

ORIGINAL RESEARCH

Rural-Urban Differences in Trends in the Wealth Index in Kenya: 1993-2009



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Abstract

BACKGROUND The aim of this study was to construct a wealth index that could be compared over time in order to understand the trends in wealth in Kenya and determine predictors of change in wealth index.

METHODS Data were from the Demographic and Health Survey program collected in Kenya between 1993 and 2009. Variable categories were collapsed to match and factor analysis was performed on the 4-year pooled data to generate a harmonized wealth index. Possible predictors of wealth were selected from household variables available for all 4 years. Household sampling weights and stratification by rural/urban was used.

RESULTS Overall, wealth increased in Kenya between 1993 and 2008; however, when stratified, no significant increase existed in urban areas and a significant increase was identified in rural areas specifically between 2003 and 2008. The strongest predictor was education, with more than a standard deviation difference for secondary or higher levels of education over those with no education. The association of gender of the head of household and whether the head of household had a partner differed between rural and urban areas, with household heads who were women and those who had a partner having more wealth in urban areas but less wealth in rural areas.

CONCLUSION Wealth in Kenya increased over time, specifically in rural regions. Differences were identified in predictors of wealth by urban/rural residence, educational level, and gender of the head of household and should be taken into account when planning interventions to target those in disproportionately low wealth brackets.

KEY WORDS wealth, rural, urban, Demographic and Health Survey, Kenya

INTRODUCTION

The importance of wealth in the health of individuals and populations has been found across the globe.¹ Poorer nations tend to have inferior health to wealthier nations, poorer people have worse health outcomes compared with wealthier people,

and economic growth has been found to improve health.¹⁻³ Health at the population level is an important factor in stimulating economic growth, through accumulation of both human and physical capital.^{3,4} For example, between 2000-2011 a quarter of the economic growth in low- and middle-income countries was attributed to health

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improvements.⁴ Not only adult survival but also disease prevalence rates and cognitive functioning have been reported as important factors in maintaining a supply of skilled labor, which is necessary for economic growth.⁵ At the macroeconomic level, health has also been linked to gross domestic product, such that a 4% raise in gross domestic product per capita is associated with a 1-year increase in life expectancy.⁴ At the personal level, income is one of the strongest determinants of health outcomes.^{1,3,4} Socioeconomic disparities in health as a result of differential income have been found in childhood mortality, immunization, treatment of common childhood illnesses, health-related behaviors, and health status determinants.^{6,7}

Difficulties in understanding the relationship between health and wealth and the possible factors that may mediate this relationship, such as education, housing, and sanitation, are in part the result of measurement problems surrounding both health and wealth.³ More recent studies have overcome some difficulties in collecting preferred indicators of economic status, such as income, which are less reliable in low- and middle-income countries, by using a wealth index.⁶ This index uses easy-to-collect information on assets, housing construction materials, and types of water and sanitation access to create a continuous scale of relative wealth and generate a measure of a household's standard of living.⁸ One of the strongest utilities of the wealth index is that it creates a standard for comparison across nations, especially with varying reliability and accessibility of income and expenditure data.⁸ The wealth index allows for comparison of socioeconomic disparities across health outcomes, and differences in access between poor and wealthy communities.

Although marginal in some areas, current health indicators reveal that Kenya has had improvement in overall population health.^{9,10} Notable of those indicators is the life expectancy increasing from 45.2 years in 1990s to 60 years in 2012.⁹ Other indicators such as infant and under-5 mortality rate have experienced similar improvement, from 77 and 115 in the 1990s to 48 and 73 per 1000 live births, respectively, in 2012.^{9,10} Despite these advances, disparities in health along lines of gender, ethnic group, socioeconomic status, and geographic access are present and affect health care outcomes.^{9,11-13} Children who are both economically and geographically vulnerable were found to be the most disadvantaged.¹⁴ Communicable diseases remain high and noncommunicable diseases are

increasing.^{10,15-17} Therefore, addressing barriers to health care will likely be a key element in positively affecting health outcomes in the long term.¹⁸

Use of the wealth index has been helpful in identifying differences by socioeconomic status in order to focus intervention efforts. In Kenya, disparities were found among the number of children immunized; for instance, in 2008, 73% of children in Nairobi were immunized, compared with 53% of children living in less urban communities.¹⁹ Among children in Nigeria, children from the wealthiest households are 13 times more likely to receive vaccination than those from the poorest families.⁸ African nations, including Tanzania, have a significantly higher prevalence of HIV among women in the wealthiest households compared with the poorest.⁸

Understanding such disparities may lead to targeted interventions to improve health outcomes for those in disproportionately low wealth brackets.^{15,20} For example, use of the wealth index has allowed for identification of various sociodemographic determinants of health in several countries.⁸ However, the literature indicates that the wealth index, as a tool, has been underutilized in Kenya, with limited data identified to understand the sociodemographic determinants of health outcomes. Therefore, the aim of this study was to construct a wealth index that can be compared over time in order to understand the trends in wealth in Kenya and determine predictors of change in wealth index.

METHODS

Study Sample. Data were from the Demographic and Health Survey (DHS) program collected through 4 surveys conducted in Kenya between 1993 and 2009.²¹⁻²⁴ The DHS program provides nationally representative data on topics such as domestic violence, child health, nutrition, HIV/AIDS, wealth, and women's empowerment collected in more than 90 countries.^{25,26} The household questionnaire is used to record data specific to the household, as well as specific to the individuals living in the household. Individual specific information includes gender, age, and education of the household head. Household-specific characteristics include region type, district, source of drinking water, toilet facilities, cooking fuel, and assets of the household. Surveys are population based to provide data that are comparable across countries. Each country uses a standard model questionnaire format but questions may be added if of particular interest

or deleted if deemed irrelevant. The model questionnaires change over time to improve data collection methods, which may lead to differences in questions or response options asked from year to year.

The present study used the household questionnaire data from the Kenya Demographic and Health Survey (KDHS) from 1993, 1998, 2003, and 2008/2009, creating a total sample size of 33,948 households. Population-based data collection design involved clustering urban or rural areas from the national master sample frame and systematic sampling of households from an updated list of households. Men and women aged 15–49 years who were either usual residents or visitors in the household on the night before the survey were eligible for the household interview. The response rate was 90% for KDHS 1993, 97% for KDHS 1998, 96% for KDHS 2003, and 98% for KDHS 2008/2009.^{21–24} Of note, data for the Northeastern district were collected only for the 2003 and 2008/2009 KDHS surveys, and therefore these were used only for the creation of the wealth index but not for the regression analyses (0.9% of the data were discarded).

Construction of the Harmonized Wealth Index. The DHS wealth index is a relative measure of socioeconomic status²⁷ and is constructed for each survey using household assets and amenities.²⁸ The DHS wealth index is survey specific and therefore results are applicable only for a specific country and at a given time.^{27,28} To address this issue, the harmonized wealth index²⁹ has been proposed in order to generate an absolute measure of wealth that can be compared over time. The main steps in constructing the harmonized wealth index are (1) identify household asset variables measured across all years, (2) harmonize the categorical variables such that equivalent categories are available across all years, (3) perform a data reduction analysis using factor analysis to generate wealth scores for each household.

For Kenya, we identified 11 common asset variables measured by the DHS surveys across 4 years: assets including electricity, radio, television, refrigerator, and bicycle; the source of drinking water; type of toilet facility; main floor material; main roof material; number of people sleeping per room; and whether the household had a domestic worker. Categories from later surveys were collapsed such that they would match earlier surveys with fewer categories. An indicator variable was

generated for each category and any missing values were replaced with zero.²⁷ The number of people sleeping per room was rounded to the nearest integer with the exception of values between 0 and 1, which were rounded to zero, and missing values were imputed with the average value.²⁹ Following DHS methodologic reports on creation of wealth indices, factor analysis was performed on the pooled data, with factor extraction based on principal component analysis and adjusted for household sampling weights.²⁹ Scores corresponding to the first factor were estimated using the “predict” statement in Stata Version 13 (Statacorp LP, College Station, TX), with the default regression scoring assumed.

Of note, the wealth index provides a wealth status more specific to the urban area.³⁰ Questions more relevant to wealth for the rural areas (such as “land owned,” “number of chattel”) were included only in more recent surveys and therefore could not be used in the construction of the harmonized wealth index. To address this issue, when determining predictors of wealth, analyses were stratified by region (urban vs rural).³⁰

Predictors of Wealth. Possible predictors of wealth were selected from household variables that were available for all 4 years. These included age of the head of the household (continuous), gender of the head of the household (male, female), whether the head of a household has a wife/husband/partner (yes, no), educational attainment of the head of the household (no education, incomplete primary, complete primary, incomplete secondary, complete secondary, higher), and district (Nairobi, Central, Coast, Eastern, Nyanza, Rift Valley, Western).

Ethics and Consent. Approval was obtained from the DHS program to download and use applicable DHS datasets. The study did not require ethics approval because DHS data are publicly available and are deidentified. Consent to publish was not required.

Statistical Analysis. Analysis was conducted in 3 steps. First, correlations (for continuous variables) or 1-way analysis of variance (for categorical variables) were run between the wealth index and possible predictors. Second, a series of unadjusted regression models were used to assess associations between each predictor and the wealth index. Finally, an adjusted regression model was run between the predictors of interest and the wealth index. The adjusted regression model was constructed in a hierarchical manner with variables entered in blocks: block 1, demographic variables

(age, gender, and partner); block 2, educational attainment; and block 3, district.

To correct for oversampling or undersampling, we used the household sampling weights (hv005) available in the household record files. The sampling weights provided by DHS are normalized for each year, so for our 4-year pooled dataset DHS weights were adjusted by dividing each household weight by 4. The adjusted weights were used in the factor analysis for the wealth index as well as in the regression analyses. Regression analyses also accounted for clustering (using primary sampling unit identifier hv021) and stratification (using sample stratum number hv022) in a complex survey design statement (“svyset” in Stata). All analyses were performed using Stata Version 13, and a 2-tailed α of 0.05 was used to assess significance.

RESULTS

Construction of the Harmonized Wealth Index. The harmonized wealth index constructed for the pooled data over the 4 years (1993, 1998, 2003, and 2008/2009) was highly correlated with the original DHS wealth index (0.98, 0.97, 0.93, and 0.94, respectively). Summary statistics of the variables included in the formation of the wealth index and loadings corresponding to the first factor are presented in Table 1. The corresponding scoring coefficients are also presented in Table 1. These represent the regression coefficients used to estimate the wealth index for each individual. The negative loadings in the factor analysis and corresponding negative scoring coefficients suggest that lower wealth was associated with an increased number of

Table 1. Harmonized Wealth Index Factor Analysis

Variable	Overall (N = 33,948)	1993 (n = 7950)	1998 (n = 8380)	2003 (n = 8561)	2008/2009 (n = 9057)	Factor Loadings	Scoring Coefficients
1 Domestic worker	.017	0.010	0.013	0.029	0.014	0.272	0.055
2 Sleep per room	2.788	2.837	2.795	2.636	2.723	−0.289	−0.061
3 Has electricity	.171	0.099	0.124	0.214	0.254	0.771	0.151
4 Has radio	.647	0.514	0.618	0.744	0.712	0.402	0.081
5 Has television	.172	0.055	0.115	0.240	0.297	0.678	0.135
6 Has refrigerator	.052	0.026	0.033	0.087	0.091	0.550	0.115
7 Has bicycle	.256	0.220	0.249	0.276	0.287	0.010	0.004
8 Source of drinking water							
Piped house	.228	0.192	0.209	0.243	0.262	0.670	0.128
Piped public	.124	0.145	0.124	0.122	0.106	0.032	0.002
Well	.211	0.203	0.215	0.181	0.243	−0.148	−0.033
River	.198	0.332	0.042	0.315	0.115	−0.313	−0.054
Lake	.183	0.073	0.374	0.057	0.223	−0.290	−0.057
Rain	.019	0.021	0.013	0.023	0.019	0.043	0.006
Other water	.035	0.029	0.021	0.057	0.032	0.048	0.013
9 Type of toilet facility							
Own flush	.073	0.046	0.057	0.083	0.102	0.615	0.126
Public flush	.050	0.040	0.035	0.061	0.064	0.353	0.062
Traditional pit	.615	0.685	0.689	0.600	0.500	−0.315	−0.057
Ventilated pit	.096	0.067	0.070	0.079	0.161	0.171	0.027
No facility	.158	0.152	0.142	0.169	0.166	−0.370	−0.074
Other toilet	.005	0.005	0.002	0.006	0.007	0.012	0.004
10 Main floor material							
Natural	.615	0.696	0.650	0.579	0.545	−0.807	−0.154
Rudimentary	.006	0.004	0.011	0.006	0.004	0.050	0.013
Finished	.375	0.296	0.335	0.409	0.449	0.800	0.152
Other floor	.001	0.0005	0.0002	0.004	0.0006	0.056	0.012
11 Main roof material							
Natural	.268	0.353	0.291	0.224	0.213	−0.539	−0.104
Rudimentary	.661	0.607	0.673	0.669	0.690	0.259	0.041
Finished	.061	0.028	0.026	0.090	0.095	0.520	0.111
Other roof	.007	0.004	0.007	0.015	0.002	−0.010	−0.001

Table 2. Sample Demographic Characteristics Stratified by Region												
Variable	Urban					P	Rural					P
	Overall	1993	1998	2003	2008		Overall	1993	1998	2003	2008	
	(N = 7932)	(n = 1527)	(n = 1988)	(n = 2104)	(n = 2314)		(N = 25,630)	(n = 6423)	(n = 6392)	(n = 6270)	(n = 6545)	
	% or Mean ± Standard Deviation						% or Mean ± Standard Deviation					
Gender*												
Male	75.0	78.5	76.8	74.5	71.6	.08	65.2	64.7	65.6	66.1	64.5	.57
Female	25.0	21.5	23.2	25.5	28.4		34.8	35.3	34.4	33.9	35.5	
Partner*												
No	52.8	55.7	54.3	51.5	50.9	.22	44.5	44.3	44.6	42.7	46.2	.09
Yes	47.2	44.3	45.7	48.5	49.1		55.5	55.7	55.4	57.3	53.8	
Education*												
No education	8.2	9.8	7.9	7.1	7.0	.00	26.8	35.7	20.1	24.0	19.7	.00
Some primary	12.1	14.3	13.6	12.2	9.5		28.2	27.7	27.5	29.9	27.9	
Primary	21.3	22.3	19.7	24.3	19.4		23.6	20.8	22.2	23.6	27.7	
Some secondary	15.9	43.6	10.7	10.2	7.9		8.7	14.4	6.7	6.7	7.0	
Secondary	27.7	6.4	38.1	28.0	32.8		9.2	0.9	13.3	10.1	12.6	
Higher	14.9	3.8	10.1	18.1	23.4		3.4	0.5	2.2	5.7	5.3	
District†												
Nairobi‡	39.2	42.2	43.1	39.1	34.1	.97	0	0	0	0	0	.63
Central	7.3	8.4	5.2	8.8	6.9		16.7	18.0	17.0	18.6	14.01	
Coast	16.0	15.7	13.4	14.7	19.6		5.6	6.8	5.3	5.9	4.5	
Eastern	6.8	6.2	8.5	5.3	7.1		19.0	19.5	17.7	19.2	20.5	
Nyanza	7.6	6.3	10.2	6.8	7.0		19.2	17.9	22.5	18.3	19.1	
Rift Valley	17.5	16.5	14.5	19.4	18.9		25.0	23.3	24.1	24.3	29.3	
Western	4.8	4.8	5.2	4.3	4.9		13.4	14.5	13.4	14.0	12.6	
Age*	37.8 ± 12.44	36.7 ± 11.81	37.6 ± 12.14	37.4 ± 12.26	38.5 ± 13.04	.46	46.2 ± 16.16	46.7 ± 16.13	46.2 ± 15.76	45.5 ± 16.26	46.3 ± 16.26	.01
Wealth Index	1.13 ± 1.09	0.87 ± 1.03	0.94 ± 1.03	1.12 ± 1.11	1.38 ± 1.08	.00	−0.34 ± 0.68	−0.47 ± 0.61	−0.38 ± 0.66	−0.28 ± 0.71	−0.21 ± 0.73	.00

* Variable is specific to the head of household.

† Northeastern region was included in wealth index construction but excluded from sample demographics and regression analyses because it did not appear in all datasets.

‡ No rural population in Nairobi.

people sleeping per room; drinking water from well, river, or lake; using a traditional pit or no toilet; and living in a dwelling with natural roof or natural floor. The proportion of total variance explained by the first factor alone was 18%. The mean of the harmonized wealth index for the 4-year pooled data was 0.02, with a standard deviation of 1.03 and a range between -1.50 and 3.44.

Sample Demographics. The sample demographic characteristics stratified by region (urban/rural) are presented in Table 2. There were 8565 households in the urban regions and 24,280 households in the rural regions in the 4-year pooled dataset. For the urban regions, the head of the household was 37.8 years old on average, usually male (75%), and more likely to have completed primary (21.3%) or secondary education (27.7%). Most households in the urban area were sampled from Nairobi, Coast, or Rift Valley regions (72.7% overall). For the rural regions, the head of household was slightly older (46.2 years) and was more likely to have no education (26.8%), incomplete primary education (28.2%), or complete primary education (23.6%). Similar to the urban areas, the head of the household was usually male (65%). Most rural households were sampled from Rift Valley, Eastern, or Nyanza regions (63.2% overall). Across years, there were statistically significant differences in the levels of education of the head of the household and levels of wealth index that suggested an increasing trend over time for both rural and urban areas.

Trends in Wealth Index. Figure 1 shows plots of mean wealth index across the 4 years, based on the unadjusted and final adjusted models, overall and stratified by region. Overall, wealth index increased over time with adjusted means not increasing until after 1998. For the urban area, the unadjusted means suggest an increase in wealth over time. However, the adjusted means suggest a nonlinear relationship between wealth and time, with a decrease in wealth from 1993 to 1998, a slow increase from 1998 to 2003, and a steeper increase from 2003 to 2008/2009. For the rural area, both adjusted and unadjusted means suggest a linear increasing trend in wealth over time, with a similar delay in the increase in wealth as found in the overall model.

Predictors of Wealth. Table 3 presents results of the unadjusted and adjusted regression analyses. In the unadjusted models for the urban areas, in 2008/2009 the average wealth was significantly higher compared with 1993 ($\beta = 0.46, P < .01$). Increasing age of head of household was

significantly associated with increased wealth ($\beta = 0.01, P < .01$). Households where a woman was the head of household were associated with less wealth ($\beta = -0.08, P < .05$), whereas heads of household with a partner were associated with more wealth ($\beta = 0.24, P < .001$). Increasing education was associated with greater wealth when compared with no education for those who completed primary ($\beta = 0.19, P < .01$), had incomplete secondary ($\beta = 0.60, P < .001$), completed secondary ($\beta = 0.93, P < .001$), and had higher education ($\beta = 1.66,$

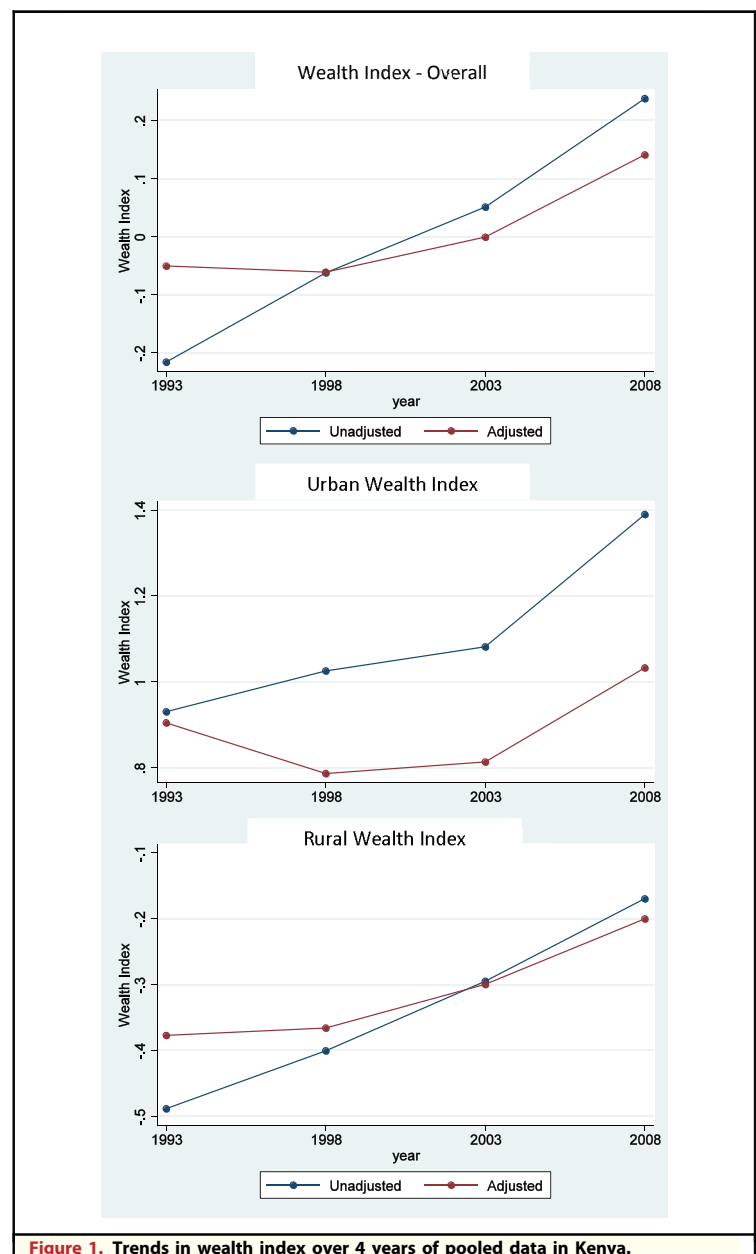


Figure 1. Trends in wealth index over 4 years of pooled data in Kenya.

$P < .001$). Nairobi had the highest levels of wealth compared with all other regions.

In unadjusted models for the rural areas, there was a significant increase in the wealth index for all 3 years (1998, 2003, 2008/2009) compared with the reference year 1993 ($\beta = 0.09$, $\beta = 0.19$, and $\beta = 0.32$, respectively). Increasing age of head of household was significantly associated with decreased wealth ($\beta = -0.002$, $P < .01$). Heads of household who were women ($\beta = -0.07$, $P < .001$) and those with a partner ($\beta = -0.05$, $P < .001$) were associated with less wealth. Similar to the urban regions, increasing education was associated with greater wealth compared with no education for those with some primary

($\beta = 0.32$, $P < .001$), complete primary ($\beta = 0.32$, $P < .001$), incomplete secondary ($\beta = 0.46$, $P < .001$), complete secondary ($\beta = 0.75$, $P < .001$), and higher education ($\beta = 1.38$, $P < .001$). The Central region had the highest levels of wealth compared with all other regions.

In the final model (model 3) for the urban areas, after adjusting for demographics, education, and district, there was no statistical difference in wealth across the 4 years. Moreover, results suggest that there was a decrease in wealth in 1998 and 2003 before an increase in 2008, though none of these coefficients were significant. Increased wealth was associated with a head of household who was older ($\beta = 0.01$, $P < .001$), female ($\beta = 0.21$, $P < .001$),

Table 3. Unadjusted and Adjusted Hierarchical Models for the Association Between Wealth Index and Predictors

Variable	Urban				Rural			
	Unadjusted Univariate				Unadjusted Univariate			
	Analyses	Model 1	Model 2	Model 3	Analyses	Model 1	Model 2	Model 3
Year								
1993	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
1998	0.10	0.08	-0.13	-0.12	0.09 [†]	0.08 [†]	-0.003	0.01
2003	0.13	0.14	-0.12	-0.09	0.19 [‡]	0.19 [‡]	0.08 [‡]	0.08 [‡]
2008	0.46 [‡]	0.44 [‡]	0.07	0.13	0.32 [‡]	0.31 [‡]	0.16 [‡]	0.18 [‡]
Age	0.01 [†]	0.01 [†]	0.01 [‡]	0.01 [‡]	-0.002 [‡]	-0.001 [†]	0.01 [‡]	0.01 [*]
Gender								
Male	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
Female	-0.08 [‡]	0.03	0.16 [‡]	0.21 [‡]	-0.07 [‡]	-0.27 [‡]	-0.13 [‡]	-0.11 [†]
Partner								
No	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
Yes	0.24 [‡]	0.23 [‡]	0.15 [‡]	0.19 [‡]	-0.05 [‡]	-0.25 [‡]	-0.27 [†]	-0.24 [*]
Education								
No education	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
Some primary	0.04	0.04	0.23 [‡]	0.22 [†]	0.12 [‡]	0.12 [‡]	0.21 [‡]	0.20 [‡]
Primary	0.19 [†]	0.19 [†]	0.41 [‡]	0.38 [‡]	0.32 [‡]	0.32 [‡]	0.44 [‡]	0.39 [‡]
Some secondary	0.60 [‡]	0.60 [‡]	0.78 [‡]	0.75 [‡]	0.46 [‡]	0.46 [‡]	0.60 [‡]	0.57 [‡]
Secondary	0.93 [‡]	0.93 [‡]	1.14 [‡]	1.08 [‡]	0.75 [‡]	0.75 [‡]	0.87 [‡]	0.82 [‡]
Higher	1.66 [‡]	1.66 [‡]	1.81 [‡]	1.70 [‡]	1.38 [‡]	1.38 [‡]	1.45 [‡]	1.41 [‡]
District								
Nairobi	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)	(Ref)
Central	-0.61 [‡]	-0.61 [‡]	-0.61 [‡]	-0.49 [‡]	-0.49 [‡]	-0.49 [‡]	-0.49 [‡]	-0.41 [‡]
Coast	-0.68 [‡]	-0.68 [‡]	-0.68 [‡]	-0.47 [‡]	-0.47 [‡]	-0.47 [‡]	-0.47 [‡]	-0.25 [‡]
Eastern	-0.53 [‡]	-0.53 [‡]	-0.53 [‡]	-0.36 [‡]	-0.36 [‡]	-0.36 [‡]	-0.36 [‡]	-0.48 [‡]
Nyanza	-0.67 [‡]	-0.67 [‡]	-0.67 [‡]	-0.66 [‡]	-0.66 [‡]	-0.66 [‡]	-0.66 [‡]	-0.48 [‡]
Rift Valley	-0.57 [‡]	-0.57 [‡]	-0.57 [‡]	-0.50 [‡]	-0.50 [‡]	-0.50 [‡]	-0.50 [‡]	-0.33 [‡]
Western	-0.70 [‡]	-0.70 [‡]	-0.70 [‡]	-0.64 [‡]	-0.64 [‡]	-0.64 [‡]	-0.64 [‡]	-0.48 [‡]

Unadjusted analyses between wealth index and each covariate of interest.
Adjusted analyses entered in blocks based on theoretical relationships—block 1, demographics; block 2, socioeconomic; block 3, region.
Ref, reference group.
* $P < .05$.
† $P < .01$.
‡ $P < .001$.

or had a partner ($\beta = 0.19$, $P < .001$) and those with increasing levels of education (incomplete primary [$\beta = 0.22$, $P < .01$], complete primary [$\beta = 0.38$, $P < .001$], incomplete secondary [$\beta = 0.46$, $P < .001$], complete secondary [$\beta = 0.75$, $P < .001$], or higher education [$\beta = 1.38$, $P < .001$]). Nairobi had the highest levels of wealth.

For the rural areas, the final adjusted model (model 3) suggests that the wealth index increased over time and was significantly higher for 2003 ($\beta = 0.08$, $P < .01$) and 2008/2009 ($\beta = 0.18$, $P < .001$) compared with 1993. Similar to the urban region, increased wealth was associated with a head of household who was older ($\beta = 0.01$, $P < .05$) and those with increasing levels of education (incomplete primary [$\beta = 0.20$, $P < .001$], complete primary [$\beta = 0.39$, $P < .001$], incomplete secondary [$\beta = 0.57$, $P < .001$], complete secondary [$\beta = 0.82$, $P < .001$], and higher education [$\beta = 1.41$, $P < .001$]). Unlike for the urban region, decreased wealth was associated with a head of the household who was a female ($\beta = -0.11$, $P < .05$) or had a partner ($\beta = -0.24$, $P < .05$). The Central region had the highest levels of wealth.

DISCUSSION

By creating a harmonized wealth index measure, the present study found that overall wealth increased in Kenya between 1993 and 2008; however, when stratified by rural versus urban regions, the wealth index indicated no significant increase in urban areas and a significant increase in rural areas specifically between 2003 and 2008. As may be expected, the strongest predictor of wealth was education, with more than a standard deviation difference over those with no education for those with secondary or higher levels of education in both rural and urban areas. Wealth consistently increased with increasing levels of education; however, the change in wealth index for secondary and higher levels of education was higher for those in urban areas than those in rural areas. The association of gender of the head of household and whether the head of household had a partner also differed between rural and urban areas, with household heads who were women and those who had a partner having more wealth in urban areas but less wealth in rural areas. Increased age was associated with higher wealth, but the degree of association was low. Finally, region was a significant factor in wealth, with Nairobi (for urban households) and the Central region (for

rural households) having significantly higher wealth. The Nyanza and Western regions had the lowest wealth for both rural and urban households.

These results have implications for addressing the health disparities resulting from socioeconomic differences in low- and middle-income countries such as Kenya. Given the immense literature supporting the relationship between health and wealth,¹⁻⁶ addressing economic opportunities when seeking to improve health in communities is one way to promote health. Good health promotes the capacity to obtain education, as well as the capacity to work, dramatically affecting income at the household level.³ Structural interventions promote health by altering the structural contexts that affect the health of the population.³¹ Upgrading health care institutions, integrating disease-specific treatment into other essential services, community mobilization, and rooting interventions in laws and policies can all have multilevel influence and be highly sustainable.^{3,31} Results of this study can help guide development of structural interventions in Kenya and other low- and middle-income countries facing similar predictors of wealth by focusing efforts on areas that may have the most impact on the codependent relationship between increased health and increased wealth. For example, results indicated that changes in wealth and predictors of higher wealth differed by urban and rural residence. Higher wealth existed in Nairobi and the rural region closest to it (Central region), whereas wealth was lowest in the rural regions farthest from the capital (Nyanza and Western regions). This suggests a need to target rural communities far from city centers differently because the structural determinants of wealth may differ. For example, an intervention focused on improving health through improved food security in Rwanda focused on rural districts.³² Initiatives such as capital investment in agricultural inputs, assistance in small livestock projects, and provision of nutrition education were all targeted for the rural communities.³²

Results of this study also suggest the utility of a harmonized wealth index on guiding health policy recommendations, especially in the rural area. Geographic inequities and the impact on health have been noted globally, with more than 70% of those living in extreme poverty located in rural areas.^{33,34} Use of a wealth index to understand differences between rural and urban areas can offer insight on factors that are determinants of gaps and inform interventions to address them. For example, the

present study found that an incremental benefit of education to the wealth of a household differed by rural versus urban residence. Although the difference between no education and either some primary or primary was similar, the amount of benefit found by an increase in wealth difference for higher levels of education was rather significant (a difference of 0.3 standard deviations). Higher education predicted 1.70 standard deviations increase in wealth in urban areas and 1.40 in rural areas compared with those with no education. Additionally, a secondary education predicted a full standard deviation higher difference in wealth in urban areas. Although increased education is linked to an increase in wealth across residence type, these results may suggest a need to tailor interventions for the type of education most appropriate for economic opportunities available. For instance, providing secondary education along with technical skills appropriate for the area may be important in rural areas. One way to improve the health of rural communities while increasing education may be promotion of training in health professions. Comprehensive community programs that aim to increase community engagement with health while at the same time building the capacity to meet the health care needs to the community could result in increased education, increased wealth, and improved health outcomes. Investment in health care can have a multiplier effect, but policies to generate employment opportunities that do not take barriers such as access to education, gender equality, and access to preventative health services into account can lead to larger disparities.⁴

Finally, these results illustrate the importance of considering multiple factors influencing differences in wealth when implementing health policy. For example, it is important to note the gender differences in wealth changes by rural versus urban residence. Wealth for female heads of household was higher than male heads of household in urban areas but lower in rural areas. This may indicate a difference in the opportunities available to women in urban areas and suggests interventions are needed specifically to increase opportunities for economic advancement for women in rural areas. Microcredit programs are one example of an opportunity that aims to improve women's economic status and increase autonomy by removing economic dependency.³¹ A 4-year project in Nairobi to reduce adolescents' vulnerability to poor reproductive health

outcomes through improving livelihood options using microfinance found that after the program participants had significantly higher incomes, more assets, and lower risk reproductive practices.³⁵ The wealth index can be used to compare across populations target groups that may benefit most from creation of a microcredit or microfinancing opportunity. Because the index can be compared across countries, regions, and communities, nongovernmental organizations can use it to inform spending and locating new programs.

Although this study used a population-based sample and a large sample size, there were some limitations. First, to harmonize the wealth index newer questions used to calculate the index had to be removed. These newer questions were generally focused on better measurement of wealth in rural areas and so would not be expected to change the difference found in wealth over time, but their removal might have influenced comparisons between rural and urban areas. Second, the data were collected as 4 cross-sectional panels and therefore cannot be used as evidence of causation between variables. A number of factors over time may have influenced the predictors of wealth and how they changed. Finally, additional factors that were not measured as part of the DHS survey likely influence and predict wealth and should not be ignored when data on additional factors exists.

CONCLUSION

In conclusion, the present study found that overall wealth increased in Kenya between 1993 and 2008; however, when stratified by rural versus urban regions, the wealth index indicated no significant increase in urban areas and a significant increase in rural areas specifically between 2003 and 2008. Differences were found in predictors of wealth by urban versus rural residence, educational level, and gender of the head of household, and these should be taken into account when planning structural interventions, implementing health policy changes, and targeting priority populations with programs that can affect wealth and health in low- and middle-income countries such as Kenya.

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