Secondaire (0-4 grades) + Format. Prof CAP/BTP/BTS (0-4 grades)	Nine years of lower secondary education + Lycée (0-4 grades) and 13 years of secondary education + Higher (Supérieur) (0-11 grades	0-24

Survey	Year	Country	No education	Primary level	Secondary level (=years of primary education + highest grade of secondary level)	Highest level (=years of primary and secondary education+ highest grade of higher level)	Range eduyears
			never attended school.				
			The educational levels Format. Prof CAP/BTP/BTS are all considered as lower secondary education.				
PAPFAM	2003	Yemen	Not available.				
DHS	2012	Yemen		Primary	Nine years of primary education + diploma before secondary (0-3 grades) + secondary (0-3 grades)	12 years of secondary education + Diploma before university (0-3 grades) +Diploma (0-6 grades)	0-18
			The primary level includes the educational levels primary and fundamentals.				

Note: Comparing one level of education with another across countries is not straightforward since content and curriculums vary. To address this issue, a mixed approach is applied utilizing, on the one hand, years of schooling to define levels in a comparable manner following the International Standard Classification of Education (ISCED). According to ISCED, basic education corresponds to the first nine years of formal schooling, and is made of two levels distinguished as level 1 (primary: first six years of schooling) while the remaining three years should correspond to level 2 (lower secondary). The other indicator is 'completion of secondary education' using the national definition where the majority of education systems consist of 12 years of education. In Mauritania and Tunisia it is 13.

2. Net attendance ratios

Most surveys also ask more detailed questions to assess the current school attendance of the population aged 5-24. Usually, MICS and PAPFAM surveys also collect detailed information about the school attendance of the previous years and pre-primary education. Thus, for children of school age, the school attendance ratio can be obtained and can be broken down by sex, age, area of residence, and wealth quintile of the child's household, and reveal disparities that might have been concealed by the national average. Most of the surveys have information on whether household members aged 5 (sometimes aged 6) or older have ever attended school, and if they have, what was the highest level attended and the highest grade completed in that level.

Based on this information, it is possible to construct the net attendance ratios (NAR) for primary and secondary schooling. The NAR for primary schooling is defined as: the total number of students of the official primary school age group who attended primary or secondary education at any time during the reference academic year, expressed as a percentage of the corresponding population. It is calculated by dividing the total number of students in the official primary school age range who attended primary or secondary education at any time during the reference academic year by the population of the same age group, and multiplying the result by 100. The age range for the net attendance ratios follows the national definitions of primary or basic schooling of the respective country. The ratio is called an adjusted ratio as it considers students attending secondary education.

Furthermore, the primary and secondary completion rate is calculated. It is defined as: the percentage of a cohort of children or young people aged 3-5 years above the intended age for the last grade of each level of education who have completed that grade. The intended age for the last grade of each level of education is the age at which pupils would enter the grade if they had started school at the official primary entrance age, had studied full-time and had progressed without repeating or skipping a grade. It is calculated by taking the share of persons in the relevant age group who have completed the last grade of the given level of education out of the total population (in the survey sample) of the same age group.

There is one caveat when dealing with education data in household surveys: the data collection period may not always be aligned with the academic year. This can create distortions in the age data used to calculate education indicators. Education systems generally define the intended or 'official' ages for a given level of education based on the age of the child at the beginning of the academic year. Thus, the reference date for ages is the start month of the academic year. However, household surveys sometimes collect data on the educational status and age of children many months after the start of the school year. Thus, the reference date for age information is the date when the survey data were collected, which means it varies among households. Taking into account the gap between the start of the school year for which attendance data are collected and the date on which the survey was carried out is crucial for accurate calculation of education indicators. The methodology follows the UIS measure to reduce errors. Depending on the number of months between the start of the academic reference year and the time of survey data collection, different corrections are applied to calculate the exact age of each person at the beginning of the academic year, as follows:

- When information is available on the birth month and year of school-age children, age data are recoded to the age at the start of the academic reference year;

- If age is available in full years only, and data for the majority of observations were collected six or more months after the start of the school year, one full year is subtracted from the age recorded during data collection (adjusted age = recorded age – 1). For example, if the school year starts on 1 September and data for the majority of observations were collected in March of the following year or later, the ages will be adjusted;
- If only the age in years is available, and data for the majority of observations were collected five months or less after the start of the school year, age data are used as recorded. For example, if the school year starts on 1 September and data for the majority of observations were collected during the period up to February of the following year, the recorded ages are used without adjustment;
- Some surveys already provide a variable called "schage" which is the age of the child at the beginning of the respective school year.

Table 4 shows the age ranges for the primary/secondary net attendance ratios and the associated age ranges and adjustment methods (if applicable). The following surveys did not collect the necessary information to calculate the indicators:

- Comoros 2000;
- Jordan (both points in time);
- Morocco 2011;
- State of Palestine 2006;
- Tunisia 2001;
- Yemen 2003.

Table 4. Net attendance ratio and completion rate: official age ranges and adjustments

Survey	Year	Country	Primary NAR		Secondary NAR		Compl Prim Age		Compl Sec Age		Acadmic Year		Data Collection		Adjustment
			Age	Age	Age	Age	Age	Age	Age	Age	Start	End	Start	End	
PAPFAM	2002	Algeria	6	11	12	17	14	16	20	22	Sep	Jun	21 Sep 02	30 Nov 02	Not necessary
MICS	2012	Algeria	6	10	11	17	13	15	20	22	Sep	Jun	21 Oct 12	31 Jan 13	Not necessary, schage available
MICS	2000	Comoros	-	-	-	-	14	16	20	22	Sep	Jun	05 Oct 00	20 Nov 00	No NAR; only completion
MICS	2012	Comoros	6	11	12	18	14	16	21	23	Sep	Jun	20 Aug 12	05 Dec 12	Not necessary
DHS	2000	Egypt	6	10	11	16	13	15	19	21	Sep	Jun	Feb 00	Apr 00	Not necessary
DHS	2014	Egypt	6	11	12	17	14	16	20	22	Sep	Jun	10 Apr 14	30 Jun 14	Yes, schage available
MICS	2000	Iraq	7	12	13	17	15	17	20	22	Sep	Jun	Oct 00	Dec 00	Not necessary
MICS	2011	Iraq	6	11	12	17	14	16	20	22	Sep	Jun	13 Feb 11	09 May 11	Yes, schage available
DHS	2002	Jordan	6	11	12	17	14	16	20	22	Sep	Jun	1 Jul 02	30 Sep 02	No NAR; only completion
DHS	2012	Jordan	6	11	12	17	14	16	20	22	Sep	Jun	9 Sep 12	20 Dec 12	No NAR; only completion
PAPFAM	2007	Libya	6	11	12	17	-	-	-	-	Sep	Jun	Mai 07	Oct 07	Age adjustment; adjusted age = recorded age – 1

Survey	Year	Country	Primary NAR		Secondary NAR		Compl Prim Age		Compl Sec Age		Acadmic Year		Data Collection		Adjustment
PAPFAM	2014	Libya	7	12	13	18	15	17	21	23	Sep	Jun	Jan 14	Mar 14	Not necessary
DHS	2007	Mauritania	6	11	12	17	14	16	20	22	Sep	Jun	May 07	Sep 07	Yes, adjusted age = recorded age –1
MICS	2015	Mauritania	6	11	12	18	14	16	21	23	Sep	Jun	Jul 15	Nov 15	Yes, schage available
DHS	2003	Morocco	6	11	12	17	14	16	20	22	Sep	Jun	Oct 03	Feb 04	Not necessary
PAPFAM	2011	Morocco	6	11	12	17	14	16	20	22	-	-	Nov 11	Feb 12	No NAR
PAPFAM	2006	State of Palestine	6	9	10	17	12	14	20	22	Sep	Jun	1 Dec 06	20 Jan 07	No NAR; only completion
MICS	2014	State of Palestine	6	9	10	17	12	14	20	22	Sep	Jun	Mar 14	Apr 14	Yes, schage available
MICS	2000	Sudan	5	12	13	16	15	17	19	21	Jun	Mar	30 Jul 00	Aug 00	Not necessary
MICS	2014	Sudan	6	13	14	16	16	18	19	21	Jun	Mar	10 Sep 14	30 Oct 14	Not necessary, but schage available
PAPFAM	2001	Tunisia	-	-	-	-	-	-	-	-	-	-	1 Jun 02	01 Aug 02	No NAR
MICS	2011	Tunisia	6	11	12	18	14	16	21	23	Sep	Jun	Dec 11	Apr 12	Not necessary, but schage available
PAPFAM	2003	Yemen	-	-	-	-	14	16	-	-	-	-	14 Dec 02	06 Jan 03	No NAR
DHS	2012	Yemen	6	11	12	17	14	16	20	22	Sep	Jun	14 Sep 13	23 Nov 13	Not necessary

Below are further indicators that can be constructed from the datasets.

Table 5. Additional education indicators

Education in the household	No household member has completed 6/9/12 years of education
Never been to school	Percentage of children 6-15 years that have never been to school
Educational achievement (secondary)	Percentage of population that have entered secondary education (as per national definition) by age groups (19-24; 25-34; 35-44; 45-54; 55-64; 65-74; 75+)
Educational achievement (tertiary)	Percentage of population that have entered tertiary education (university degree) by age groups (25-34; 35-44; 45-54; 55-64; 65-74; 75+)

Table 6. Definition of the educational achievement indicators

Survey	Year	Country	compl_years	compl_sec	compl_ter
PAPFAM	2002	Algeria	6/9/12/15/17 years or more of education for population older than age 12/14/17/20/22	Population older than age 17 that has entered secondary level education or higher	Population older than age 22 that has entered tertiarty level education
MICS	2012	Algeria	"" ""	"" ""	"" ""
MICS	2000	Comoros	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 18 that has entered secondary level education or higher	Population older than age 23 that has entered tertiary level education
MICS	2012	Comoros	"" ""	" ""	"" ""
DHS	2000	Egypt	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 17 that has COMPLETED secondary level education or higher	Population older than age 22 that has entered tertiary level education
DHS	2014	Egypt	"" ""	Population older than age 17 that has COMPLETED secondary level education or higher	Population older than age 22 that has entered tertiary level education
MICS	2000	Iraq	6/9/12/15/17 years or more of education for population older than age 12/15/18/20/23	Population older than age 18 that has entered secondary level education or higher	Population older than age 23 that has entered tertiary level education

Survey	Year	Country	compl_years	compl_sec	compl_ter
MICS	2011	Iraq	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 17 that has entered secondary level education or higher	Population older than age 23 that has entered tertiary level education
DHS	2002	Jordan	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 17 that has COMPLETED secondary level education or higher	Population older than age 22 that has entered tertiary level education
DHS	2012	Jordan	"" ""	Population older than age 17 that has COMPLETED secondary level education or higher	Population older than age 22 that has completed tertiary level education
PAPFAM	2007	Libya	Years of Education not available	Population older than age 17 that has entered secondary level education or higher	Population older than age 22 that has entered tertiary level education
PAPFAM	2014	Libya	6/9/12/15years or more of education for population older than age 12/15/18/21	Population older than age 18 that has entered secondary level education or higher	Population older than age 22 that has entered tertiary level education
DHS	2007	Mauritania	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 17 that has entered secondary level education or higher	Population older than age 22 that has entered tertiary level education
MICS	2015	Mauritania	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 17 that has entered secondary level education or higher	Population older than age 22 that has entered tertiary level education
DHS	2003	Morocco	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 17 that has entered secondary level education or higher	Population older than age 22 that has entered tertiary level education
PAPFAM	2011	Morocco	Years of Education not available	Population older than age 17 that has entered	Population older than age 22 that has entered

Survey	Year	Country	compl_years	compl_sec	compl_ter
				secondary level education or higher	tertiary level education
PAPFAM	2006	State of Palestine	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 17 that has entered secondary level education or higher	Population older than age 22 that has entered tertiary level education
MICS	2014	State of Palestine	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 17 that has entered secondary level education or higher	Population older than age 22 that has entered tertiary level education
MICS	2000	Sudan	6/9/12years or more of education for population older than age 10/13/16	Population older than age 16 that has entered secondary level education or higher	Population older than age 21 that has entered tertiary level education
MICS	2014	Sudan	6/9/12years or more of education for population older than age 11/14/17	Population older than age 17 that has entered secondary level education or higher	Population older than age 22 that has entered tertiary level education
PAPFAM	2001	Tunisia	Not available	Not available	Not available
MICS	2011	Tunisia	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 18 that has entered secondary level education or higher	Population older than age 23 that has entered tertiary level education
PAPFAM	2003	Yemen	Not available	Population older than age 17 that has entered secondary level education	Population older than age 22 that has entered tertiary level education
DHS	2012	Yemen	6/9/12/15/17 years or more of education for population older than age 11/14/17/20/22	Population older than age 17 that has entered secondary level education	

B. Health indicators

The women's questionnaire and the questionnaires for children under the age of five offer detailed information on women's and children's health status, including anthropometric

measurement for all children under 5 and sometimes also for women aged 15-49/54. Maternal health is also an important health topic that is covered by all surveys. Furthermore, most surveys offer a full birth history which allows to calculate direct estimates of child mortality. Consequently, it is possible to investigate inequality in health and nutrition outcomes by sex, area, wealth quintile, and further socio-economic characteristics for the following indicators:

- Nutrition indicators (stunting, wasting, and underweight) for children age 0-59 months old. These indicators are available for all surveys except for one (Tunisia 2002);
- Information about immunization of children age 0-4 is available in all 24 surveys.

1. Children's health: nutrition indicators

Nutrition indicators are calculated using the child growth standards of the World Health Organization (WHO) to identify severe acute malnutrition in infants and children, and uses the raw information provided in the data files to calculate those indicators.

If a date of the child age in months is available, the provided age in months is used. Otherwise, the age in months is calculated according to CMC following the DHS methodology. Furthermore, the following rules are applied for handling missing or incomplete data:

- Children who were not weighed and measured and children whose values for weight and height were not recorded are excluded from both the denominators and the numerators;
- Children whose month or year of birth are missing or unknown are flagged and excluded from both the denominators and the numerators;
- Children whose day of birth is missing or unknown are assigned day 15 (if day of birth has been collected);
- Children who are flagged for out-of-range z-scores or invalid z-scores are excluded from both the denominator and the numerators.

Table 7. Definition of the nutrition indicators

Stunted children (Height for age)	Children whose height-for-age measures are below minus two standard deviations (-2 SD) from the median of the reference population are considered short for their age, or stunted (reflects chronic malnutrition)
Wasted Children (Weight for height)	Children whose weight-for-height measures are below minus two standard deviations (-2 SD) from the median of the reference population are considered too thin for their height, or wasted (reflects acute malnutrition)
Underweight Children (Weight for age)	Children whose weight-for-age measures are below minus two standard deviations (-2 SD) from the median of the reference population are underweight for their age (reflects chronic or acute or a combination of both)
Overweight	Children whose weight-for-age measures are above two standard deviations (+2 SD) from the median of the reference population are overweight

Nutrition indicators (weight and height) for women aged 15-49 are only available for three countries (Egypt, Jordan, Yemen; all time periods). Three other surveys (Algeria 2002; Comoros 2012; Morocco 2003) offer nutrition indicators for one point in time.

While wasting and underweight can be treated, chronic malnutrition (stunting) in the early childhood has severe and irreversible effects: it increases the likelihood of children dying from common infections, as well as the frequency and severity of infections, and contributes to delayed recovery (UNICEF and others, 2018). Further, it is associated with impaired cognitive ability and reduced school and work performance (United Nations Department of Economic and Social Affairs, 2018). Undernutrition contributes to nearly half of all deaths in children under 5, translating into the loss of about 3 million young lives a year (International Food Policy Research Institute, 2016).The following analysis considers only inequalities in stunting across time, as this is an irreversible event and has lifelong impacts. Analyzing wasting and underweight as well in detail would be beyond the scope of this report.

2. Children's health: mortality indicators and others

The estimates of child mortality are obtained using 'synthetic cohort life table approach' developed by DHS. In this approach, mortality probabilities from small age segments based on real cohort mortality experience are combined into the more common age segments. This approach is also applied to the MICS and PAPFAM surveys. To provide stable estimates for smaller subgroups, the 10-year period before the survey is used when the data is disaggregated by several socioeconomic characteristics, such as area, sex, wealth, or poverty. For more information on this approach, see the DHS Guide to Statistics (2012) or Croft (1991). Direct estimates of child mortality (table 8) can be calculated for all surveys with a full birth history. Only four surveys (Sudan, Iraq, Comoros, 2000; Mauritania 2007) do not have a full birth history but only a summary birth history.

Table 8. Child mortality indicators

Neonatal mortality	Probability of dying within the 1st month of life
Infant mortality	Infant mortality– the probability of dying before the 1st birthday
Postneonatal mortality	Postneonatal mortality– the difference between infant and neonatal mortality
Under-five mortality	Under-five mortality– the probability of dying before the fifth birthday
Child mortality	Child mortality– the probability of dying between the 1st and 5th birthdays

3. Maternal health indicators

All three types of surveys offer an extensive range of information on maternal health and related issues. The most common indicators across all 24 surveys are related to antenatal care coverage and quality of antenatal care, as well as attendance at delivery and postnatal care. Antenatal care coverage (as percentage of women aged 15–49 years that attended antenatal care check-ups by any provider) is available for almost all countries across two points in time. Only two surveys (Mauritania 2007; Sudan 2000) do not include information on the number of visits. Information on

attendance of skilled personnel at birth is available for all surveys except for one (Morocco; 2003). Information on postnatal care coverage is also available for all countries except for six surveys (Iraq and Mauritania; both points in time; Comoros and Sudan, both 2000). However, the way to measure postnatal care needs to be specified further as the questions in the questionnaires differ a lot. In general, the surveys have been harmonized to ensure comparability across time. Thus, all DHS surveys have been adjusted to reflect the same reference periods, the two years preceding the survey, for the maternal health indicators.

Table 9. Maternal health indicators

Antenatal care - number of visits	Percent of women aged 15-49 years with a live birth in a given time period who received antenatal care, four times or more during the last pregnancy
Antenatal care - skilled provider	Percentage of women with a live birth in a given time period receiving antenatal care from a skilled provider during the last pregnancy
Skilled attendance at birth	Percent of live births attended by skilled health personnel during a specified time period.
Child pregnancy (before age 15)	Percentage of women aged 20 to 24 that had a live birth before the ages 15/18
Child pregnancy (before age 18)	Percentage of women aged 20 to 24 that had a live birth before the ages 18
Child marriage	Percentage of women aged 20 to 24 that got married before the age of 18
Child pregnancy (before age 18, women younger than 28)	Percentage of women younger than 28 that had a live birth before the age of 18
Female genital mutilation (FGM)/cutting	Percent of women aged 15-49 years who have undergone FGM/cutting.

The indicator 'skilled attendance at birth' is analysed in detail in the 2019 report entitled Rethinking Inequality in Arab Countries. The availability of skilled health personnel during birth is essential for both mothers and newborns, and is an important and lifesaving intervention. The definition of skilled health personnel follows the national definition of each country, as described in table 10, and includes personnel trained in providing lifesaving obstetric care, including giving the necessary supervision, care and advice to women during pregnancy, labour and the post-partum period, conducting deliveries on their own, and caring for newborns. Due to the structure of the PAPFAM questionnaire, it has to be assumed that skilled personnel were present if the birth took place in certain institutions (table 10) in four surveys (Algeria 2002, Libya 2007 and 2014, Yemen 2003).

Table 10. National definition of 'skilled health personnel' for the indicator 'skilled attendance at birth'

Survey	Year	Country	Skilled attendance at birth – National Definition of "skilled health personnel"
PAPFAM	2002	Algeria	Medecin; sage-femme/infirm.; due to the data structure of the PAPFAM survey, it is be assumed that skilled personnel was present if birth took place in a hospital/ maternite, polyc. /centre sante, or clinique privee.
MICS	2012	Algeria	Médecin généraliste; infirmière / sage-femme; médecin
MICS	2000	Comoros	Medecin accouchement; sage-femme/infirmiere accouchement; auxiliaire medecin accouchement
MICS	2012	Comoros	Doctor, nurse, midwife
DHS	2000	Egypt	Doctor, nurse, midwife
DHS	2014	Egypt	Doctor, nurse, midwife
MICS	2000	Iraq	Doctor, nurse/midwife, auxiliary midwife
MICS	2011	Iraq	Doctor private/public; nurse/midwife
DHS	2002	Jordan	Doctor; nurse/midwife
DHS	2012	Jordan	Doctor; nurse/legal midwife
PAPFAM	2007	Libya	Due to the data structure of the PAPFAM survey, it is be assumed that skilled personnel was present if birth took place in public hospital or health institution, public health centre, private hospital or health institution, doctors clinic
PAPFAM	2014	Libya	Due to the data structure of the PAPFAM survey, it is be assumed that skilled personnel was present if birth took place in public hospital/institution, public health centre, private hospital/institution; private doctor
DHS	2007	Mauritania	Medecin; infirmiere/sage-femme; sage-femme auxiliaire
MICS	2015	Mauritania	Médecin; sage-femme; infirmière
DHS	2003	Morocco	Doctor; nurse/midwife
PAPFAM	2011	Morocco	Médecin; infirmiére/accoucheuse; accoucheuse traditionnelle,
PAPFAM	2006	State of Palestine	General practitioner, specialist, staff nurse/midwife
MICS	2014	State of Palestine	Doctor; nurse/midwife
MICS	2000	Sudan	Not available
MICS	2014	Sudan	Doctor; nurse/midwife; health visitor; trained midwife
PAPFAM	2001	Tunisia	Medicin; sage fem
MICS	2011	Tunisia	Medicin; sage fem; sage-femme auxiliaire

Survey	Year	Country	Skilled attendance at birth – National Definition of "skilled health personnel"
PAPFAM	2003	Yemen	Due to the data structure of the PAPFAM survey, it is be assumed that skilled personnel was present if birth took place in a public hospital or clinic, public health centre, primary health care unit, private hospital or clinic, hospital/clinic/NGO centre Doctor; nurse/midwife
DHS	2012	Yemen	Doctor; nurse/midwife

Information on maternal mortality is only available in three countries, namely Comoros, Mauritania, and Yemen. The information in the surveys also allow us to investigate the degree of inequality between rich and poor (as measured by the wealth index) with regard to harmful practices against children and women. Parsons and others (2015) give an overview of literature on economic impacts of child marriage, and find that education and socioeconomic status are linked to child marriage. Furthermore, child marriage is more likely in poor families that have fewer resources and chances to provide alternative options for girls. UNDP (2016) also finds significant differences between rural and urban areas with regard to child marriage, gender-based violence and practices such as FGM. The following indicators can be investigated:

- Prevalence of child marriage (marriage before the age of 18 or the minimum legal age). Information on the age at first marriage is available in all surveys except for two (Iraq, 2000; Sudan, 2000);
- Prevalence of child pregnancy. The age at first pregnancy is available in all 24 surveys.

Information on FGM/cutting (is available for four countries (Egypt, Mauritania, Sudan, and Yemen; two points in time). Two more surveys (Libya 2014; Iraq 2011) also have information on FGM.

C. Living standard indicators

As mentioned above, the household questionnaire also collects information on a household's characteristics. This information is used in measurements of multidimensional poverty to capture the living standards of a household. Multidimensional poverty indices are usually also based on DHS, MICS and PAPFAM surveys. Thus, the following indicators of multidimensional poverty indices (using the definition of the Arab MPI) can be analysed:

- The asset indicator. Information on assets is available in all surveys except for two (Iraq 2000; Mauritania 2007);
- The overcrowding indicator: information on either the number of rooms or sleeping rooms or both is available in all surveys;
- Type of dwelling. Information on the kind of dwelling and whether it is owned or rented is available across two points in time in eight countries (Yemen, Palestine, Libya, Jordan, Iraq, Egypt, Comoros, and Algeria). Most other surveys have partial information. Only the

early MICS surveys (Comoros, Iraq and Sudan, 2000) do not have any information on the type of dwelling or its property status;

- The water and sanitation indicators: information on water and sanitation is in general also available in all surveys. However, in some of the older surveys, parts of the definition of the MPI indicators is missing (i.e. time to get water, water piped into courtyard, shared toilet), which makes comparability difficult.

1. Definition of improved source of drinking water and safe sanitation

Figure 2. Classification of drinking water (left) and safe sanitation (right) technologies

First level classification	Second level classification	Improved	Unimproved
Tap water	Piped water into dwelling	X	
	Piped water to yard/plot	X	
	Public tap, standpipe	X	
	Other	X	
Ground water	Tubewell, borehole	X	
	Protected well	X	
	Protected spring	X	
	Unprotected well		X
	Unprotected spring		X
Rainwater	Covered cistern/tank	X	
	Uncovered cistern/tank	X	
Packaged water*	Bottled water	X	
	Sachet water	X	
Delivered water*	Cart with small tank/ drum	X	
	Tanker truck provided	X	
Surface water	River		X
	Lake		X
	Dam		X
	Pond		X
	Stream		X
	Irrigation channel		X
Other	Other improved	X	
	Other unimproved		X
DK/Missing			X

*Packaged and delivered water were previously categorised as unimproved for MDG monitoring

First level classification	Second level classification	Improved	Unimproved
Flush toilets	to piped sewer system	X	
	to septic tank	X	
	to pit	X	
	to unknown place/not sure/DK	X	
	to open drain		X
	to elsewhere		X
Pour flush latrines	to piped sewer system	X	
	to septic tank	X	
	to pit	X	
	to unknown place/not sure/DK	X	
	to elsewhere		X
Dry latrines	Ventilated Improved Pit latrine	X	
	Composting toilets	X	
	Pit latrine with slab	X	
	Pit latrine without slab/ open pit		X
	Hanging toilet/hanging latrine		X
	Bucket latrine		X
No facility	Bush, field		X
Other	Other improved	X	
	Other unimproved		X
DK/Missing			X

Source: WHO/UNICEF, 2018.

Figure 2 describes the classification of different drinking water technologies and sanitation technologies into improved and unimproved sources of drinking water. Unimproved sources are unprotected sources of groundwater and surface water in general. The 24 household surveys differ slightly in the way that access to safe drinking water is capture. However, three indicators were constructed.

The first indicator is the indicator that measures acute poverty in the framework of MPI. In this indicator, members of the household are considered deprived in access to safe drinking water if the household does not have access to safe drinking water according to MDG guidelines, or safe drinking water is more than a 30-minute walk from home roundtrip.

"A household has improved drinking water supply if it uses water from sources that include: piped water into dwelling, plot or yard; public tap/ stand pipe; tube well/borehole; protected dug well; protected spring; rain water collection. s(...) Households using bottled water are only considered to be using improved water when they use water from an improved source for cooking and personal hygiene."[1]

The second indicator, which is also used as a measurement for poverty in the framework of MPI, measures whether the household has access to piped water into the dwelling/yard.

Regarding the sanitation indicator, a household is considered deprived of access to safe sanitation if the sanitation facility used is considered unimproved, or if it is improved but shared with other households. Table 11 presents an overview of the comparability of the indicators across time.

Table 11. Comparability of Water and Sanitation Indicators across time

			Water			Sanitation	
Survey	Year	Country	MDG definition comparable across time	MPI1 Acute poverty definition Comparable across time	MPI2 Poverty Definition Comparable across Time	information on shared toilet facility	Comparable across time
PAPFAM	2002	Algeria	Yes	No	Yes	Yes	Yes
MICS	2012	Algeria				Yes	
MICS	2000	Comoros	No	Yes	No	No	No
MICS	2012	Comoros				Yes	
DHS	2002	Egypt	Yes	Yes	Yes	Yes	Yes
DHS	2014	Egypt				Yes	
MICS	2000	Iraq	Yes	Yes	Yes	No	No
MICS	2012	Iraq				Yes	
DHS	2002	Jordan	Yes	No	Yes	No	No
DHS	2012	Jordan				Yes	
PAPFAM	2007	Libya	Yes	No	Yes	Yes	Yes
PAPFAM	2014	Libya				Yes	
MICS	2007	Mauritania	Yes	Yes	Yes	Yes	Yes
MICS	2015	Mauritania				Yes	
DHS	2003	Morocco	Yes	No	Yes	Yes	Yes
PAPFAM	2011	Morocco				Yes	
PAPFAM	2006	State of Palestine	Yes	No	Yes	Yes	Yes
MICS	2014	State of Palestine				Yes	
MICS	2000	Sudan	Yes	No	Yes	No	No

[1] UN-Habitat, 2010, ch. 1, pp. 16, 21.

			Water			Sanitation	
Survey	Year	Country	MDG definition comparable across time	MPI1 Acute poverty definition Comparable across time	MPI2 Poverty Definition Comparable across Time	information on shared toilet facility	Comparable across time
MICS	2014	Sudan				Yes	
PAPFAM	2001	Tunisia	No	No	No	Yes	Yes
MICS	2011	Tunisia				Yes	
PAPFAM	2003	Yemen	Yes	No	No	Yes	Yes
DHS	2013	Yemen				Yes	

2. Groups of extremes

The indicators can also be cross tabbed by several characteristics. As mentioned in table 1, most surveys are representative for rural/urban areas and on a subnational level. Furthermore, as the surveys collect data on socioeconomic characteristics, a cross tabulation by wealth quintile and decile is possible, as well as by household head's education. To include a gender-sensitive perspective, the data is disaggregated by sex whenever possible. To analyse inequalities across certain vulnerable groups, the analysis also looks into the part of the population that holds combinations of certain characteristics. We focus on two groups of extremes holding different characteristics, as defined below:

Group of extremes 1: Wealth and household head's education.

- The head of household has no education and the household is in the poorest wealth quintile (Deprived group 1);
- The head of household has higher education and the household is in the richest wealth quintile (Non-deprived group 1).

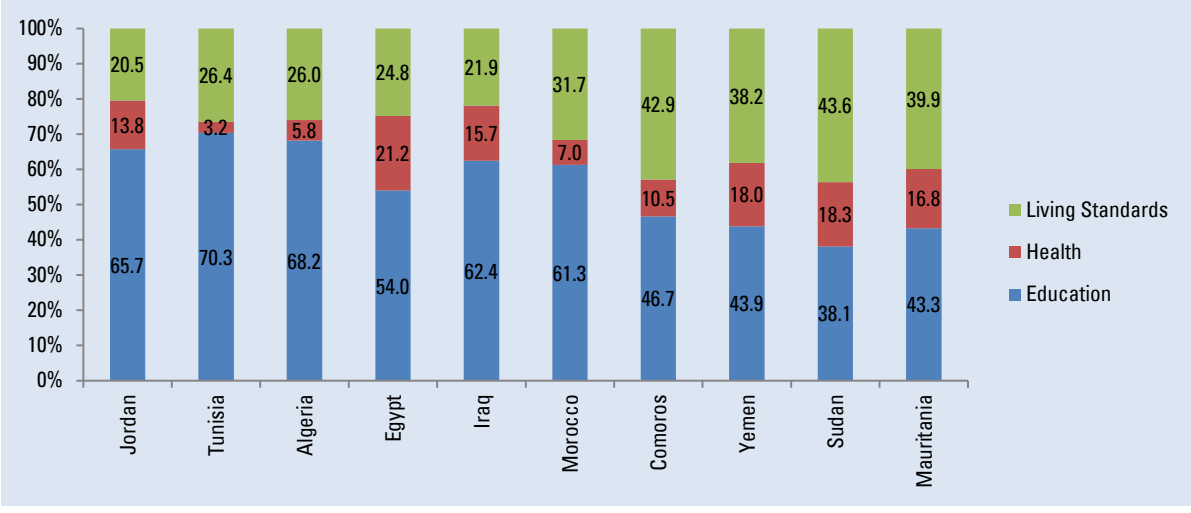
Group of extremes 2: Spatiality and household size.

- Household location is in a rural area and the household size exceeds seven persons (Deprived group 2);
- Household location is in an urban area and the household size is up to five persons (Non-deprived group 2).

Moreover, a cross tabulation by multidimensional poverty status is also possible. (See the full-results database for an exact definition of each indicator and all country specific comments, and the results of the indicators for the 24 surveys).

These two definitions were inspired by the results of the Arab MPI, where the highest contributors to poverty were education then living standards (figure 3).

Figure 3. Contribution of different dimensions to household poverty index (MPI)



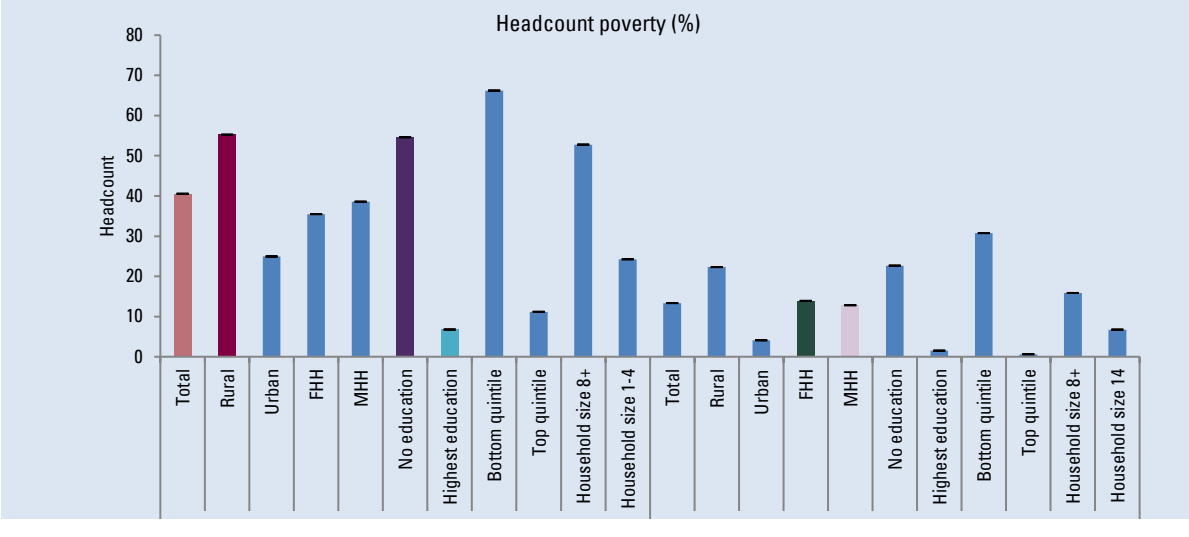
Source: Arab Multidimensional Poverty Report, 2017.

Inequality was shown to be high at four levels:

1. The spatial level (between rural and urban areas).
2. Household size.
3. Education of the head of household, or
4. The wealth quintile of the household.

Figure 4 summarizes these disparities.

Figure 4. Headcount poverty across household characteristics



Source: Arab Multidimensional Poverty Report, 2017.

Considering the average years of schooling, the poorest quintiles always have the lowest years of schooling (figure 5). This is also true for rural areas, which systematically have lower years of schooling (figure 6).

Figure 5. Average years of schooling by wealth quintile

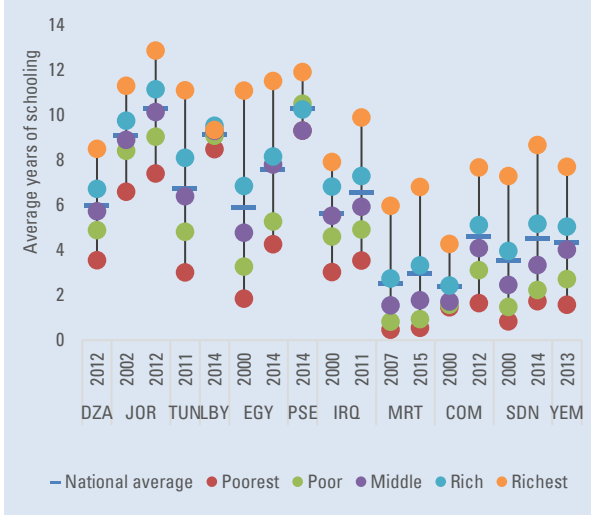
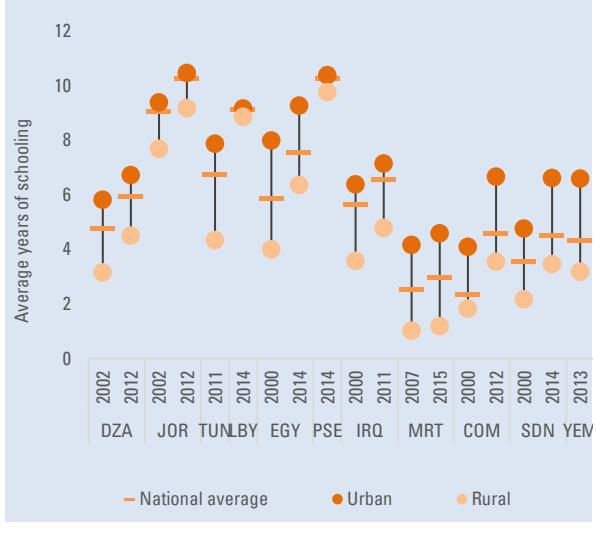


Figure 6. Average years of schooling by area



Source: ESCWA calculations.

Consequently, the years of schooling inequality ratios 'richest to poorest' and 'urban to rural' are always greater than 1. However, the change in these ratios over time shows that inequality in average years of schooling is constantly decreasing between rural and urban areas, while it may be increasing among rich and poor for some countries (figures 7 and 8). This finding makes it interesting to study the inequality trends of the groups with combined characteristics: education crossed with wealth quintiles, designated as 'Group of extremes 1'.

Figure 7. Years of schooling wealth inequality ratios

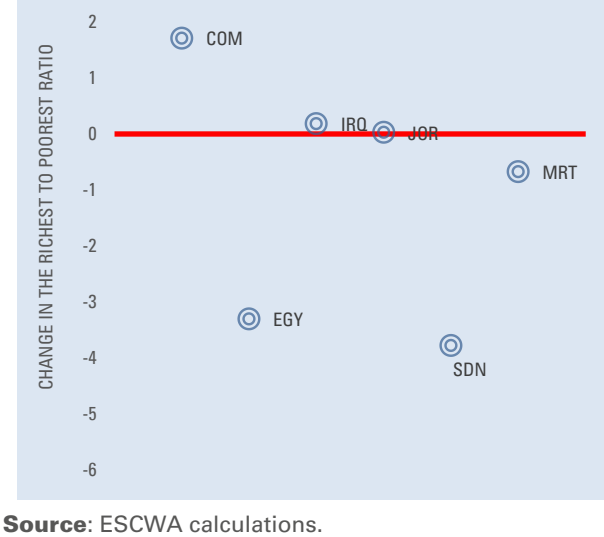
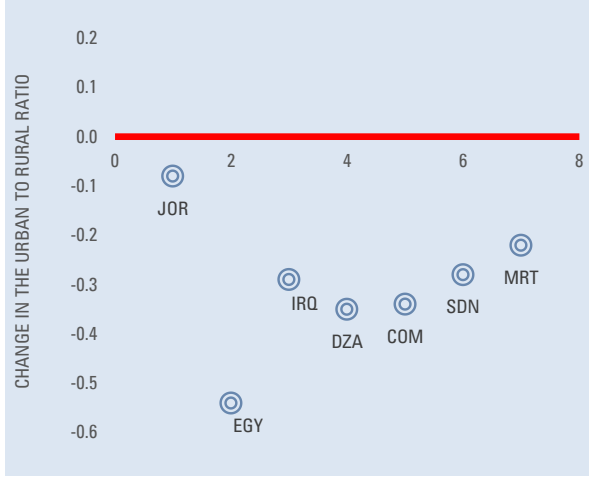


Figure 8. Years of schooling spatial inequality ratio



Source: ESCWA calculations.

This leaves a combination of the last two characteristics: rural/urban crossed with size of household. The upper and lower groups of such combined characteristics is called 'Group of extremes 2'.

D. Other indicators on economic activities of household members

surveys collect information for all household members. However, a range of surveys offer information on specific subgroups, such as women or children.

1. Child labour indicators

Indicators related to child labour are available for five countries (Comoros, Egypt, Iraq, Mauritania, and the Sudan) for both points in time, and for another five countries (Algeria, Libya, Mauritania, the State of Palestine, and Tunisia) for one point in time. Only Jordan and Yemen do not have any information on child labour. The child labour indicators are based on the UNICEF definition of child labour, which states that a child is considered to be involved in child labour activities under the following classification: children 5 to 11 years of age that during the week preceding the survey did at least one hour of economic activity or at least 28 hours of domestic work; and children 12 to 14 years of age that during the week preceding the survey did at least 14 hours of economic activity or 28 hours of household chores. Based on the available information, the following indicators in table 12 and their subcomponents can be calculated.

Table 12. Child labour indicators

Child labour, economic activity 1 hour or more, age 5-11	Children 5 to 11 years of age who during the week preceding the survey did at least one hour of economic activity
Child labour, domestic activity less than 28 h, age 5-11	Children 5 to 11 years of age who during the week preceding the survey did less than 28 hours of domestic work
Child labour, domestic activity 28h or more, age 5-11	Children 5 to 11 years of age who during the week preceding the survey did at least 28 hours of domestic work or more
Child labour, age 5-11	Children 5 to 11 years of age who during the week preceding the survey did at least one hour of economic activity or at least 28 hours of domestic work
Child labour, age 12-14	Children 12 to 14 years of age who during the week preceding the survey did at least 14 hours of economic activity or 28 hours of household chores.
Child labour, economic activity less than 14 hours, age 12-14	Children 12-14 years of age who during the week preceding the survey did less than 14 hours of economic activity
Child labour, economic activity 14h or more, age 12-14	Children 12-14 years of age who during the week preceding the survey did 14 hours of economic activity or more
Child labour, domestic activity less than 28 h, age 5-11	Children 12-14 years of age who during the week preceding the survey did less than 28 hours of domestic work
Child labour, domestic activity 28h or more, age 5-11	Children 12-14 years of age who during the week preceding the survey did at least 28 hours of domestic work

2. Employment indicators for women

Some surveys also offer information on the working status and occupation, mainly of women. Information on working status and occupation of women is available for two points in time for six countries (Algeria, Egypt, Jordan, Libya, Morocco and Yemen) and two more surveys have information on employment at one point in time (Comoros 2012; Tunisia 2001). Three countries (Sudan, State of Palestine, Iraq) do not have any information on the working status of women or household members. Algeria, Libya, Morocco and Yemen also include information about economic activities for all household members for both times in time, while three more surveys offer information about one point in time (Egypt, 2000; Mauritania, 2011; Tunisia 2001).

Table 13. Employment indicators for women

Current (i.e. in the seven days preceding the survey) employment of women age 15-49	Percentage of women age 15-49 who are currently employed, i.e. having done work in the past seven days.
Current occupation in professional, technical, and managerial positions or in clerical occupation, sales and services, and (un) skilled manual labour.	Percentage of women age 15-49 who are currently employed in professional, technical, and managerial positions or in clerical occupation, Sales and Services, and (Un) Skilled manual labour.
Women that are currently employed, by type of employer: self-employment	Percentage of women age 15-49 who are currently employed and self-employed
Women that are currently employed*, by type of employer: employed by someone	Percentage of women age 15-49 who are currently employed by someone (either family or someone else)

2. Measuring inequality and testing significance

A. Concentration curves: testing for significance of socioeconomic inequalities

The concentration curve (CC) and its related concentration index (CI) are a widely used tool to assess socioeconomic inequality and can be used to quantify the degree of socioeconomic-related inequality, mainly in health variables (O'Donnell and others, 2008). The CC ranks the sample of interest by socioeconomic status. The horizontal axis of the CC begins with the poorest individual and progresses through the wealth distribution to the richest individual. The concentration index summarizes the magnitude of inequality and is defined as twice the area between the concentration curve and the line of equality (45-degree line).

The health outcome variable should be ratio-scale measured without an upper bound. Health variables, however, are often measured as ordinal or cardinal variables and tend to be bounded which poses several limitations, especially when trying to do cross-country comparisons.

To simplify, the analysis reports the negative of the concentration index for indicators that report ill-health so that the concentration index is always positive and higher inequality is reflected in a higher value of the concentration index.

Nonetheless, there are still limitations to the CI. The main three limitations are listed below:

1. The CI may produce different ranking of countries depending on whether the variable measures inequality in terms of health or ill-health (Clarke and others, 2002). However, it is disputed whether this "mirror-property" is a desirable property of a socioeconomic health index (see Kjellson, Gerdtham and Petrie, 2015; and Bosmans, 2016).
2. The limits of the CI for binary variables are not necessarily -1 and 1 but depend on the mean health in the population (Wagstaff, 2005).
3. If the variable is categorical, the value and also the ranking of the CI depends on the scale of the health variable (Erreygers, 2009) and may be arbitrary.

If the overall prevalence is near 0 per cent or 100 per cent, the amount of variation across categories such as wealth quintiles or regions is necessarily low, but if the overall prevalence is near 50%, the amount of potential variation across categories can be very large. Corrections to the concentration index that take into account the mean of the outcome were first proposed by Wagstaff (2005) and Erreygers (2009). A correction is important because it allows for comparisons between countries with very different levels of the outcomes. Wagstaff (2005) and Erreygers (2009) proposed two modified versions of the concentration index to account for the limitations mentioned above. The modified index proposed by Erreygers (CI-E) corrected for the deficiency that the value of the index is not invariant to permissible transformations of ratio-scaled and cardinal variables. The index proposed by Wagstaff (CI-W) corrects for the deficiency that the range of the CI depends on the mean of the bounded variable and suggests rescaling the standard concentration index to ensure that the index lies between -1 and 1. Our analysis uses the modified index proposed by Wagstaff (2005) to account for equity in health outcomes. The CI-W has been estimated using the conindex command of Stata.

Difference with the 45-degree line

As suggested by Khaled, Makdissi, Tabri and Yazbeck (2018), testing if the concentration curve is different from the 45-degree line is the appropriate way to detect presence of socioeconomic health inequality. Unfortunately, their test which is based on non-parametric regression cannot be applied to non-continuous health variables like the binary variables we are using in this report. We have followed their insight and done the following thing.

Each survey is a sample of size n from which we construct the estimator of the concentration curve using:

Where $\hat{\mathrm{C}}(\mathrm{p}) = \frac{1}{\mathrm{n}}\sum_{\mathrm{i}=1}^{\mathrm{n}} 1\left(\mathrm{y_i} \leq \hat{\mathrm{F}}_{\mathrm{y}}^{-1}(\mathrm{p})\right)$.

$\mathrm{F}\hat{F}_y^{-1}(p)$ is the estimator of the pth quantile of income. We build the curve on a grid of 100 points (i.e. p = (0.01, 0.02, . . ., 0.99, 1)). This gives us an estimation of the concentration curve. We then construct a 95% confidence band using the following bootstrap procedure:

Repeat for b = 1, . . ., 999.

- Draw a sample of size n from the sample and compute the nonparametric estimator $\hat{C}(p)b$;
- For each p in the grid of point, the confidence band is defined by dropping the 2.5 per cent lowest and highest values.

This procedure allows us to generate all the graphs. If a part of the 45-degree line is out of the confidence band, then there is socioeconomic health inequality.

Testing for robust increase or decrease of socioeconomic health inequalities

For this exercise, we have two surveys (or two groups within the same survey) of size n_1 and n_2. For each sample, we have built a concentration curve and a confidence band using the procedure described above. This is how we get the graphs that you have in this section.

In addition, we have run a proper hypothesis testing using Khaled, Makdissi and Yazbeck (2018). This procedure can be easily described:

Denote the two samples by S_0 (observations from the first survey or the first demographic group in a survey) and S_1(observations from the second survey or second demographic group in the survey) respectively. Let S be the combined sample (note that this bootstrapped procedure pools together all the observations from the two samples). Let

$$\Delta\hat{C}_{01}(p) = \hat{C}_o(p) - \hat{C}_1(p).$$

and let $\hat{T} = \sqrt{\frac{n_o n_1}{n_0+n_1}}\ \mathrm{sup}_{\mathrm{p}}\Delta\hat{C}_{01}(p)$.

Repeat for $b = 1, \ldots, 999$.

- Draw a sample of size n_0 from S. Compute the nonparametric estimator $\hat{C}_{0b}(p)$;
- Draw a sample of size n_1 from S. Compute the nonparametric estimator $\hat{C}_{1b}(p)$;
- Compute $\Delta\hat{C}_{01b}(p) = \hat{C}_{0b}(p) .- \hat{C}_{1b}(p)$;
- Compute $\hat{\tau}_b = \sqrt{\frac{n_0 n_1}{n_0+n_1}}\ \sup_p \Delta\hat{C}_{01b}(p)$.

Using the sample $\hat{\tau}_b, \ldots, \hat{\tau}_{999}$, compute the bootstrap *p*-value.

$$\frac{1}{999}\sum_{b=1}^{999} 1(\hat{\tau}_b > \hat{\tau}).$$

1. Detecting the presence of socioeconomic health inequalities

When plotting the health concentration curve, one may wonder if this curve is significantly different from the 45-degree diagonal, line of perfect equality. Khaled, Makdissi, Tabri and Yazbeck (2018) explain that having a concentration index equal to 0 does not necessarily mean that there is no socioeconomic health inequality in this health indicator. In the appendix of their paper, the latter provide an interesting 10 persons example for which the health concentration index is 0 despite the presence of socioeconomic health inequality. One needs to make sure that the concentration curve has no portion that is significantly different from the line of equality.

From figure 9, one can see that the child stunting concentration curves for the Comoros, Egypt, Mauritania, Morocco, the Sudan and Yemen are all clearly significantly different from this line of inequality. If one looks carefully the child stunting concentration curves for Palestine, they also display some portions that are significantly different from the line of equality. This means that there are some socioeconomic inequalities in child stunting in all these countries.

For skilled birth attendance (figure 12), we have data for Egypt, Iraq, Mauritania and Morocco. For all these countries, the skilled birth attendance concentration curve is statistically significant from the line of equality. This means that there are socioeconomic inequalities in the distribution of skilled birth attendance in all these countries.

2. Evolution of socioeconomic health inequalities in child stunting

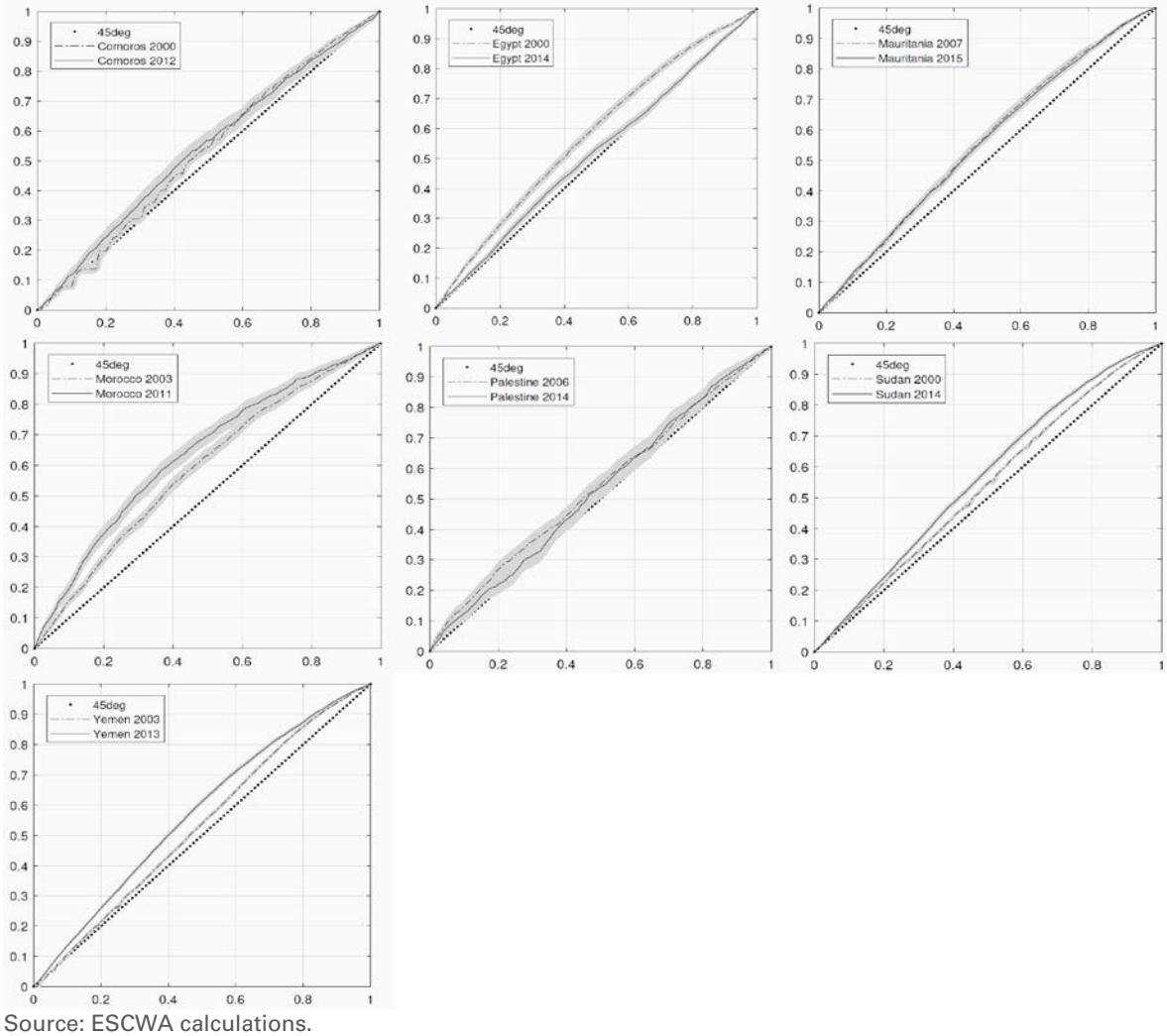
In addition to comparing concentration indices, the evolution of socioeconomic health inequalities can be monitored by comparing health concentration curves. Makdissi and Yazbeck (2014) proved that if the health concentration curves do not intersect, socioeconomic health inequalities will be lower for any rank dependent socioeconomic health inequality index in the population with the health concentration curve that is above the other. This means that it is impossible to find a mathematical form for the index that would reverse the result. The result is robust and does not depend on the specific mathematical form chosen for the index as it may be the case when reporting a change in the health concentration index.

In order to account for sampling variability, Khaled, Makdissi and Yazbeck (2018) propose methods to test for these dominance cases. These statistical tests consist in assessing if there are

some intervals for which one curve is significantly above the other while the reverse does not happen on any other interval. We opt for a level of statistical significance of 5 per cent for these tests.

Figure 9 displays the child stunting concentration curves and their 95 per cent bootstrapped confidence bands. We have three different cases when comparing the initial periods with the second point in time in these figures and when applying the statistical tests. For the Comoros, Morocco, Yemen and the Sudan, there is an increase of socioeconomic health inequalities in child stunting over that period. For the State of Palestine and Mauritania, there is no dominance of a curve over the other. This means that even if some indices may point at an increase of socioeconomic inequalities in child stunting, it is possible to construct other indices that will point to a decrease of socioeconomic inequalities in child stunting and vice versa. Finally, for Egypt, there is a robust decrease of socioeconomic health inequalities in child stunting over that period.

Figure 9. Child stunting concentration curves

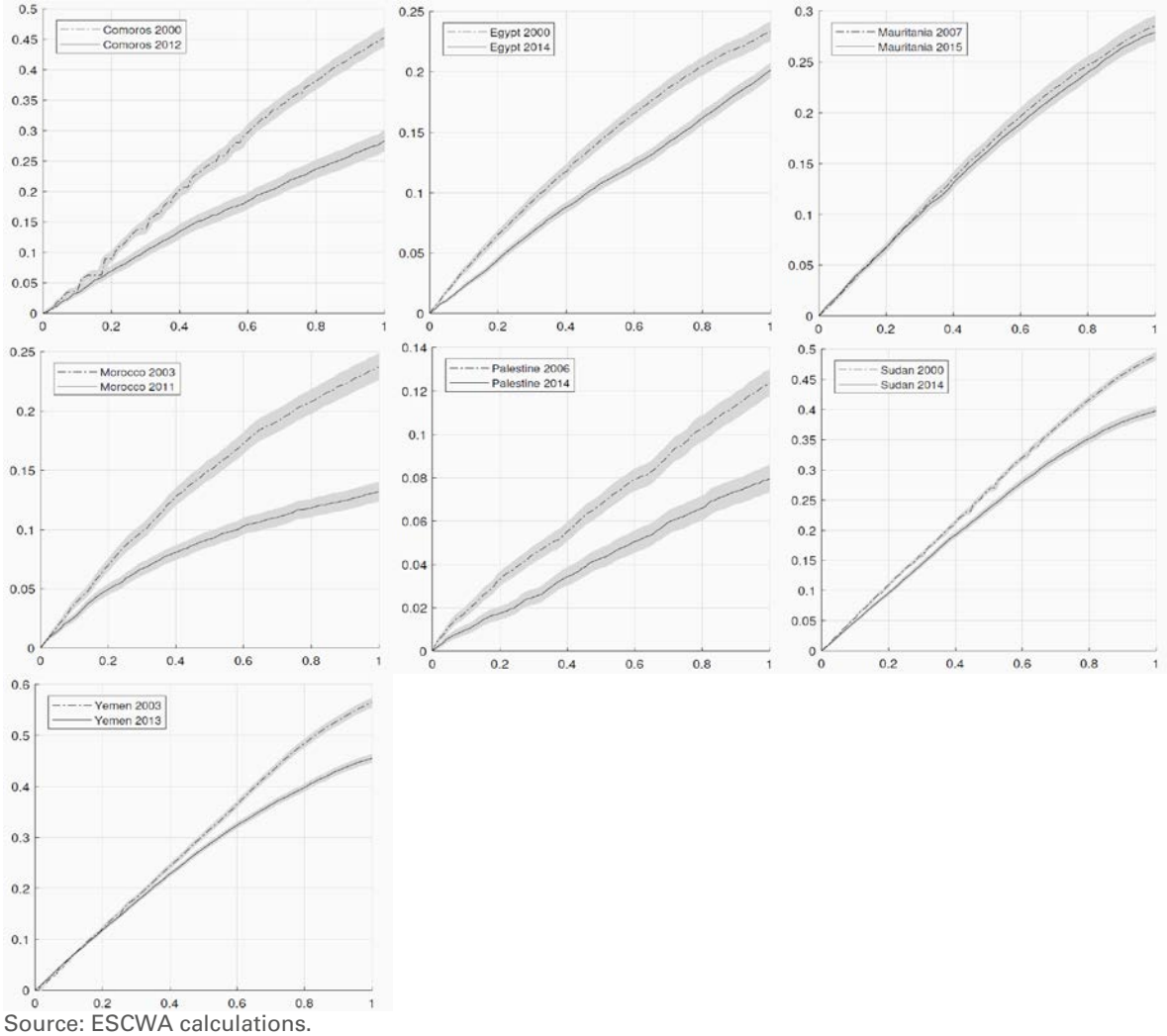


Source: ESCWA calculations.

3. Evolution of overall shortfall in child stunting

Wagstaff (2002) argues that policymakers are interested in both improving the average health outcome and decreasing socioeconomic health inequality. In this context, only assessing changes in socioeconomic health inequalities may be misleading from a policy-making perspective. He proposes a health achievement index that account for both the average health level and its socioeconomic distribution. In order to illustrate graphically the concept of health achievement, one can use the generalized health concentration curve, which is the health concentration curve multiplied by the average health status. Makdissi and Yazbeck (2014) show that if one compares the generalized health concentration curves of two distributions and one curve is above the other, health achievement will be higher in the population with this higher curve. If one is interested in a health shortfall variable, than the result is the same, the shortfall is higher in the population with the higher generalized concentration curves. In this context, a decrease of the curve would be a policy improvement. Khaled, Makdissi and Yazbeck (2018) also offer the methodology to account for sampling variability for generalized concentration curves dominance.

Figure 10. Child stunting generalized concentration curves, over time



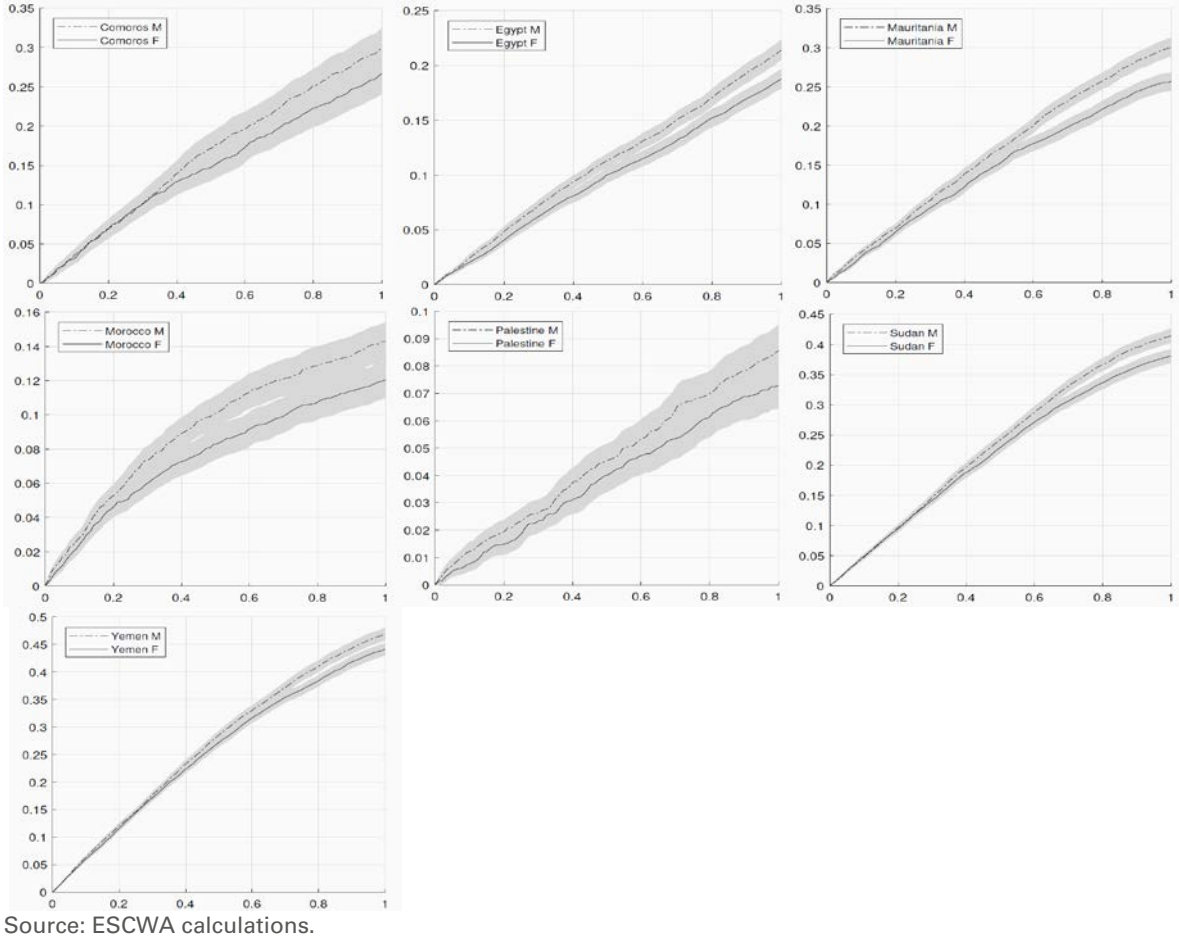
Source: ESCWA calculations.

We apply this methodology to child stunting with a 5 per cent significance level. The generalized concentration curves are shown in figure 10. For all the countries under investigation, shortfall in child stunting is decreasing over the period. This means that all possible rank dependent shortfall indices displaying aversion to socioeconomic health inequality are decreasing. This is a very important result that has the following implication. If one chooses any cut-off in social ranks and computes the incidence of child stunting in the group of people with a socioeconomic status lower than this rank, there will be a decrease in the incidence of child stunting.

4. Gender differences in child stunting

We now compare the generalized child stunting concentration curves of boys and girls for each one of these countries. The generalized concentration curves and their 95 per cent confidence bands are shown in figure 11. For all the countries under investigation, the generalized child stunting concentration curve for boys is higher than the one for girls. We also perform a statistical test to check dominance at the 5 per cent significance level and the result holds. This means that all possible rank dependent shortfall indices displaying aversion to socioeconomic health inequality would display higher values for boys than for girls. These results generalize the result of figure 4.3 in the main document in two dimensions. First, even if the points in the figure appeared to be very close, we now know that their difference is statistically significant. Second, the result will be the same if we would have picked up any other index of health shortfall.

Figure 11. Child stunting generalized concentration curves, by gender

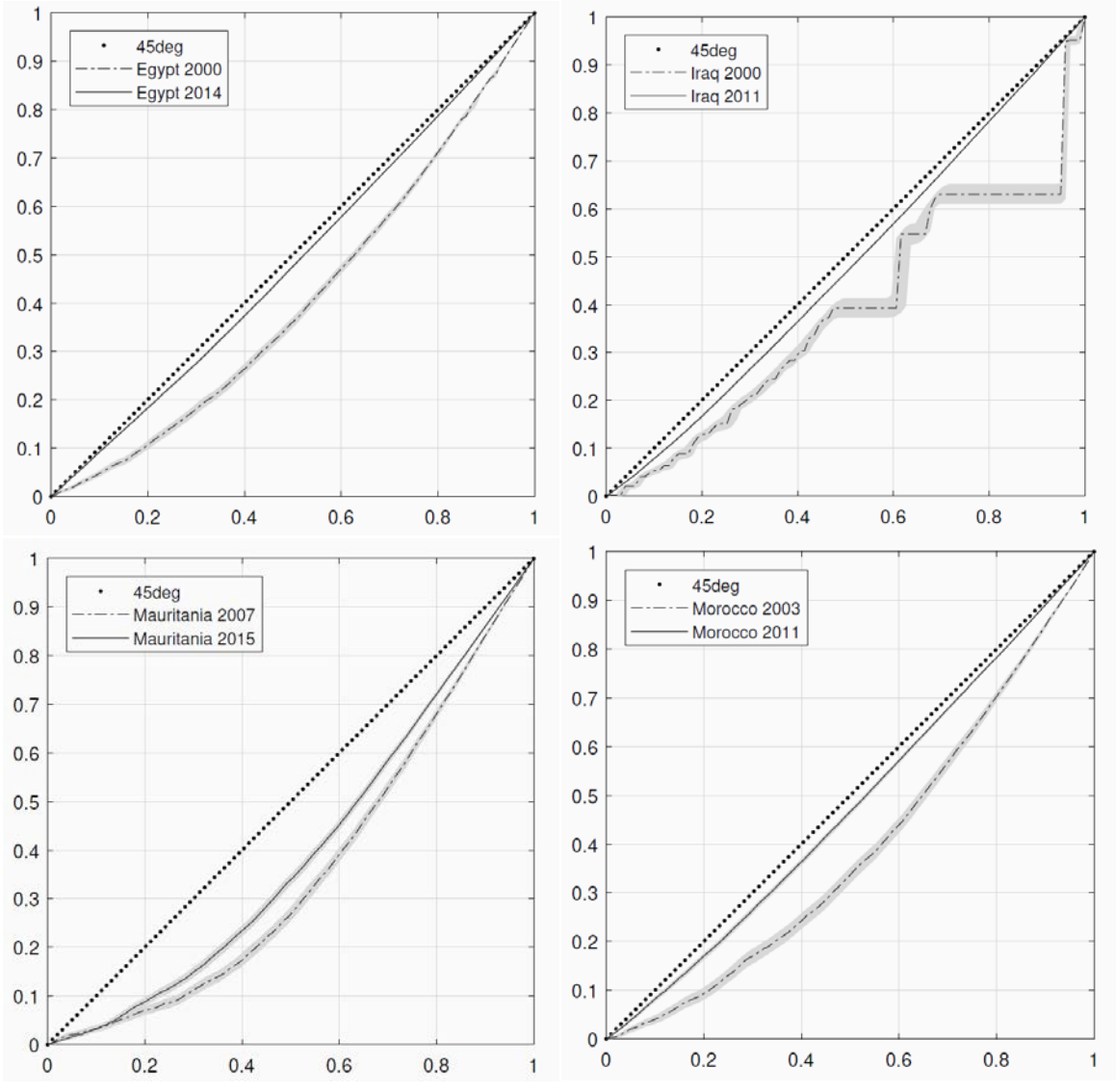


Source: ESCWA calculations.

5. Evolution of socioeconomic health inequalities in skill birth attendance

The concentration curves (figure 12) and generalized concentration curves (figure 13) for skill birth attendance depict a very good picture that is confirmed if one runs the statistical tests at the 5 per cent significance level. There is a clear decrease in socioeconomic health inequalities in skill birth attendance in the four countries for which we have data. This result is valid for any rank dependent socioeconomic health inequality index. There is also an increase in health achievement in skill birth attendance and this result is also valid for any rank dependent health achievement index.

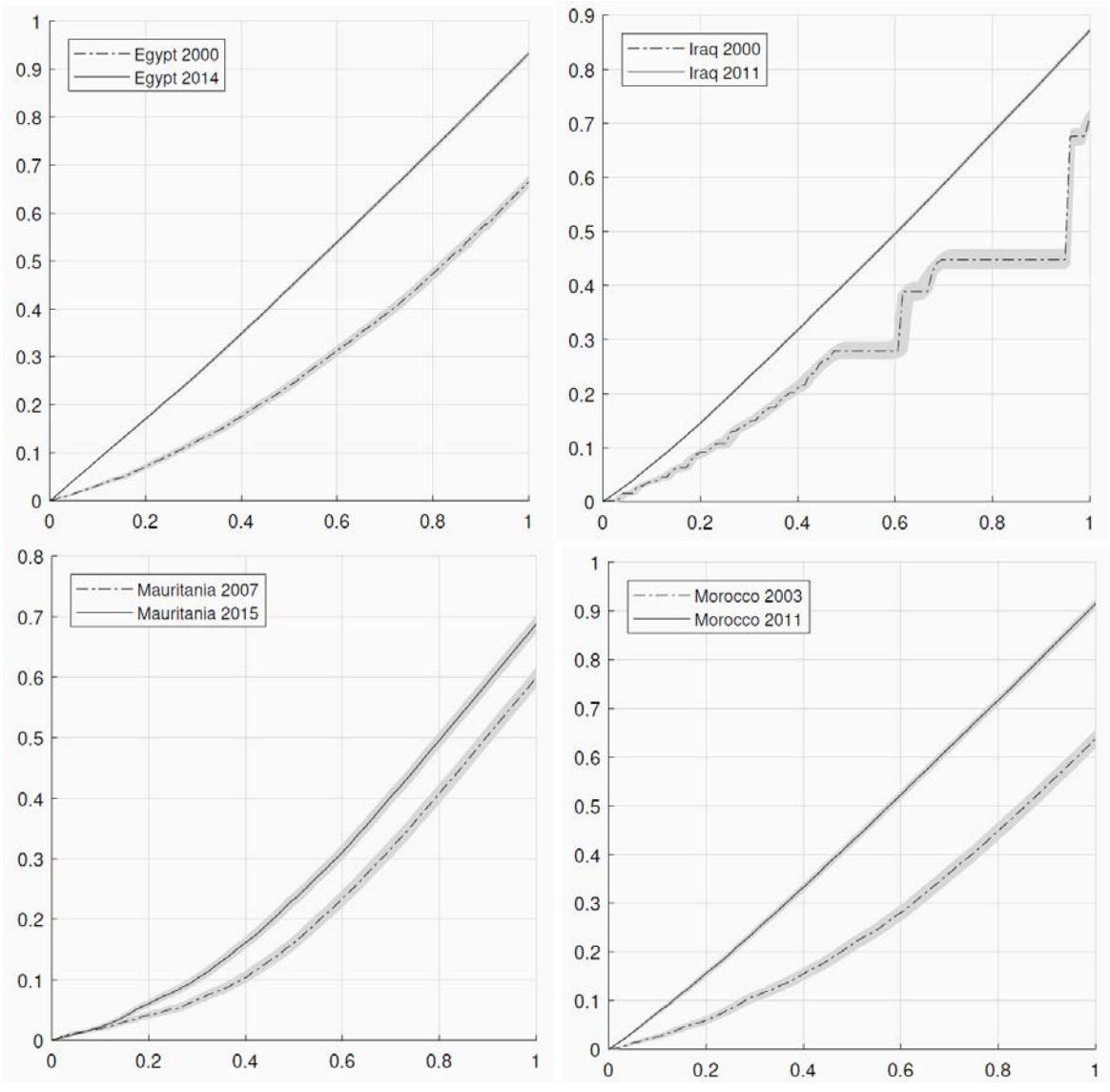
Figure 12. Skilled birth attendance concentration curves, over time



Source: ESCWA calculations.

Note: The shape of the Iraq skill birth attendance concentration curve indicates that there is bunching of data in terms of welfare index.

Figure 13. Skilled birth attendance generalized concentration curves, over time



Source: ESCWA calculations.

Note: The shape of the Iraq skill birth attendance concentration curve indicates that there is bunching of data in terms of welfare index.

B. Probability of deprivation: determinants in education and health

The analysis of the determinants of deprivation in health and education employs a logistic regression to analyse the likelihood of deprivation. The method is implemented in two steps. First, variables relevant for explaining deprivation are listed. Given the large set of explanatory factors (socio-demographic characteristics of the household head, the characteristics of the household), the question is which ones matter the most in explaining the pattern observed in deprivation? The answer is obtained first normatively by looking at the earlier analysis on inequalities in outcomes and the

relevance of each socio-economic variable and availability in the datasets across countries and the two points in time. This long list is then tested using standard tools such as the Kolmogorov-Smirnov test and the Pearson's chi-squared test. The resulting short list of explanatory variables is used for the estimation of a logistic regression model: the dependent variable is the deprivation outcome (e.g. 1 if deprived, and 0 otherwise). In order to facilitate the interpretation of the regression estimates we have reported in the text the so-called average marginal effects. The estimated coefficients have a straightforward interpretation as the risk or probability of being deprived associated to each explanatory variable. The explanatory variables considered are household head characteristics (age, sex, and education) and household characteristics (wealth, region of residence, and size). The methodology is presented below, and the results in tables 1 and 2 below, for school attendance and stunting, respectively.

The parameters of the logistic model, β, are estimated by Maximum Likelihood. The log-likelihood function has the following equation:

$$\log \mathcal{L}(\beta) = \sum_{i=1}^{N} \{y_i \cdot \log(P[y_i = 1|x_i]) + (1 - y_i) \cdot \log(1 - P[y_i = 1|x_i])\}$$

with:

$$P[y_i = 1|x_i] = \frac{e^{x_i'\beta}}{1 + e^{x_i'\beta}}$$

In the previous equations y_i represents the dependent variable, which is a binary indicator for the observed condition that we want to study (e.g. the condition of a household where a child is stunted versus household where children are not stunted); N is the estimation sample size and x_i' is the (transposed) vector of individual explanatory variables that enter the model (e.g. the age of the household head, the household size, etc.). Once the parameters have been estimated, marginal effects can be easily obtained. As Cameron and Trivedi (2005) note, "a marginal effect, or partial effect, most often measures the effect on the conditional mean of $\mathrm{y_i}$ of a change in one of the regressors, say $\mathrm{x_k}$. In the linear regression model, the ME equals the relevant slope coefficient, greatly simplifying analysis. For nonlinear models such as logit or probit, this is no longer the case, leading to remarkably many different methods for calculating MEs" (p. 333).

Let us consider the ME computed from a logit model for a categorical independent variable. In this case the ME shows how the estimated probability of being poor - $P[y_i = 1|x_1, x_2, x_3, \dots, x_K]$ - changes as the categorical variable changes from the reference category to another category, after controlling for the other explanatory variables in the model (in the simple case of a dichotomous independent variable, the marginal effect is the difference in the adjusted predictions for the two groups, e.g. for urban and rural areas). There are different ways of controlling for the other variables in the model, leading to different types of MEs. The marginal effect at the means (MEM) is obtained by comparing the probability of being poor for two hypothetical average individuals that differ only with respect to the category of the independent variable under analysis, with all the other independent variables fixed at their mean values in the sample. Notwithstanding the wide use of MEM in the literature the figures cannot be interpreted intuitively as they refer to average individual. In light of

this, many researchers prefer average marginal effects (AMEs). Intuitively, the AME for individuals from urban areas is computed as follows:

Treat each person in the sample as though s/he was from an urban area, regardless of what the person's environment is. Leave all other independent variable values as is. Compute the probability that each person would have to be poor, that is $P[y_i = 1|x_1, x_2 = 1, x_3, \dots, x_K]$, where x_2 is the dichotomous independent variable indicating whether the household lives in a urban $(x_2 = 1)$ or a rural area $(x_2 = 0)$.

Repeat step 1, this time treating each household of the sample as though s/he was from a rural area: $P[y_i = 1|x_1, x_2 = 0, x_3, \dots, x_K]$.

The difference in the two probabilities just computed is the individual marginal effect, which is therefore different for each person in the sample.

Compute the average of all the marginal effects. This gives you the AME for people from an urban area:

$$AME = \frac{1}{N} \cdot \sum_{i=1}^{N} \{P[y_i = 1|x_1, x_2 = 1, x_3, \dots, x_K] - P[y_i = 1|x_1, x_2 = 0, x_3, \dots, x_K]\}$$

Given this methodology, with AMEs two hypothetical populations are compared: One where all are from an urban area and one where all from a rural area, with the values of the other independent variables fixed at their observed values. Since the only difference between these two populations is their environment, living in an urban/rural are must be the cause of the differences in their likelihood of being poor. Hence, with respect to the MEM all of the data is being used, not just the means, leading to more realistic estimates.

C. Measuring inequality of opportunity

Similar to the outcome inequalities, inequality of opportunity in health and education analysis is conducted for 12 Arab countries using three main survey sources: MICS, DHS and PAPAFAM. We also conduct trend analysis using two survey points, one in the early 2000s and another after 2010. The empirical analyses is grounded on the theoretical framework of Roemer's model (1998, 2003). Following Roemer's classification, the circumstances that we consider are variables specific to the child, the parents, and the household. These include the child's sex, the household's economic status as measured by the wealth index, the mother's education level, the father's education level, and the region of residence.

1. Dissimilarity index

For each health and education indicator, we compute the dissimilarity index (D-index) as a measure of the inequality of opportunity. The D-index reflects the percentage of opportunities that must be redistributed from the groups that are better-off to the groups that are worse-off to achieve equality of opportunity. The D-index ranges from 0 to 1, where a D-index of 0 would imply perfect

equality of opportunity. The higher the value of the D-index the greater the degree of the inequality of opportunities.

Consider we have a random sample from the population of children with information on whether a child i has a specific health or education outcome ($H_i = 1$ if the child has that outcome and $H_i = 0$ otherwise), and a vector X indicating the child's circumstances (sex, household's wealth, head of household's education, region of residence).The D-index is estimated using the following four steps.

The first step is to estimate the conditional likelihoods by specifying a binary function between each health or education outcome and the circumstances variables ($X_1, X_2 \dots X_m$) for each child i using a probit regression model as in equation (1).

$$(1) \qquad Ln\left(\frac{P(H=1|X_{1,\dots,}X_m)}{1-P(H=1|X_{1,\dots,}X_m)}\right) = \sum_{k=1}^{m}\beta_k(X_k).$$

In the second step, we estimate the predicted probability of observing the health or education outcome,$\widehat{p_1}$, for each child, based on the estimated coefficients β_k from equation 1 and the vector of their circumstances that offer different opportunities as shown in equation (2).

$$(2) \qquad \widehat{p_1} = \frac{\exp(\widehat{\beta_0}+\sum_{k=1}^{m}X_{ki}\widehat{\beta_k})}{1+\exp(\widehat{\beta_0}+\sum_{k=1}^{m}X_{ki}\widehat{\beta_k})}.$$

In the third step, we compute the overall population mean,$\bar{p}$, for the health or education outcome as in equation (3).

$$(3) \qquad \bar{p} = \sum_{i=1}^{n} w_i\widehat{p_1}.$$

where n is the total population, and w_i is the sampling weights.

In the last step, we compute the D-index ($\widehat{D}$) as in equation (4).

$$(4) \qquad \widehat{D} = \frac{1}{2\bar{p}}\sum_{i=1}^{n} w_i|p-\bar{p}|.$$

2. Shapley decomposition

The hoi module in Stata was used for the estimations of the dissimilarity index. To determine the contribution of each circumstance to the inequality of opportunity, we use the Shapley decomposition. The intuition behind the Shapley decomposition procedure is that it calculates the marginal impact of each circumstance as it is eliminated from the calculations, and then averages the marginal effects over all the possible eliminations sequence. The effect of adding a set of circumstances A is calculated as in equation (5).

$$(5) \qquad D_A = \sum_{S\subseteq N\{A\}}\frac{|S|!(n-|S|-1)!}{n!}[D(S\cup\{A\}) - D(S)].$$

where N is the set of all circumstances, n is the subset of circumstances, S is a subset of N that excludes the particular circumstance A. D(S) is the D-index computed with the set of circumstances S, and D $(S \cup \{A\})$ is the D-index computed with the set if circumstances S and circumstance A.

Accordingly, the contribution of a set of circumstances A to the dissimilarity index is calculated as in equation (6).

$$(6) \qquad C_A = \frac{D_A}{D_{(N)}} \text{ with } \sum_{i \in N} C_i = 1.$$

The next sub-sections briefly describe the health and education indicators examined in inequality of opportunity and provide further specific notes on the methodology.

(a) Inequality of opportunity in health

In this report, we examine the inequality of opportunity in several indicators of child and maternal health. The child's health outcomes include, the child's nutrition status (stunting, wasting, and underweight), neonatal mortality, infant mortality, full immunization of a child by the age of 2 years. Full immunization is determined based on receiving vaccines against tuberculosis, measles, 3 doses against diphtheria, pertussis, and tetanus, and 3 doses against polio. Child nutrition status is measured using three anthropometric measures; the height-for-age, the weight-for-age, and the weight-for-height Z-scores. We use the data on the child's anthropometrics to examine the inequality of opportunities in child malnutrition, namely stunting (a child is classified as stunted if his/her height-for-age is more than two standard deviations below the WHO Child Growth Standards median), wasting (a child is classified as wasted if his/her weight- for-height is more than two standard deviations below the WHO Child Growth Standards median) and underweight (a child is classified as underweight if his/her weight-for-age is more than two standard deviations below the WHO Child Growth Standards median).

Table 14. List of the health indicators and circumstances and their definition

Variable	Definition
Stunting	A binary variable equals 1 if the child's height-for-age is below minus two standard deviations (-2 SD) from the median of the reference population and equals zero otherwise. (This variable reflects chronic malnutrition).
Wasting	A binary variable equals 1 if the child's weight-for-height is below minus two standard deviations (-2 SD) from the median of the reference population and equals zero otherwise. (This variable reflects acute malnutrition).
Underweight	A binary variable equals 1 if the child's weight-for-age is below minus two standard deviations (-2 SD) from the median of the reference population are underweight for their age and equals zero otherwise. (This variable reflects chronic or acute or a combination of both).
Fully immunized (children ages 12-23 months)	A binary variable equals 1 if the child is fully immunized (child has received BCG, a measles or MMR vaccination, three DPT vaccinations, and three polio vaccinations) by the age of 23 months, and equal zero otherwise.

Variable	Definition
Antenatal care - number of visits	A binary variable equals 1 if the mother received antenatal care, four times or more during the last pregnancy, and equals zero otherwise.
Antenatal care - skilled provider	A binary variable equals 1 if the mother received antenatal care from a skilled provider during the last pregnancy, and equals zero otherwise.
Skilled attendance at birth	A binary variable equals 1 if the mother was attended by a skilled health personnel during delivery and equals zero otherwise.
Head of household's education level	A categorical variable which we stratify into different education levels.
Household's socioeconomic status (wealth quintiles)	Wealth index is used to create 5 wealth categories.
Child's sex	A binary variable with two categories (males and females)
Region of residence	A binary variable with two categories (urban, rural)

(b) Inequality of opportunity in education

Table 15. List of the education indicators and circumstances and their definition

Variable	Definition
Ever attending school	A binary variable equals 1 if the person has ever attended school and 0 otherwise. The examined age group is 6-25.
Primary completion	A binary variable equals 1 if the person has completed primary schooling conditional on having attended school and 0 otherwise. The examined age group is 6-25.
Secondary completion	A binary variable equals 1 if the person has completed secondary schooling conditional on having completed primary schooling and 0 otherwise. The examined age group is 6-25.
Above secondary enrolment	A binary variable equals 1 if the person has attended above secondary levels conditional on having completed secondary schooling and 0 otherwise. The examined age group is 6-25.
Head of household's education level	A categorical variable which we stratify into different education levels.
Household's socioeconomic status (wealth quintiles)	Wealth index is used to create five wealth categories.
Child's sex	A binary variable with two categories (males and females).
Region of residence	A binary variable with two categories (urban, rural).

D. Difference in differences

The analysis in Chapter 4, section E. *Gender and Conflict,* relies on a generalized difference in differences (DID) identification strategy.

1. Methodology

The two-group two-period DID design is intuitive, but it does not accommodate the complexity encountered in applications, which often involve treatment exposures in multiple groups and multiple time periods.[2] In this case the treatment exposure is conflict. The main features of the DID design also apply in a broader set of conditions. When we have two or more groups and two or more periods, D_{gt} = 1 if the treatment is active in group g and period t; otherwise, D_{gt} = 0, as in the two-group two-period case, the core assumption in the generalized DID is that any unmeasured determinants of the outcomes are either time invariant or group invariant.

The method can be expressed according to the following formula:

$$Y_{gt} = a_g + b_t + \delta D_{gt} + \varepsilon_{gt}$$

where Y_{gt} is the development outcome (stunting, in the present study) for children in group *g* observed at time *t;* a_g , the group fixed-effect, can be seen as a vector that combines all the group characteristics that are time invariant, in other words it is the time-invariant combined effect of group *'g',* when Y is plotted against time; b_t, *the time-fixed effect,* is the time trend shared by all groups according to the parallel trend assumption, in other words it is the combined effect of time-varying factors*;* $a_g + b_t$ is the outcome of the untreated group *'g'* in time *'t'; δ* is the treatment effect that captures the causal effect of conflict on the dependent variable; and finally ε is the error term.

The generalized DID stems from the same common trend assumption involved in the simple two-group two-period DID but accommodates for more variation in the details of the research design3. The generalized version of the DID methodology, allowed for a more flexible treatment variable, using different start dates of conflict for each governorate, switching on and off depending on the monthly exposure to conflict and intensity. The generalized DID turned out to be a "two-way fixed effects" regression model, with fixed effects for governorate and for time period.

The widely used social science definition of armed conflict was developed by the Uppsala Conflict Data Program (UCDP). It defines conflict as a "contested incompatibility that concerns a government and/or territory over which the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths each year".4 But the Arab region counts an immensely larger number of incidents per year. We determined the variable for exposure to conflict based on this definition, the thresholds of violence exposure would go far beyond the lower limit, to a monthly granularity since data allows, unfortunately. We defined exposure to

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[2] Wing, Simon and Bello-Gomez, 2018, p. 456.

[3] For further details on the methodology refer to Wing, Simon and Bello-Gomez, 2018, p. 457.

[4] Definitions, sources and methods for Uppsala Conflict Data Program Battle-Death estimates https://ucdp.uu.se/downloads/old/brd/ucdp-brd-conf-41-2006.pdf.

conflict as a dummy variable indicating exposure to events resulting in 25-49 battle-related deaths per month, as well as a dummy variable indicating 50+ battle-related deaths per month, for each individual since the moment of conception (10 months prior to the respective birth date). We also estimated the number of months of exposure to violence at each threshold for each individual in the sample. The main assumption of the model was that outcomes in treated and untreated units would follow a common path through time in the absence of a treatment effect, in this case the absence of conflict. That assumption needed to be verified in order to validate the estimation results. We conducted a set of robustness checks to validate the common-trends assumption; results are presented in *Trends and Impacts issue no. 5*. The parallel trends assumption requires that the trends in the outcome variable for both conflict afflicted regions and non-conflict afflicted regions during the pre-conflict era are similar. This assumption does not require that the level of the outcome variable for the different regions be the same in the pre-treatment era. More results in *Trends and Impacts issue no. 5* suggest that the parallel trend assumption is met for outcomes of interest.

2. Specification and results for the stunting development outcome

The present section presents the detailed results of assumptions verification and the model specifications followed for one outcome and one country, as guiding example, namely the stunting outcome for Iraq. It also presents descriptive statistics of the variable of interest, as well as the results of the statistical estimation.

Stunting is an indicator of long-term nutritional deficiencies and health problems. It is also an important marker of brain development and cognitive abilities. Operationally, the height of children aged 59 months or less (that is, under 5 years of age) is measured as part of the survey process. The recorded heights are compared to an average distribution for the age of the children, provided by WHO, leading to a standardised z-score. All children with a score under -2 (that is, two standard distributions below the mean of the normalized height-for-age score) are identified as stunted; those under -3 standard deviations are classified as severely stunted.

Figure 14. Stunting prevalence trend by level of conflict, Iraq

Source: ECRI-UN ESCWA (2019) based on UCDP data and MICS data for Iraq.

Figure 14 shows the trend in stunting prevalence by violence level in Iraq, since 1995. The parallel trends assumption requires that the trends in stunting prevalence across regions are similar before the onset of conflict. In the case of Iraq, the medium and high violence governorates appear to follow a similar trend in the period 1996-2003; however, the low violence governorates appear to have a declining trend throughout the period 1996-2018.

Table 16 shows the stunting rates for Iraq according to certain background characteristics. Stunting was higher for children aged 18-23 months, which has been identified as a crucial stage of child development. Stunting is more common in children whose mother is dead or does not live in the same household. Stunting rates become less common when the mother is more educated. The same set of variables for the father does not seem to have a clear correlation. While the basic household characteristics (such as overcrowding or lack of water and sanitation facilities) do not appear to have a close correlation with stunting, it appears that, as expected, richer households and those in urban communities exhibit lower stunting rates. The figures show that, in general, stunting rates fell between 2006 and 2011.

Table 16. Stunting rates by background characteristics, Iraq

	2006		2011	
	Stunted	Severely stunted	Stunted	Severely stunted
Gender				
Male	0.28	0.13	0.20	0.09
Female	0.26	0.11	0.19	0.08
Age group				
0-17 months	0.23	0.13	0.17	0.08
18-23 months	0.35	0.19	0.26	0.12
24-59 months	0.28	0.11	0.20	0.08
Mother does not live in household	0.16	0.03	0.25	0.09
Mother is dead	0.32	0.16	0.27	0.15
Mother's education				
No education	0.34	0.08	0.14	0.06
Primary	0.29	0.13	0.20	0.08
Secondary	0.24	0.11	0.18	0.08
Post-secondary	0.18	0.08	0.17	0.08
Father does not live in household	0.28	0.14	0.14	0.05
Father is dead	0.33	0.15	0.19	0.09
Father's education				
No education	0.18	0.11	0.18	0.04

	2006		2011	
	Stunted	Severely stunted	Stunted	Severely stunted
Primary	0.28	0.12	0.21	0.08
Secondary	0.26	0.12	0.19	0.08
Post-secondary	0.25	0.12	0.15	0.07
Overcrowded housing	0.27	0.11	0.21	0.08
Improved water sources	0.25	0.11	0.19	0.08
Improved sanitation facilities	0.26	0.12	0.20	0.08
Wealth quintiles				
Poorest	-	-	0.22	0.09
Second	-	-	0.21	0.08
Middle	-	-	0.18	0.07
Fourth	-	-	0.19	0.09
Richest	-	-	0.18	0.09
Region				
Urban	0.25	0.11	0.19	0.08
Rural	0.30	0.14	0.21	0.09

Source: ESCWA calculations based on data from Iraq MICS 2006 and 2011.

Note: The figures show the average stunting rates according to background characteristics.

We estimate the following regression:

$$Y_{gt} = a_g + b_t + \delta_M D_{gt,M} + \delta_H D_{gt,H} + \varepsilon_{gt}$$

Where $Y_{gt} = 1$ if the child aged 0-59 months of age was stunted, and zero otherwise. Likewise, we estimate a similar regression for the probability of being severely stunted. Linear probability models of the stunting for children under 5 years of age were estimated. DID structure was included in the model to capture the effect of conflict on the probability of stunting. The impact of conflict is identified with a difference-in-difference approach contrasting stunting trends in regions exposed to different conflict intensities to regions which remained relatively safe during the conflict; using our violence thresholds, we clustered violence by none, medium (M) and high (H).

The regression included child, family and household characteristics. Most of them are listed in the previous table, in addition to child's age and child's age squared, mother's age and mother's age squared, father's age and father's age squared, and number of children in the household linear and squared. Governorate and year-fixed effects were also included in the model.

Results from the regressions are summarized in table 17. However, when we identify those individuals exposed to conflict at the two different thresholds (δ_M and δ_H), we observe that exposure to conflict has a countervailing effect. Stunting for children exposed to conflict does not decline at the same pace as it does for children not exposed to conflict, with stronger effects for children exposed to higher levels of violence in their governorates. Parallel results are obtained in columns three and four, which correspond to the probability of stunting in Iraq, for boys and girls respectively.

Table 17. Estimated coefficients for the stunting models, Iraq

	Iraq		
	All	Boys	Girls
δ_M	0.0788**	0.0291	0.1260**
	(-0.0357)	(-0.0319)	(-0.0544)
δ_H	0.1582***	0.1483***	0.1660**
	(-0.0498)	(-0.0492)	(-0.0766)
Observations	74,732	38,060	36,672
R-squared	0.0465	0.056	0.0423
Child characteristics	√	√	√
Parents characteristics	√	√	√
Household characteristics	√	√	√

Source: ESCWA calculations based on data from MICS 2006 and 2011 for Iraq.

Note: Linear probability model of stunting for Iraq with a DID structure. Robust standard errors are in parentheses. The symbols ***, ** and * indicate significance at 1, 5 and 10 per cent levels, respectively.

References

Alvaredo, Facundo, and Thomas Piketty (2014). Measuring top incomes and inequality in the Middle East: data limitations and illustration with the case of Egypt. Economic Research Forum Working Paper Series, No. 832. Cairo: Economic Research Forum.

Arneson, Richard J. (1989). Equality and equal opportunity for welfare. *Philosophical studies*, vol.56, No. 1 (May).

Bosmans, Kristof (2016). Consistent comparisons of attainment and sho1tfall inequality: a critical examination. *Health economics,* vol. 25, No. 11.

Cameron, A. Colin, and Pravin K. Trivedi (2005). Microeconometrics: Methods and Applications. Cambridge university press.

Clarke, Philip M., and others (2002). On the measurement of relative and absolute income-related health inequality. *Social Science and Medicine,* vol. 55, No. 11 (2002).

Cohen, Gerald Allan (1989). On the currency of Egalitarian Justice. *Ethics,* vol. 99, No. 4 (July).

Croft, Trevor (1991). Data editing and imputation. Presented at the Demographic and Health Surveys World Conference Proceedings, II: 1337-1356, Columbia, Maryland: IRD/ORC Macro. Available at https://dhsprogram.com/publications/publication-DHSG3-DHS-Questionnaires-and-Manuals.cfm.

Devarajan, Shantayanan, and Elena Ianchovichina (2017). A Broken social contract, not high inequality, led to the Arab spring. *The Review of Income and Wealth,* vol. 64, No. S1.

Demographic and Health Surveys. (2012). DHS Guide to Statistics.

Erreygers, Guido (2009). Correcting the concentration index. *Journal of Health Economics,* vol. 28, No.2.

International Food Policy Research Institute (2016). Global Nutrition Report: From Promise to Impact Ending Malnutrition by 2030. Washington, D.C.

Khaled, Mohamad A., Paul Makdissi, Rami V. Tabri, and Myra Yazbeck (2018). A framework for testing the equality between the health concentration curve and the 45-degree li11e. *Health Economics,* vol. 27, No. 5.

Khaled, Mohamad A., Paul Makdissi, and Myra Yazbeck (2018). Income-related health transfers principles and orderings of joint distributions of income and health. *Journal of Health Economics,* vol. 57 (January).

Kjellsson, Gustav, Ulf-G Gerdtham, and Dennis Petrie (2015). Lies, damned lies, and health inequality measurements: Understanding the value judgments. *Epidemiology,* vol. 26, No. 5.

Klugman, Jeni, ed, (2002*).* A sourcebook for poverty reduction strategies: Core techniques and Cross-cutting Issues, vol. 1, Washington, DC: World Bank.

Krafft, Caroline, and others (2017). Estimating poverty and inequality in the absence of consumption data: an application to the Middle East and North Africa. Economic Research Forum Working Paper Series, No. 1100. Cairo: Economic Research Forum.

Lefranc, Arnaud, Nicolas Pistolesi, and Alain Trannoy (2009). Equality of opportunity and luck: Definitions and testable conditions, with an application to income in France. *Journal of Public Economics,* vol. 93, No. 11-12 (December).

Makdissi, Paul, and Myra Yazbeck (2014). Measuring socioeconomic health inequalities in presence of multiple categorical information. *Journal of Health Economics,* vol. 34 (March).

O'Donnell, Owen, and others (2008). *Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation*. Washington, D.C.: World Bank.

Parsons, Jennifer and others (2015). Economic impacts of child marriage: a review of the literature. *The Review of Faith & International Affairs*, vol.13, no. 3 (July).

Ramadan, Racha, Vladimir Hlasny, and Vito Intini (2018). Inter-group expenditure gaps in the Arab region and their determinants: application to Egypt, Jordan, Palestine and Tunisia. *The Review of Income and Wealth,* vol. 64, No. S1.

Roemer, John E. (1993). A Pragmatic theory of responsibility for the egalitarian planner. *Philosophy and Public Affairs,* vol. 22, No. 2 (Spring).

_____ (1998). *Equality of Opportunity.* Cambridge, MA: Harvard University Press.

Roemer, John E., and others (2003). To what extent do fiscal regimes equalize opportunities for income acquisition among citizens? *Journal of Public Economics,* vol. 87.

Sarangi, Niranjan, Khalid Abu-Ismail, Heba El-Laithy, and Racha Ramadan (2015). Towards better Measurement of Poverty and Inequality in Arab Countries: A Proposed Pan-Arab Multi-Purpose Survey. E/ESCWA/SD/2014/WP. Beirut: Economic and Social Commission for Western Asia.

United Nations Department of Economic and Social Affairs (2016). Integrating a Gender Perspective into Statistics, Studies in Methods, Series F No. 111.

United Nations Children's Fund, World Health Organization and World Bank (2018). Levels and trends in child malnutrition: Key findings of the 2018 Edition of the Joint Child Malnutrition Estimates. Available at www.who.int/nutgrowthdb/2018-jme-brochure.pdf.

United Nations Department of Economic and Social Affairs (2018). Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. Available at: https://unstats.un.org/sdgs/report/2016/goal-02/. Accessed on 23 May 2018.

United Nations Development Program (2016). Arab Human Development Report. Available at www.arab-hdr.org/reports/2016/english/AHDR2016En.pdf.

United Nations Economic and Social Commission for Western Asia (2018) *The Impact of Conflict on Human Development from Childhood to Adulthood Evidence for the Arab Region.* Trends and Impacts Issue No. 5. E/ESCWA/ECRI/2017/2. Beirut.

United Nations Economic and Social Commission for Western Asia, and others (2017). *Arab Multidimensional Poverty Report.* E/ESCWA/EDID/2017/2. Beirut: Economic and Social Commission for Western Asia.

UN-Habitat (2010). The Challenge of Slums: Global Report on Human Settlements 2003. https://mirror.unhabitat.org/downloads/docs/GRHS_2003_Chapter_01_Revised_2010.pdf.

Wagstaff, Adam (2002). Inequality aversion, health inequalities and health achievement. *Journal of Health Economics,* vol. 21, No. 4.

_____ (2005). The bounds of the concentration index when the variable of interest is binary, with an application to immunization inequality. *Health Economics,* vol. 14, No. 4.

Wing, Coady, Kosali Simon, and Ricardo A. Bello-Gomez (2018). Designing difference in difference studies: best practices for public health policy research." Annual review of public health, vol.39 (April).

World Health Organization, and United Nations Children's Fund (WHO/UNICEF) (2018). *JMP Methodology: 2017 Update and SDG Baselines.* Available at https://washdata.org/sites/default/files/documents/reports/2018-04/ JMP-2017-update-methodology.pdf.

World Bank (2017). World Development Indicators Database. Available at http://datatopics.worldbank.org/world-development-indicators/.

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