Changes in Socioeconomic Inequality in Under-Five Mortality in Egypt Between 1995 and 2014: An Oaxaca Decomposition Analysis

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Abstract:

The main purpose of this study is to monitor the changes in socioeconomic inequality in under-five mortality between 1995 and 2014 in Egypt using cross sectional data from the EDHS conducted in 1995 and 2014. Nationally representative samples of 8027 and 11495 live births were selected in 1995 and 2014 respectively. The changes in contributors to socioeconomic inequality in under-five mortality between 1995 and 2014 was estimated by Oaxaca decomposition analysis. The results of Concentration curve showed that socio-economic variations in under-five morality have narrowed over time. Moreover, the highest share to socioeconomic inequality in under-five mortality in 1995 was due to households' economic status (54%), while education of mother in 2014 made the largest share to inequality in under-five mortality (38%). The findings illustrate that policy actions on improving education of mother would lead to the reduction in under-five mortality inequality especially in rural areas.

Key words: under-five mortality, socioeconomic inequality, concentration index, Oaxaca decomposition, Egypt.

Introduction

One of the most important health indices is the level of child mortality, representing the social, economic, medical services and environmental conditions in which children live. These levels are also one of the main indicators of the standard of living or development of a population (EDHS, 2014). As indicated by the World Health Organization (WHO), an estimated 5.4 million children died before their fifth birthday and about 2.5 million of those children died within the first month of life in 2017. More than half of these early child deaths are due to treatable diseases and preventable causes. The third goal of the Sustainable Development Goals (SDGs) calls for ending preventable child deaths by 2030 (WHO, 2018). Disparities in under-five mortality exist across and within countries. More than a third of all under-five deaths (38 percent) occurs in the least developed countries (UN IGME 2018). Globally, most of child mortality occur at poor, uneducated, and rural households (Wagstaff, 2000; Goldani et al., 2001; Poerwanto et al., 2003; Hosseinpoor et al., 2006; Rarani et al., 2017).

In Egypt, trends indicate that substantial progress has been made in child survival. Under-five mortality rate in 1990 compared to 2017 declined from 86 to 22 deaths per 1000 live births. In 2017, Egypt already had an under-five mortality rate below the SDG target of a mortality rate at least as low as 25 deaths per 1,000 live births (UN IGME 2018). In addition to achieving the progress in decreasing child deaths over the past few decades, distribution of childhood mortality in the population is a key priority as well. Several past studies in Egypt measured inequality in under-five mortality used traditional methods like simple measures and odds ratio from regression (Abdallah, 2012; Rashad and sharaf, 2015). Therefor our study tries to determine the causes' contributions of socioeconomic inequality in under-five mortality in Egypt by using Wagstaff decomposition.

In a previous study, Rashad and sharaf (2015) examined the trends in the socio-economic inequalities of infant mortality rates in Egypt during the period 1995-2014, using multivariate logistic regression model. The current paper, for the first time in Egypt, aimed to measure changes in socioeconomic inequality in under-five mortality over time using decomposition approach.

Study objectives

The main objectives of this paper are:

1- Measuring inequality in under-five mortality across socioeconomic, demographic, environmental, and health variables in 1995 and 2014.
2- Decomposing the causes of inequality in under-five mortality to quantify the contributions of under-five mortality determinants in 1995 and 2014.
3- Monitoring the changes in socioeconomic inequality in under-five mortality in Egypt between 1995 and 2014 by applying Oaxaca decomposition analysis.

Data Source

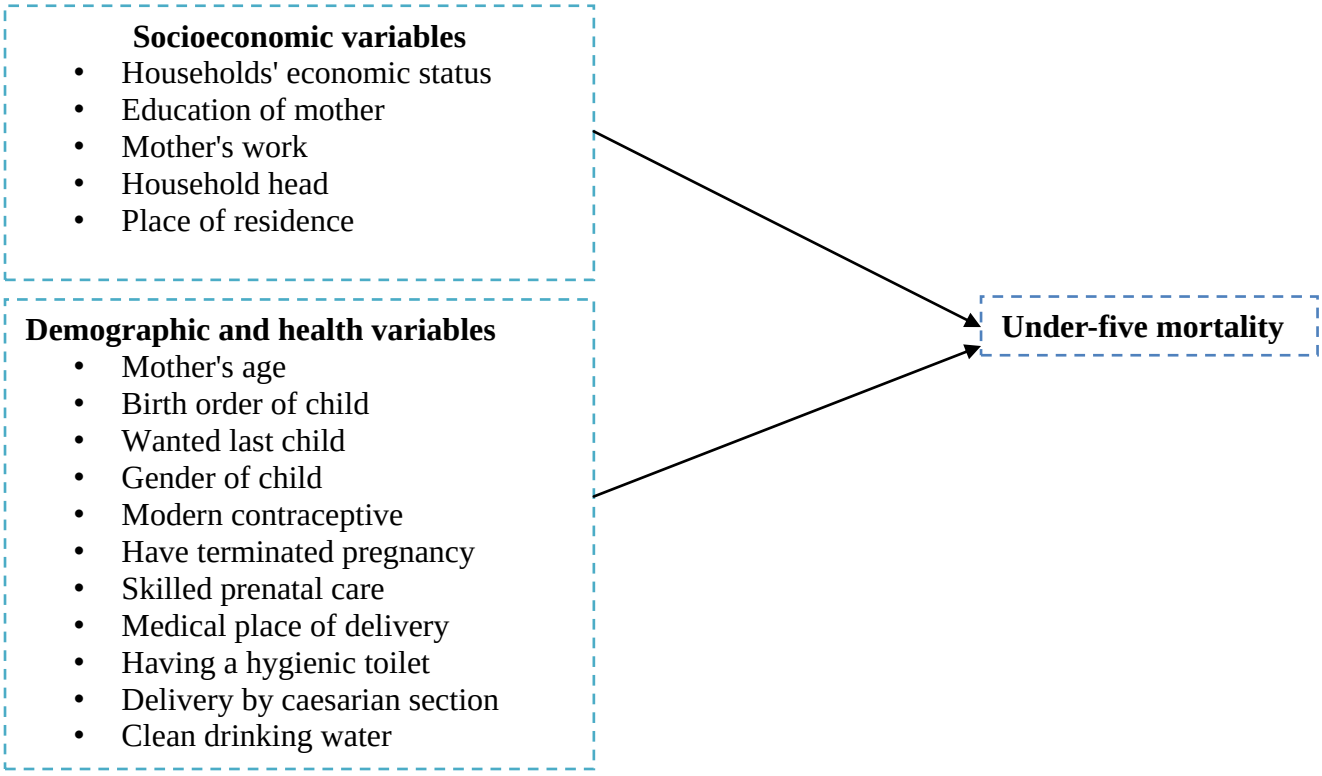
The current study was conducted by using the data from Egypt Demographic and Health Surveys (EDHS) in 1995 and 2014. Each EDHS covered representative samples of ever married women in the age group of 15-49 years. Only last births during the five-year period before the survey are included in the analysis to avoid correlation between births since woman may have more than one birth during the study period. They amounted to 8027 and 11495 live births in EDHS 1995 and 2014, respectively.

Conceptual framework

Figure 1 presents the basic analytical model of the study. The theoretical framework of this study is determined from the previous studies (Goldani et al., 2001; Hosseinpoor et al., 2006; Wagstaff, 2000; Cleland et al., 1992; Wagstaff et al., 1997; Hosseinpoor et al., 2005; Arntzen et al., 2004;

Rarani et al., 2017a), the commission on social determinants of health (CSDH) framework (WHO, 2013), and from the conceptual framework for modeling infant mortality derived from Mosley and Chen (1984) who distinguished between proximate and socioeconomic determinants.

Figure 1: Conceptual framework of under-five mortality determinants in Egypt



Source: Adjusted from Mosley and Chen (1984)

Methodology

Inequality Measurement

The concentration curve is a graphical measure of inequality that plots the cumulative percentage of the health variable (y-axis) against the cumulative percentage of the sample, ranked by economic status. There is an equality in the health variable if the concentration curve is a 45^0 line (the equality line). When there is an inequality in the health variable, the concentration curve lies above (below) the equality line. The further the curve is above the line of equality, the more concentrated the health variable is amongst the poor (Wagstaff et al., 1991; Kakwani et al., 1997; Wagstaff, 2000).

Concentration index is a relative measure of inequality that explains the extent to which an indicator of health is concentrated among the advantaged or the disadvantaged people (WHO, 2013). The value of the concentration index can vary between -1 and +1. Its negative values imply that a variable is concentrated among disadvantaged people while the opposite is true for its positive values. When there is equality, the concentration index will be zero (Wagstaff et al., 1991 and

Wagstaff et al., 1997). The concentration index is measured as twice the (weighted) covariance of a health variable and a relative economic rank variable divided by mean of health variable as follows (Wagstaff et al., 2003):

$$C = \frac{2}{\mu} Cov_w \left(y_i , R_i \right) \quad (1)$$

Where y_i is under-five mortality, μ denotes the average of under-five mortality, R_i is the fractional rank of i^{th} individual (for weighted data) within the socioeconomic distribution defined by wealth and Cov_w is the weighted covariance.

Wagstaff (2005) suggested that the concentration index could usefully be normalized by dividing it through by either the reciprocal of the average of the health variable (under-five mortality) or the bound of the concentration index in the case of a binary variable. The Wagstaff normalized concentration index (WCI) is written as (Wagstaff, 2005; Rarani et al., 2017a):

$$WCI = \frac{C}{1-\mu} \quad (2)$$

Decomposition of Inequality

The method of decomposition indicates how determinants proportionally contribute to inequality in under-five mortality. Wag staff et al. (2003) found that for any linear regression model connecting the health variable y (under-five mortality), to a set of k determinants, x_k:

$$y_i = \alpha + \sum_{k=1}^{n} \beta_k X_{ki} + \varepsilon_i \quad (3)$$

Where ε denotes an error term. Given the relationship between y_i and x_{ki}, the concentration index (C) for y is written as:

$$C = \sum_{k=1}^{n} \left(\frac{\beta_k \bar{x}_k}{\mu} \right) C_k + \frac{GC_\varepsilon}{\mu} \quad (4)$$

$$C = \sum_{k=1}^{n} \eta_k C_k + \frac{GC_\varepsilon}{\mu} \quad (5)$$

$$\text{where, } \eta_k = \frac{\beta_k \bar{x}_k}{\mu}$$

Where μ is the mean of y. $\bar{x}_k$ is the mean of x_k . C_k is the concentration index for x_k. η_k is the elasticity of x_k . In the last term (which can be computed as a residual), GC_ε is the generalized concentration index for ε_i. One can observe that C contains two items. The first is the explained component. The second is unexplained component that shows the inequality that cannot be clarified by systematic variation in the x_k across socioeconomic groups.

Oaxaca decomposition analysis

The main purpose of our study is to measure changes in socioeconomic inequality in under-five mortality between 1995 and 2014. An Oaxaca decomposition analysis is the most suitable method to measure the change between two points of time. It divides the change in socioeconomic inequality in under-five mortality into changes in elasticities of determinants ($\Delta\eta$) or changes in the unequal distribution of determinants (ΔC). Applying Oaxaca decomposition to equation (5) (Rarani et al., 2017b), the changes in inequality can be written as:

$$\Delta C = C_t - C_{t-1} = \sum_{k=1}^{n} \eta_{kt}\left(C_{kt} - C_{kt-1}\right) + \sum_{k=1}^{n} C_{kt-1}\left(\eta_{kt} - \eta_{kt-1}\right) + \Delta\left(GC_{\varepsilon t} / \mu_t\right) \quad (6)$$

And can also be formulated as:

$$\Delta C = C_t - C_{t-1} = \sum_{k=1}^{n} \eta_{kt-1}\left(C_{kt} - C_{kt-1}\right) + \sum_{k=1}^{n} C_{kt}\left(\eta_{kt} - \eta_{kt-1}\right) + \Delta\left(GC_{\varepsilon t} / \mu_t\right) \quad (7)$$

Where changes of C over time ($\Delta C = C_t - C_{t-1}$) can be measured by using an Oaxaca decomposition analysis. In the previous equations (6) and (7), η_{Kt} and η_{Kt-1} represent the elasticities of under-five mortality determinants in 2014 and 1995, respectively. Also, C_{kt} and C_{kt-1} denote the inequalities of normalized concentration index in 2014 and 1995, respectively.

Results

Descriptive Statistics

Table 1 illustrated descriptive statistics of under-five mortality and its determinants in Egypt between 1995 and 2014. The findings indicate that the percentage of under-five mortality in 1995 compared to 2014 decreased from 6.12 to 2.25 (63% reduction). For determinants of under-five mortality, the percentage of poor households and residence in rural areas have declined by 28% and

6% respectively but using medical place of delivery and using skilled prenatal care increased around131% and 161% respectively from 1995 to 2014. In terms of education of women, illiteracy rate has decreased by 64% from 1995 to 2014. Moreover, wanted last child, using modern contraceptive, and having a hygienic toilet raised about 28%, 40% and 216% respectively. This table also presented means and standard deviations of different determinants of under-five mortality that were included into the regression model as independent variables.

Table 1: Summary statistics for under-five mortality and its determinants in Egypt between 1995 and 2014

	1995, n= 8027			2014, n= 11495		
Variable	Mean	SD	%	Mean	SD	%
Under-five mortality	0.0612	0.2397	6.12	0.0225	0.1480	2.25
Place of residence						
Rural	0.6222	0.4849	62.22	0.5851	0.4927	58.51
Urban	0.3778	0.4849	37.78	0.4149	0.4927	41.49
Education of mother						
No education	0.4612	0.4985	46.12	0.1679	0.3738	16.79
primary and secondary	0.4867	0.4999	48.67	0.6650	0.4720	66.50
Higher education	0.0521	0.2222	5.21	0.1671	0.3731	16.71
Wealth index						
Poorest	0.2499	0.4330	24.99	0.1796	0.3839	17.96
Poorer	0.2039	0.4030	20.39	0.1836	0.3872	18.36
Middle	0.1958	0.3969	19.58	0.2041	0.4031	20.41
Richer	0.1780	0.3826	17.80	0.2115	0.4084	21.15
Richest	0.1723	0.3777	17.23	0.2211	0.4150	22.11
Age of mother at birth						
15-19	0.0422	0.2011	4.22	0.0280	0.1650	2.80
20-24	0.2074	0.4055	20.74	0.2069	0.4051	20.69
25-29	0.2864	0.4521	28.64	0.3355	0.4722	33.55
30-34	0.2213	0.4151	22.13	0.2453	0.4303	24.53
35-39	0.1532	0.3602	15.32	0.1302	0.3366	13.02
40-49	0.0894	0.2854	8.94	0.0541	0.2263	5.41
Education of husband						
No education	0.2873	0.4525	28.73	0.1215	0.3268	12.15
primary and secondary	0.6033	0.4892	60.33	0.7037	0.4567	70.37
Higher education	0.1083	0.3107	10.83	0.1745	0.3796	17.45
Mother's work						
Not work	0.8349	0.3713	83.49	0.8700	0.3350	87.00
Work	0.1651	0.3713	16.51	0.1300	0.3350	13.00
Birth order of child	3.3	2.5240	-	2.3	1.5040	-
Wanted last child						
Unwanted	0.3487	0.4766	34.87	0.1692	0.3750	16.92
Wanted	0.6513	0.4766	65.13	0.8308	0.3750	83.08
Household head						
Male	0.9469	0.2242	94.69	0.9568	0.2034	95.68
Female	0.0531	0.2242	5.31	0.0432	0.2034	4.32

Gender of child						
Male	0.5221	0.4995	52.21	0.5241	0.4994	52.41
Female	0.4779	0.4995	47.79	0.4759	0.4994	47.59
Modern contraceptive						
Not use	0.5839	0.4929	58.39	0.4157	0.4929	41.57
Use	0.4161	0.4929	41.61	0.5843	0.4929	58.43
Having a terminated pregnancy						
Not Have	0.7212	0.4484	72.12	0.7900	0.4100	79.00
Have	0.2788	0.4484	27.88	0.2100	0.4100	21.00
Antenatal care						
Not use	0.6107	0.4876	61.07	0.1000	0.2960	10.00
Use	0.3893	0.4876	38.93	0.9000	0.2960	90.00
Medical place of delivery						
Not medical	0.6625	0.4729	66.25	0.1185	0.3232	11.85
Medical	0.3375	0.4729	33.75	0.8815	0.3232	88.15
Having a hygienic toilet						
No	0.7863	0.4099	78.63	0.3239	0.4680	32.39
Yes	0.2137	0.4099	21.37	0.6761	0.4680	67.61
Delivery by caesarian section						
No	0.932	0.2524	93.2	0.4881	0.4999	48.9
Yes	0.068	0.2524	6.8	0.5119	0.4999	52.2
Clean drinking water						
No	0.255	0.4358	25.5	0.0915	0.2884	9.2
Yes	0.745	0.4358	74.5	0.9085	0.2884	90.9

Concentration Indices

Table 2 presented the Wagstaff normalized concentration index for under-five mortality in 1995 and 2014. The Wagstaff normalized concentration index in 1995 was -0.262 and -0.118 in 2014, meaning that under-five mortality was higher among the poor households in both years. Additionally, socio-economic inequality in under-five mortality has reduced by 55% between 1995 and 2014. According to Wagstaff normalized concentration index and its t-values, inequality in under-five mortality was significant in both years.

Table 2: Wagstaff normalized concentration indices (WCI) of under-five mortality in Egypt (1995 and 2014)

	CI	WCI	SE(WCI)	t-values (WCI)	95% confidence interval of WCI	
					low	High
1995	-0.2463	-0.262	0.023	-11.412*	-0.308	-0.216
2014	-0.115	-0.118	0.034	-3.421*	-0.186	-0.049

* Significant at 5%

Concentration Curves

Figure 2 showed changes of the concentration curves of under-five morality between 1995 and 2014. The cumulative share of under-five mortality was plotted on the y-axis against the cumulative share of children at the x-axis ranked by their economic status. The two concentration curves lied above the equality line, which revealed that poor households had more deaths of under-five children than the rich one. Furthermore, the concentration curve in 2014 was clearly closer to the equality line than that for 1995. This determined that socioeconomic inequality in under-five morality has declined over time.

Figure 2: The concentration curves of under-five mortality in Egypt (1995 and 2014)

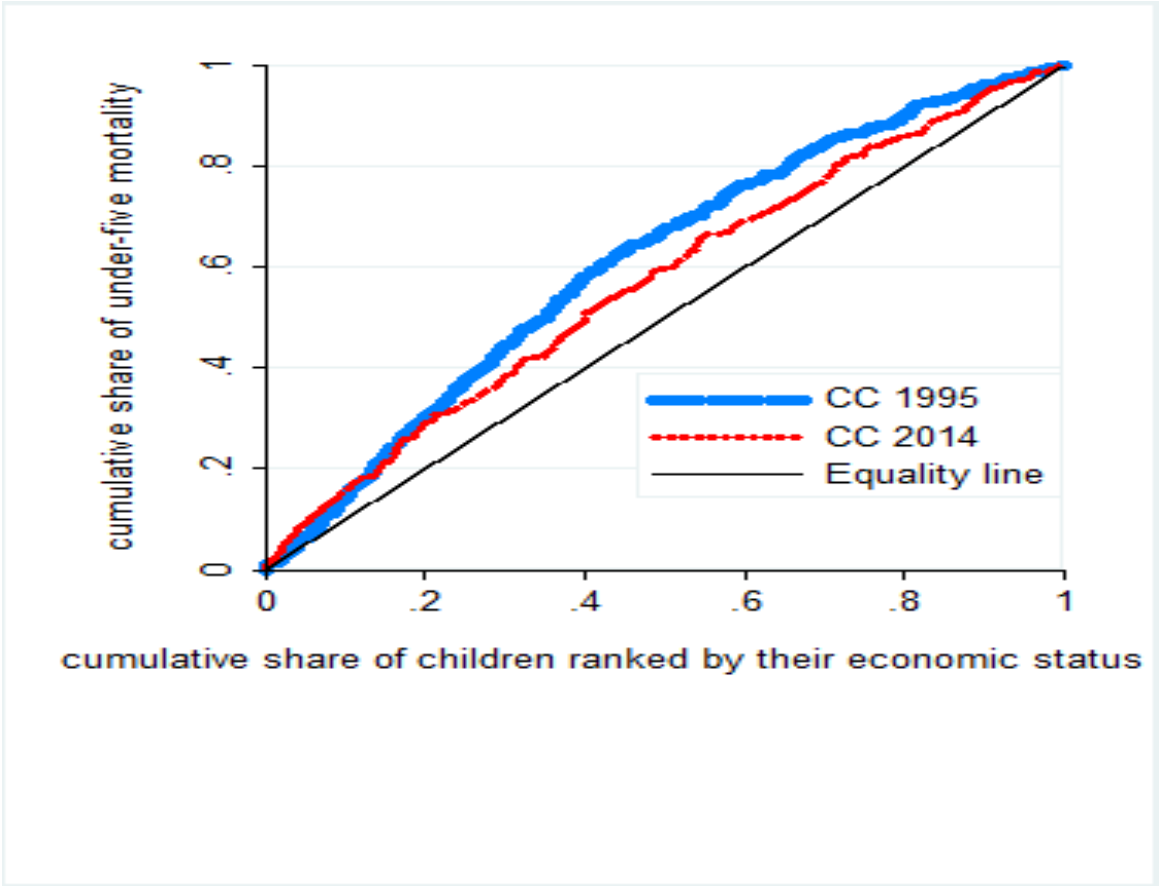


Table 3 reported the results and changes of decomposition of inequality in under-five mortality between 1995 and 2014. It presented the coefficient of determinants (β_k), the elasticity$\left(\frac{\beta_k \bar{x}_k}{\mu}\right)$, the concentration index for determinants (C_k), the shares of determinates

($\left(\frac{\beta_k \bar{x}_k}{\mu}\right)C_k$) and percentage shares of determinants. The elasticity is a unit-free measure of correlation that shows the degree of change in dependent variable (under-five mortality) correlated with one unit change in independent variable (Rarani et al., 2017b).

The concentration index (C_k) measures the unequally distribution of different variables by household's economic status. The negative values of concentration index illustrate that inequality is more concentrated among households of lower economic status and vice versa. The concentration indices of independent variables indicated that uneducated mother, poor households, age of woman at birth (ages less than 25 years old), rural residents, birth order of child and having a terminated pregnancy all were highly concentrated among poor households in 1995 and 2014. Although, the concentration indexes of richer households, worked mother having hygienic toilet, delivery by caesarian section and clean drinking water all were highly concentrated among wealthy households in both surveys.

Table 3: Decomposition of inequality in under-five mortality in Egypt (DHS1995-DHS2014)

Determinants	Coefficient		Elasticity		C_k		Share		% Share	
	1995	2014	1995	2014	1995	2014	1995	2014	1995	2014
Education of mother										
Uneducated	0.024	0.016	0.182	0.116	-0.352	-0.376	-0.064	-0.044	25	38
primary and secondary	0.033	0.011	0.263	0.321	0.213	0.001	0.056	0.000	-22	0
Higher[a]										
Sum									3	38
Wealth index										
Poorest	0.037	0.007	0.150	0.059	-0.781	-0.828	-0.117	-0.049	46	43
Poorer	0.031	0.000	0.103	0.003	-0.362	-0.463	-0.037	-0.001	15	1
Middle	0.009	0.004	0.029	0.033	0.042	-0.021	0.001	-0.001	0	1
Richer	0.014	0.003	0.039	0.024	0.433	0.442	0.017	0.011	-7	-9
Richest[a]										
sum									54	35
Age of mother at birth										
15-19	0.019	-0.005	0.013	-0.006	-0.129	-0.146	-0.002	0.001	1	-1
20-24	0.022	-0.008	0.073	-0.077	-0.074	-0.038	-0.005	0.003	2	-3
25-29	0.015	-0.008	0.068	-0.122	0.040	0.031	0.003	-0.004	-1	3
30-34	0.000	-0.006	-0.001	-0.067	0.077	0.031	0.000	-0.002	0	2
35-39	-0.007	-0.003	-0.017	-0.017	0.005	-0.021	0.000	0.000	0	0
40-49[a]										
Sum									2	1
Residence in rural	0.003	0.002	0.034	0.053	-0.280	-0.264	-0.009	-0.014	4	12
Working mother	-0.001	0.001	-0.004	0.003	0.168	0.120	-0.001	0.000	0	0
Birth order of child	0.005	-0.002	0.276	-0.210	-0.109	-0.072	-0.030	0.015	12	-13

Wanted last child	0.017	0.011	0.185	0.416	0.032	0.015	0.006	0.006	-2	-5
Male household head	-0.021	-0.008	-0.323	-0.341	0.006	0.005	-0.002	-0.002	1	2
Gender of child (male)	-0.001	0.004	-0.005	0.098	-0.004	0.001	0.000	0.000	0	0
Using modern contraceptive	-0.036	-0.020	-0.244	-0.523	0.166	0.047	-0.041	-0.025	16	21
Having a terminated pregnancy	0.019	0.001	0.084	0.014	-0.019	-0.065	-0.002	-0.001	1	1
Using antenatal care	-0.018	0.000	-0.117	0.008	0.303	0.027	-0.035	0.000	14	0
Using medical place of delivery	0.017	-0.004	0.096	-0.140	0.326	0.049	0.031	-0.007	-12	6
Having a hygienic toilet	-0.015	-0.001	-0.051	-0.043	0.684	0.145	-0.035	-0.006	14	5
Delivery by caesarian section	0.038	0.001	0.043	0.029	0.347	0.111	0.015	0.003	-6	-3
Clean drinking water	-0.001	0.000	-0.014	-0.015	0.137	0.014	-0.002	0.000	1	0
Total observed CI							-0.253	-0.115	97	98
Residual CI							-0.009	-0.003	3	2
Total CI							-0.262	-0.118	100	100

[a] Reference category

Regarding the column titled % share, the value of the % share of variable K is positive (negative) k, then the inequality in under-five mortality would decline (raise) by k% if the variable were to become equally divided across the socio-economic households (Rarani et al., 2017b). In 1995, the highest share to socioeconomic inequality in under-five mortality was due to households' economic status (54%) which explained if income were equally divided among households from various socioeconomic groups, then inequality in under-five mortality would decrease by 54%. Furthermore, using modern contraceptive (16%), using skilled prenatal care (14%), having a hygienic toilet (14%), and birth order of child (12%) revealed notable shares to socioeconomic inequality in under-five mortality in 1995. Residence in rural areas (4%), and mother's education (3%) also proved less prevalent shares to the measured inequality in 1995. On the other hand, mother's education in 2014 made the largest share to inequality in under-five mortality (38%) which illustrated if education were equally divided among different mothers, then inequality in under-five mortality would reduce by 38%. Moreover, households' economic status (35%), using modern contraceptive (21%), and residence in rural areas (12%) showed remarkable shares to observed inequality in 2014. Using medical place of delivery (6%), and having a hygienic toilet (5%), also scored less remarkable shares to the measured inequality in 2014.

Table 3 showed that the volume of break down in explained inequalities in under-five mortality between 1995 and 2014 were due to changes in mother's education, residence in rural areas, and using medical place of delivery. Oppositely, changes regarding households' economic status, birth order of child, using skilled prenatal care, and having a hygienic toilet remarked to narrow inequality in under-five mortality between 1995 and 2014. Moreover, changes in mother's

age at birth, working mother, wanted last child, male household head, male child, delivery by caesarian section, clean drinking water and having a terminated pregnancy were negligible.

The total normalized concentration index of under-five mortality in 1995 and 2014 were -0.262 and -0.118, respectively. Moreover, the explained components of the total observed normalized concentration indices in 1995 and 2014 were -0.247 and -0.114, respectively. These components showed that determinants of under-five mortality could illustrate 97% and 98% of the measured inequalities in under-five mortality in Egypt in 1995 and 2014, respectively. Finally, the residual components were 3% and 2% in the two surveys, respectively.

Table 4: Changes in socioeconomic inequality in under-five mortality in Egypt between 1995 and 2014: An Oaxaca decomposition analysis

	η: Elasticity, C: Concentration Index (measure of inequality), t:2014, and (t-1):1995							
	Differences in		**share**			**% share**		
Determinants	**Elasticity** $(\eta_{kt}-\eta_{kt-1})$	**Inequality** $(C_{kt}-C_{kt-1})$	**Elasticity** $C_{kt-1}(\eta_{kt}-\eta_{kt-1})$	**Inequality** $\eta_{kt}(C_{kt}-C_{kt-1})$	**Total**	**Elasticity**	**Inequality**	**Total**
Education of woman								
Uneducated	-0.0658	-0.0247	0.0231	-0.0029	0.0203	16.80	-2.08	14.72
primary and secondary	0.0572	-0.2123	0.0122	-0.0680	-0.0559	8.85	-49.40	-40.55
Higher[a]								
Sum						**26**	**-51**	**-26**
Wealth index								
Poorest	-0.0907	-0.0469	0.0709	-0.0028	0.0681	51.44	-2.02	49.42
Poorer	-0.1004	-0.1004	0.0364	-0.0003	0.0361	26.42	-0.21	26.21
Middle	0.0037	-0.0627	0.0002	-0.0021	-0.0019	0.11	-1.51	-1.39
Richer	-0.0154	0.0092	-0.0067	0.0002	-0.0064	-4.84	0.16	-4.68
Richest[a]								
Sum						**73**	**-4**	**70**
Age of mother at birth								
15-19	-0.0199	-0.0172	0.0026	0.0001	0.0027	1.86	0.08	1.94
20-24	-0.1504	0.0364	0.0111	-0.0028	0.0083	8.08	-2.05	6.03
25-29	-0.1904	-0.0091	-0.0076	0.0011	-0.0065	-5.51	0.81	-4.70
30-34	-0.0659	-0.0453	-0.0051	0.0030	-0.0020	-3.67	2.20	-1.47
35-39	0.0004	-0.0259	0.0000	0.0004	0.0004	0.00	0.32	0.32
40-49[a]								
Sum						**0.76**	**1.35**	**2.12**
Residence in rural	0.0192	0.0153	-0.0054	0.0008	-0.0046	-3.90	0.59	-3.31
Working mother	0.0068	-0.0481	0.0012	-0.0001	0.0010	0.84	-0.11	0.73
Birth order	-0.4860	0.0371	0.0529	-0.0078	0.0452	38.44	-5.65	33
Wanted last child	0.2314	-0.0169	0.0074	-0.0070	0.0004	5.35	-5.10	0.26
Male household head	-0.0182	-0.0005	-0.0001	0.0002	0.0001	-0.08	0.13	0.06
Gender of child (male)	0.1028	0.0050	-0.0004	0.0005	0.0001	-0.32	0.36	0.04
Using modern contraceptive	-0.2784	-0.1192	-0.0463	0.0623	0.0160	-33.63	45.21	12

Having a terminated pregnancy	-0.0707	-0.0462	0.0014	-0.0006	0.0007	0.99	-0.46	0.53
Using antenatal care	0.1243	-0.2759	0.0376	-0.0021	0.0355	27.31	-1.54	26
Using medical place of delivery	-0.2361	-0.2766	-0.0770	0.0387	-0.0383	-55.87	28.10	-27.77
Having a hygienic toilet	0.0082	-0.5385	0.0056	0.0230	0.0286	4.07	16.67	21
Delivery by caesarian section	-0.0144	-0.2364	-0.0050	-0.0067	-0.0118	-3.63	-4.90	-8.53
Clean drinking water	-0.0007	-0.1231	-0.0001	0.0019	0.0018	-0.07	1.35	1.28
Total			**0.1089**	**0.0289**	**0.1377**	**79**	**21**	**100**

[a] Reference category

Table 4 illustrated the changes of socioeconomic inequality in under-five mortality between 1995 and 2014 using an Oaxaca decomposition analysis. It presented the difference in elasticity $(\eta_{kt} - \eta_{kt-1})$, the difference in inequality $(C_{kt} - C_{kt-1})$, the shares of elasticity $C_{kt-1}\ (\eta_{kt} - \eta_{kt-1})$, the shares of inequality $\boldsymbol{\eta_{kt}}\ (C_{kt} - C_{kt-1})$, the shares of total (elasticity and inequality) and percentage shares of elasticity, inequality and total.

A positive change in elasticity share indicates declined effect of the determinants of socioeconomic inequality in under-five mortality, while a negative change indicates increased effect. Similarly, a positive change in concentration index share indicates a decline in inequalities and the negative indicates an increase in inequalities in the determinants of socioeconomic inequality in under-five mortality.

The findings show that the highest share of determinants to decrease the changes in socioeconomic inequality in under-five mortality was due to household's economic status (70%). Moreover, Birth order of child (33%), using skilled prenatal care (26%), having a hygienic toilet (21%), and using modern contraceptive (12%), revealed notable shares to decline the changes in socioeconomic inequality in under-five mortality. Clean drinking water and mother's age at birth also proved less prevalent shares to decrease the measured inequality. All these mentioned determinants pushed inequality towards line of equality.

In the other hand, % share of changes in determinants specifically using medical place of delivery, mother's education, delivery by caesarian section, and residence in rural areas increased the changes in socioeconomic inequality in under-five mortality. Furthermore, changes in working mother, wanted last child, male household head, male child, and having a terminated pregnancy were negligible.

Discussion

Concentration curve at previous studies had shown that socio-economic disparities in under-five morality have declined over time (Sharaf & Rashad, 2015; Rarani et al., 2018).Our study findings also support this notion as the concentration curve indicated a decrease in the degree of

under-five mortality between the poor and the rich households over time where concentration curve for the year 2014 is closer to the equality line than that for the year 1995.

The burden of under-five mortality inequality in Egypt was concentrated among disadvantaged households in 1995 and 2014. This result is in conformity with what is demonstrated in several previous studies (Wagstaff, 2000; Hosseinpoor et al., 2005; Sharaf & Rashad, 2015; Rarani et al., 2017a&b). Similar to finding of other studies, the results found that however pro-rich inequality remains over that period, inequality in under-five mortality decreased by 55% in Egypt between 1995 and 2014 (Sharaf & Rashad, 2015; Khajavi et al., 2017; Rarani et al., 2017b).

Our findings demonstrate that the largest shares to under-five mortality inequality changed from 1995 to 2014 in Egypt. Inequalities in household's economic status and mother's education were the largest shares to under-five mortality inequality in 1995 and 2014, respectively. This result suggested that the change in under-five mortality inequality was most sensitive to these two factors. These results were consistent with findings obtained from other studies (Khajavi et al., 2017; Rarani et al., 2017b). The contribution of wealth index to under-five mortality inequality decreased by 45% from 1995 to 2014. In contrast, the contribution of woman's education increased by 28% from 1995 to 2014. These results were inconsistent with findings obtained from a previous study which discussed changes in socio-economic inequality in neonatal mortality in Iran between 1995 and 2010 (Rarani et al., 2017b).

Conclusion

One of the main objectives of several national governments is tackling health inequalities in mortality within countries (Ostlin et al. 2005). The present study clarified changes in socioeconomic inequality in under-five mortality in Egypt between 1995 and 2014 using decomposition approach. The main contributors to under-five mortality inequality changed over that period. The results indicate that there was a pro-rich inequality in under-five mortality in both surveys however the inequality in under-five mortality declined over time. The findings demonstrate that household's economic status, birth order of child, using skilled prenatal care, and having a hygienic toilet were responsible for narrowing inequality of under-five mortality in Egypt between 1995 and 2014.

In overall, mother's education, residence in rural areas, father's education, and using medical place of delivery were responsible for inequality of under-five mortality in Egypt between 1995 and 2014. Therefore, more governmental intervention is advised to improve education of parents to decline of inequality in under-five mortality. In addition, it is important to target women who live in rural areas.

Strengths and limitations

This paper explores changes in socioeconomic inequality in under-five mortality over time using decomposition approach for the first time in Egypt. The study selected only last child of the mother to overcome correlation between births since mother may have more than one birth during the study period. The first limitation of this study is depending on wealth index as a proxy variable of income. The other limitation of the study is related to the decomposition analysis. Changes in inequality between 1995 and 2014 can be measured by Oaxaca-type decomposition instead of the simplest method in equation (5). Oaxaca-type decomposition will be used in further research.

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