ESI Preprints **Not Peer-reviewed**

Health Outcomes, Public Health Spending and Education nexus in Kenya

James Murunga, PhD
The Department of Economics, Machakos University, Kenya
Elijah Ruttoh Chebet, PhD
The Department of Economics, Daystar University, Kenya

Doi: 10.19044/esipreprint.12.2025.p474

Approved: 19 December 2025
Posted: 21 December 2025

Cite As:
Murunga, J. & Chebet, E.R. (2025). *Health Outcomes, Public Health Spending and Education nexus in Kenya.* ESI Preprints. https://doi.org/10.19044/esipreprint.12.2025.p474

Abstract

The Sustainable Development Goal 3 requires countries to provide good health and well-being for their people through quality health care. It is therefore important for a country to have information on the right mix of public expenditure in the health sector and education quality to have better health outcomes. This study contributes to achieving Goal 3 by studying the role of government spending on the health sector and the role education quality has on health outcomes, namely the longevity and child mortality rate in Kenya. The study adopts the ordinary least squares method to estimate this relationship. This study applies time series data for a period spanning from 1990 to 2022. The results show that government spending on the health sector has statistically significant asymmetric quadratic effects on health outcomes in Kenya. Results of the study reveal that sustainable government spending on the health sector can achieve better health outcomes, as 1.31 for the child mortality rate and 1.42 for longevity or life expectancy at birth. In addition, results show that interacting government expenditure in the health sector and education quality reduces child mortality rate and also improves longevity. Lastly, the interaction term indicates that improving education quality beyond a threshold of 1.81 can reduce child mortality rate and beyond 1.99 can improve longevity. The study therefore recommends that policymakers ensure both public health expenditure and educational quality exceed the established thresholds for sustainable health outcomes in Kenya.

Keywords: Health outcomes, longevity, Public health expenditures, Educational quality, Moderation modelling, Kenya

Introduction

Health and economic development are strongly correlated among many countries. Health improves the labour productivity of any country. Healthy individuals lose less time due to illness, thus making them productive when engaged in economic activity. Secondly, health contributes to the education of a country. Healthy children have higher cognitive ability. Childhood health also improves school attendance, an important factor in their educational performance. Again, adult health increases returns to education. The high returns may act as an incentive for individuals to invest in education. Thirdly, good health improves people's lifespan. This implies that individuals save for a longer period, thus contributing to countries' savings that are critical for development. This important role of health on economic performance has led to global discussions in focusing on the need for governments to increase public health spending. These discussions have mainly focused on the Sub-Saharan Africa region, which is characterised by low public health spending. Many countries in the region are yet to meet the Abuja Declaration of 2001, which requires health to take 15 per cent of countries' national budgets. The international community takes cognizance of public health spending as a critical component that can guarantee not only an effective but also efficient health sector performance. Public health spending is the primary source of resources for health systems. Public health spending is also critical for health sector performance through enhancing equity in the society, efficiency of the health system and health outcomes (Manda, Mugo and Murunga, 2020; Adegoke, George and Mbonigaba,2022). Other than public health expenditure, quality education is also important for better health outcomes (Xue, 2020).

In Kenya, the health outcomes are low. The child mortality rate and maternal mortality ratio are high, while longevity is low. Kenya’s child mortality rate is at 32 per 1000 live births compared to 26 per live births in South Africa. The mortality ratio is 536 per 1000000 live births, higher than 127 per 100 1000 live births in South Africa. The figure for Kenya is also higher than 12 per 100000 live births in highly industrialised countries. The longevity in Kenya is 61 years lower than 62 of South Africa. It is lower than 80 years for high-income countries (World Bank, 2022). The health outcomes among the developing countries attracted the attention United Nations, which came up with Millennium Development Goals (MDGs) for the period running from 2000 to 2015 and the Sustainable Development Goals (SDGs) meant to run from 2015 to 2030. Both MDGs and SDGs show

the importance of good health for the economic prosperity of any country. The role of health in the economic performance of countries is also manifested by having three out of the eight MDGs that focus on health. These were Goals 4, 5 and 6. The goals were to reduce the child mortality rate, improve maternal health by 2015, respectively. In that vein, SDGs 3 and 6 focus on good health and well-being and clean water and sanitation, respectively (United Nations, 2015; Adegoke et al., 2022).

Kenya has invested heavily in the health sector and has embarked on the implementation of policies aimed at improving health care. One of the policies was the increase in government expenditure on health care. The trends in government expenditure in the health sector share in total government expenditure are shown in Figure 1.

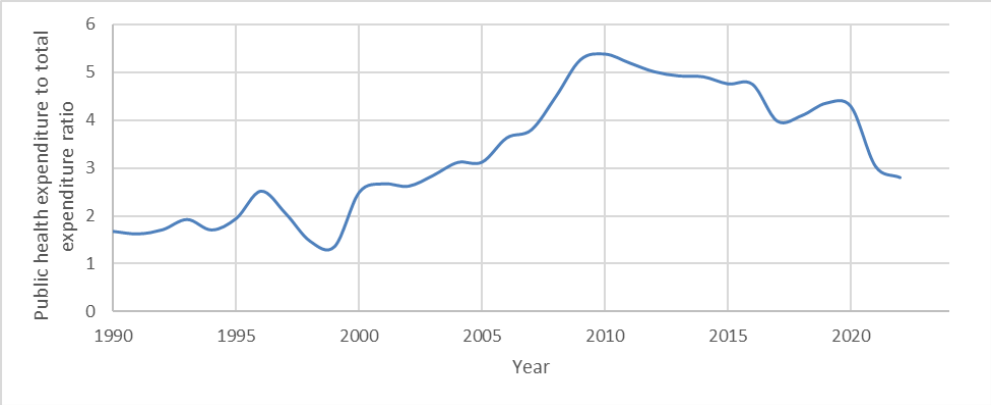


Figure 1: Trends in Public Health Expenditure

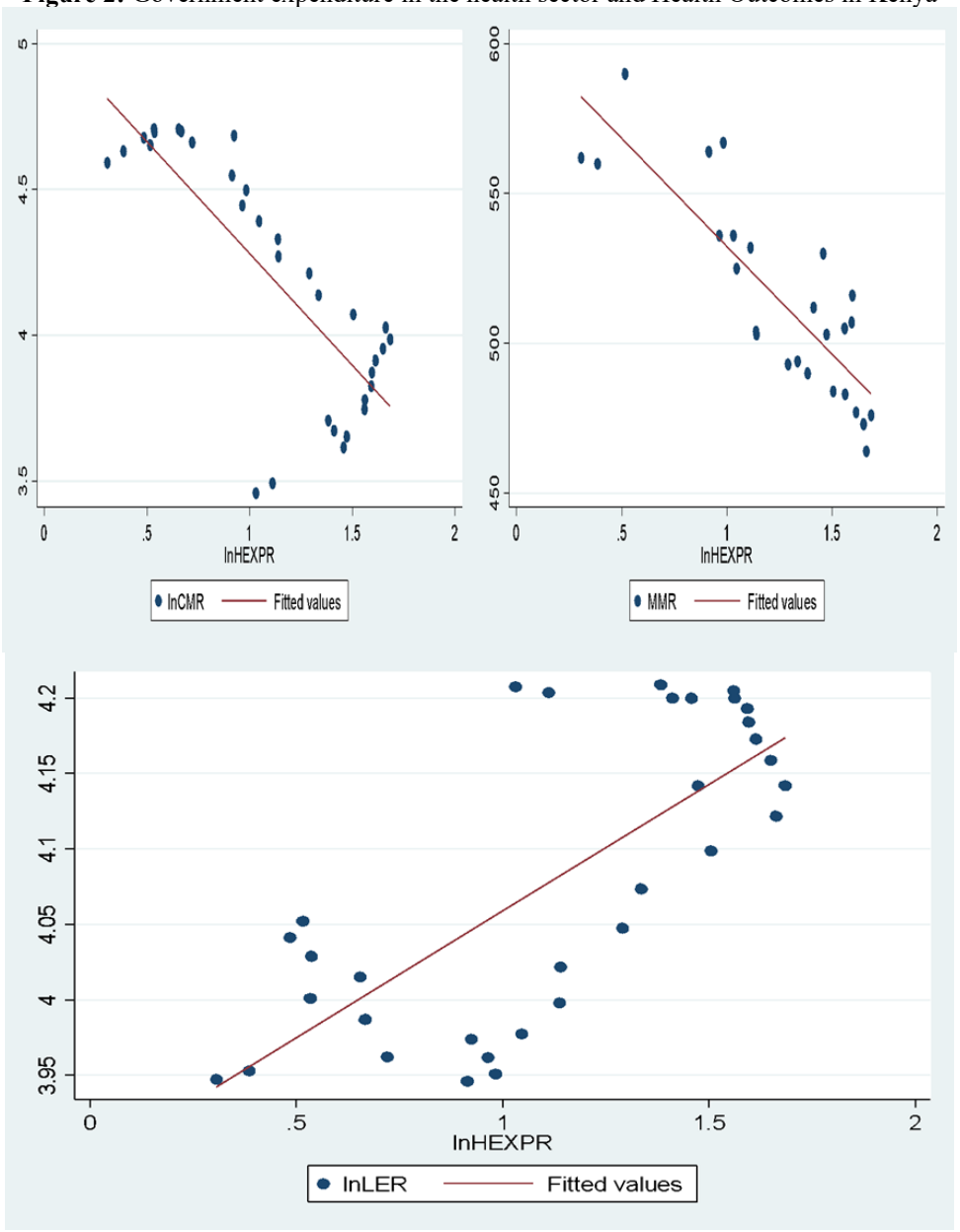
From Figure 1 above, it is shown that government expenditure in the health sector's share of total government expenditure fluctuated between 1 per cent and 2.5 per cent during the 1990 to 2002 period. According to the Republic of Kenya (2003), this low investment in the health sector can be attributed to poor implementation and management of economic policies. In addition, the country's institutions of governance were weak, thus leading to the misuse of resources due to corruption. The state of affairs reversed the initial gains that had been made after independence, leading to deteriorated health status. However, there was a continuous increase in the public health expenditure ratio in total government expenditure from 2003 and 2010. This improved performance of the health sector can be linked to measures that were put in place by the National Rainbow Coalition (NARC), that put in place economic recovery aimed at improving slow economic growth that adversely reduced the well-being of Kenyans. The increase in budgetary allocation during the period was to fund the special healthcare endowment fund that targeted vulnerable groups during the recovery period. In addition,

the increased budgetary allocation was to finance the rehabilitation of the existing health facilities (Republic of Kenya 2003; Manda et al., 2020).

The investment in the health sector resulted in a reduction in child mortality from 94.5 deaths per 1000 live births recorded in 2000 to 31.8 deaths in 2022. Further, government policies aimed at combating HIV/AIDS resulted in a decrease in prevalence rate among the adult population from 11 per cent in the 1990s to 3.7 per cent in 2022 (Murunga et al., 2019; Republic of Kenya, 2022). Diseases like malaria, HIV/AIDS, and Non-Communicable Diseases (NCDs) have been on the government's watch to be fully controlled (Manda et al., 2020). Despite this rise in current public health spending, health outcomes in Kenya have yet to reach the standards recommended by international bodies. For example, child mortality in Kenya is far beyond the 12 per 1000 live births as recommended by the SDGs. This failure of the health outcomes to respond to increased investment in the health sector might be a result of existing health frameworks not accounting for the correct mix of government spending in the health sector and education quality that can lead to the desired better health outcomes. This study is anchored on this drawback and investigates the role of educational quality on the relationship between government health spending and health outcomes in Kenya. The existing studies have focused on the role of public health spending on health outcomes, leaving aside the moderation role of quality of education and public health spending on health outcomes (Murunga et al., 2019; Manda et al., 2020).

If an enabling environment is provided, it is expected that allocation of resources to the health sector and education will lead to better health outcomes. This means that with an enabling environment, the maternal mortality ratio and the child mortality rates are expected to be low. We also expect an increase in longevity. The enabling environment may be ensuring a corruption and inflation-free society, among other economic problems. Figure 2 shows the scatterplots illustrating the association between government expenditure in the health sector and health outcomes.

Figure 2: Government expenditure in the health sector and Health Outcomes in Kenya



Source: Various Economic Surveys

From Figure 2, it is evident that both maternal and child mortalities are negatively related to government expenditure in the health sector. The figure illustrates a direct link between longevity and public health spending. Drawing from Figure 1, this study concentrates on child mortality rate(CMR), maternal mortality rate (MMR) and longevity.

Figure 3 shows scatterplots illustrating education and health outcomes.

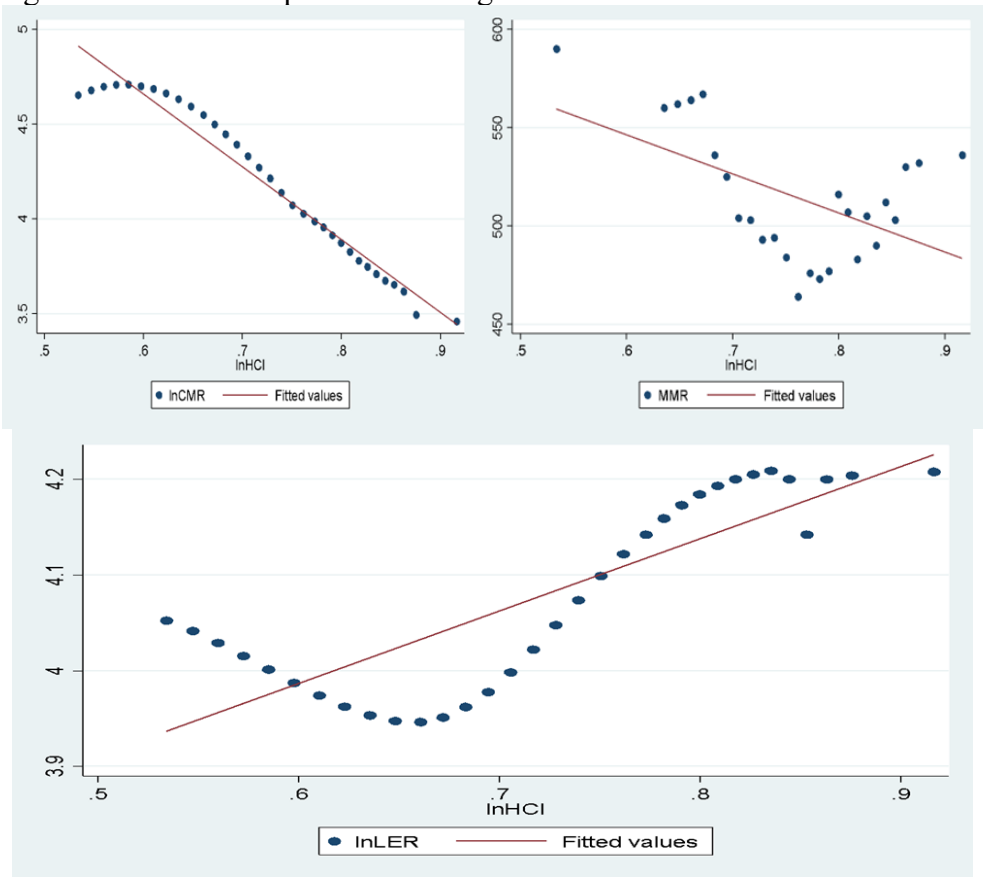


Figure 3: Educational Quality and Health Outcomes in Kenya

From Figure 3, we find that both the MMR and CMR illustrate an inverse relationship with the quality of educational. A direct relationship between longevity and education quality is revealed. Drawing from Figures 2 and 3, this study considers two health outcomes: CMR and longevity due to data limitations on MMR for Kenya. The need to investigate government expenditure in the health sector, education quality and sustainable thresholds is motivated by low health outcomes in Kenya. Again existing gap in the literature has not adequately studied the nexus. Extending Manda et al.(2020) study, this current study sought to: (i) estimate the public health spending threshold on the health outcomes in Kenya; (ii) establish the moderation effect of the quality of education on the effect of public health spending on health outcomes; (iii) evaluate conditional effect of public health spending on health outcomes, and (iv) offer suggestion to the stakeholders on minimum threshold of quality of education needed to maintain public health spending in affecting health outcomes. The current study used the OLS

estimation technique to estimate the relationships. Time series data running from 1990 to 2022 was used. The structure of the rest of the study is as follows: The second section is a review of past studies. The methodology section follows this. The data and model used in the analysis are explained in the methodology section. The empirical results section follows the methodology section. In this section, their interpretation of the results and their discussions are provided. The last section is the conclusion and policy implications.

Literature Review

The link between government expenditure in the health sector and health outcomes has attracted the attention of many scholars. For example, in developing countries, Fasina Fagbeminiyi (2015) studied the effect of government expenditure in the health sector and health outcomes in Nigeria. The study used the Vector Error Correction Model to estimate the relationship in the data running from 1979 to 2018. The results showed a significant link between government expenditure in the health sector and health outcomes in Nigeria. Bein, Unlucan, Olowu and Kalifa (2017) investigated healthcare expenditure and health outcomes among selected East African countries. The study adopted a panel data methodology for the period between 2000 and 2014. The study's results revealed a positive link between health expenditure and longevity. The study also found that increasing government expenditure in the health sector improves longevity among females than among males. The study also found a negative association between health expenditure and infant and under-five deaths. In another study, Manda et al. (2020) investigated the role of government expenditure in the health sector in Kenya. Using the Auto-regressive Distributed Lag (ARDL) model on the time series running from 1970 to 2018, a negative relationship between public health expenditure and health outcome was established for Kenya. The study used child mortality as a measure of health outcome. In another study, Adegoke et al. (2022) studied the role of public health expenditure and education quality on health outcomes in Sub-Saharan African countries. The study considered the three measures of health outcomes, namely the maternal mortality rate, the child mortality rate and also longevity. The study used a panel of 25 SSA countries for the period running from the year 2000 to 2020. The study used a fixed effects model. The results from both suggest a negative relationship between public health expenditure and MMR and CMR. The results revealed a positive relationship between health expenditure and health outcomes. The same results were obtained for education quality using both econometric models.

Kiross, Chojenta, Barker and Loxton (2020) studied the effect of health expenditure on health outcomes across the SSA countries. The study used the infant mortality rate as a measure of health outcome. Using panel data methodology, controlling for socio-economic and macroeconomic factors, for instance, GDP per capita. The study results showed a negative and significant coefficient of health expenditure. This suggested that an increase in public health expenditure led to a reduction in infant mortality. However, the limitation of the study lies in the failure to fully isolate the causal channels since the analysis failed to directly consider the quality of education. For Kenya, this may imply that while more spending may lead to better health outcomes, its effectiveness may depend on how well the resources are managed.

In a similar study, Houeninvo and colleagues (2022) studied the role of both private and public health spending on child mortality in African countries. The objective of the study was to identify the relative effect of private versus public health expenditure on health outcomes. The study employed a panel data methodology and the system Generalised Method of Moments (GMM) so as to address endogeneity issues. The results showed that public health expenditure had an adverse effect on the child mortality rate compared to private spending. The strength of the study is captured in its methodological rigour. The potential weakness remains in the instrument's validity. These findings suggest that for Kenya, strengthening educational quality is essential to maximise the returns from increased health spending.

Oladosu et al. (2022) studied the effect of public health expenditure on health outcomes in Ghana and Nigeria. The study used mortality rates and life expectancy as measures of health outcomes. Using the panel data method. The coefficient of public health expenditure was found to be positive and significant in Nigeria. This showed that public health expenditure improves longevity in Nigeria. However, for Ghana, although positive, the coefficient was insignificant. The authors linked the differences in results to the variations in the quality of institutions in the two countries. Though the comparative approach of this study offers valuable information, its external application is limited due to considering only two countries. However, the study's findings reveal that proper allocation of health budgets is are important determinant of whether increased expenditure leads to better health outcomes, a lesson relevant for Kenya to learn with regard to public health expenditure.

In developed countries, Rana, Alam and Gow (2018) carried out a study on the effects of health spending and health outcomes among the industrialised and developing countries. The results showed that government expenditure in the health sector on health outcomes is more effective among the developing countries than the developed countries. In another study,

Raghupathi and Raghupathi (2020) studied the influence of education on health outcomes among the 26 OECD countries for the period running from 1995 to 2015. Using panel data, a significant and positive link between education and the health outcomes among the OECD member countries was established.

Methods

Estimation techniques, Variables and expectations

This study used OLS to carry out the regression. A total of eight variables sourced from various economic surveys from the period running from 1990 to 2022 were used to respond to the study's questions and also to achieve the objectives. The study had two dependent variables to represent the health outcomes. These variables included the longevity (LONG) and child mortality rate (CMR). The independent variable used in the study was the public health expenditures ratio in total government expenditure (HEXP). The moderating variable was quality of education (EDU) proxied by human capital index, the control variables used in the study were: ICT proxied by mobile cellphone subscriptions (MOBILE), number of adults that are newly infected with HIV (NHIV), and doctors per 100,000 population (DOC).

Regarding a priori expectations, we expected an increase in government expenditure in the health sector to improve health outcomes, that as higher longevity and a lower child mortality rate. Also, ICT was expected to improve the health outcomes. Lastly, the study expected that an increased number of doctors per 100000 population to improve health outcomes. On the contrary, we expected the number of newly infected with HIV and the HIV prevalence rate to have a positive relationship with are child mortality. We also expected an increase in the number of newly infected with HIV and the HIV prevalence rate to have a negative relationship with longevity. However, a positive association is expected between public health spending and longevity. Lastly, education quality is expected to lead to higher longevity and a lower child mortality rate.

Model

In the determination of government expenditure in the health sector, thresholds which address the first objective, each of the health outcomes is expressed as a function of government expenditure in the health sector, a quadratic specification, education quality and a set of various control variables. That is:

$$CMR = \beta_0 + \beta_1 lnHLTEXP_t + \beta_2 lnEDUC_t + \beta_3 lnNHIV_t + \beta_4 lnMOBILE_t + \beta_5 lnDOC_t + \beta_6 lnHLTEXP^2{}_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .1$$

$$LONG = \beta_0 + \beta_1 lnHLTEXP_t + \beta_2 lnEDUC_t + \beta_3 lnNHIV_t + \beta_4 lnMOBILE_t + \beta_5 lnDOC_t + \beta_6 lnHLTEXP^2{}_t + \mu_t \ldots\ldots 2$$

Where CMR and $LONG$ represent child mortality and longevity at birth, respectively; HLTEXP represents government expenditure in the health sector; EDUC represents education quality; Z represents a vector of the study's control variables (ICT, NHIV, HIV, DOC), and ln is the natural logarithm. The β's are the parameters the study sought to estimate; The error terms ε and μ are idiosyncratic error terms. The study transformed all the variables into their natural logarithms so as to correct for outliers and reduce the "noise" in the data. To determine the health expenditures threshold, coefficients of HLTEXP and $HLTEXP^2$ in Equations 1 and 2 are considered. More importantly, Equations 1 and 2 allow for testing the various forms of the relationships. That is, (i) $\beta_1 < 0$, $\beta_6 > 0$ illustrates a U-shaped relationship, (ii) $\beta_1 > 0$, $\beta_6 < 0$ reveals an inverse U-shaped relationship. The health expenditure turning point of this curve is therefore given by $\hat{\tau} = 0.5\frac{\beta_1}{\beta_6}$, (iii) $\beta_1 > 0$, $\beta_6 > 0$ illustrates a monotonic increasing linear relationship,(iv) $\beta_1 < 0$, $\beta_6 < 0$ reveals a monotonic decreasing linear relationship, and $\beta_1 = 0$, $\beta_6 = 0$ reveals a level relationship. In general, the turning point illustrates a level relationship. Generally, a critical point is where the first derivatives of equations 1 and 2 with respect to government expenditure in the health sector are equal to zero (0).

To achieve the study's second and third objectives, each of the two health outcomes was expressed as a function of government expenditure in the health sector, education quality, an interaction term of government expenditure in the health sector and the education quality (lnHLTEXPt *lnEDUCt) and control variables. That is:

$$CMR = \beta_0 + \beta_1 lnHLTEXP_t + \beta_2 lnEDUC_t + \beta_3 lnNHIV_t + \beta_4 lnMOBILE_t + \beta_5 lnDOC_t + \beta_6 lnHLTEXP * lnEDUC_t + \mu_t \ldots\ldots\ldots\ldots 3$$

$$LONG = \beta_0 + \beta_1 lnHLTEXP_t + \beta_2 lnEDUC_t + \beta_3 lnNHIV_t + \beta_4 lnMOBILE_t + \beta_5 lnDOC_t + \beta_6 lnHLTEXP * lnEDU_t + \mu_t \ldots\ldots\ldots\ldots\ldots 4$$

The coefficient and sign of the interaction term, β_6 in equation 3, assesses if the interaction of EDUC and HLTEXP improves or distorts the government expenditure in the health sector impact on CMR. Since β_1 in equation 3 is expected to be negative (reducing child mortality), a positive β_6 will mean EDUC distorts (worsens) the role of government expenditure in the health sector in reducing CMR. On the other hand, a negative β_6 for

equation 3 implies EDUC improves the role of government expenditure in the health sector on CMR.

The sign of the study's interaction term, β_6 in equation 4, evaluates the interaction of EDUC and HLTEXP improves or reduces the impact of public health spending on longevity. Since β_1 in equation 4 is expected to be positive (increasing longevity), a positive β_6 will mean EDUC enhances the role of EDUC on longevity. On the other hand, a negative β_6 for equation 3 will imply EDUC distorts the role of public health expenditure on longevity.

Thus, the conditional effect of HEXP on a country's health outcomes is computed as:

$$\frac{\partial CMR}{\partial HltEXP} = \beta_1 + \beta_6 lnEDUC_t \quad \ldots\ldots 5$$

$$\frac{\partial LONG}{\partial HLTEXP} = \beta_1 + \beta_6 lnEDUC_t \quad \ldots\ldots 6$$

From Equation 5 and 6, the HLTEXP effect on the health outcomes is dependent on the signs of estimated parameters β_1 and β_6, their significance and the magnitude of EDUC. However, if either coefficient of β_1 and $\beta_6 = 0$, then the conditional effect cannot be evaluated. The a priori expectation is that raising government expenditure in the health sector will lessen the child mortality rate but raise longevity. We expect a negative β_6 for the child mortality model and a positive for the longevity model. Thus, minimum thresholds of quality of education required to sustain public health spending in affecting the health outcomes are computed as shown in equation 7:

$$lnEDUC = -\frac{\beta_1}{\beta_6} \quad \ldots\ldots 7$$

Where $lnEDUC$ illustrates the quality education threshold beyond which public health expenditure reduces CMR but raises longevity.

Results

The Descriptive Statistics

Table 1 below presents descriptive statistics of the data used.

Table 1: The Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
CMR	33	71.82	28.30	31.8	110.9
LONG	33	59.33	5.83	51.75	67.29
HLTEXP	33	3.345	1.35	1.36	5.39
EDUC	33	2.07	0.22	1.71	2.5
NHIV	33	107554.54	64323.582	35000	240000
MOBILE	33	19094550	22259071	1100	65737164
DOC	33	17.27	2.441	13.8	22

The average CMR over the period was 71.82 deaths per 1000 live births and ranged from 31.8 to 110.9. This range implies a reduction in the child mortality rate during the study period. On the other hand, the public health expenditure ratio in total government expenditure ranged from 1.36 per cent to 5.39 per cent. The drop in the child mortality rate may be attributed to increased intervention in the health sector by the government, as evidenced by the increased budgetary allocation to the sector. The results further showed an improvement in the education quality as evidenced by an increase in the human capital index from 1.7 to 2.5. This improvement may be attributed to the government programme of free primary education that was implemented in 2003. The average number of doctors per 100,000 population was 17.27. However, the variation in the number of doctors per 100,000 is minimal, as shown by the standard deviation, probably reflecting the duration and cost of training qualified doctors. The ratio of doctors per 100,000 population in Kenya, at 17, is far below the European average of 350 doctors per 100,000 population. However, Kenya has more doctors per 100,000 population when compared with other Eastern African countries (Uganda, 8; Rwanda, 5; Burundi, 3; Tanzania, 2; and Ethiopia, 3).

Correlation Matrix

The pairwise correlations among the explanatory variables are illustrated in Table 2.

Table 2: Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)
(1) lnHLTEXP	1.000				
(2) lnEDUC	0.893	1.000			
(3) lnNHIV	-0.847	-0.981	1.000		
(4) lnMOBILE	0.927	0.963	-0.927	1.000	
(5) lnDOC	0.798	0.844	-0.832	0.782	1.000

From Table 2, it is evident that there is a strong negative correlation between public health expenditure and new HIV infections in Kenya. This is in agreement with theory since an increase in government resources in creating awareness about HIV may lead to a reduction in new HIV infections. There is a strong positive correlation between public health expenditure and educational quality. This is in agreement with economic theory since, other than education, health is another component used in the construction of the human capital index.

Table 3: Empirical Results

VARIABLES	(1) CMR	(2) LER	(3) Moderation-CMR	(4) Moderation-LER
lnHEXPR	0.072	-0.081	1.392***	-0.448
	(0.131)	(0.094)	(0.362)	(0.323)
lnEDU	-0.088*	0.061	-0.081*	0.059
	(0.050)	(0.036)	(0.040)	(0.036)
lnHEXPR*lnHCI			-2.329***	0.649
			(0.612)	(0.546)
lnNHIV	0.516***	-0.147***	0.160	-0.048
	(0.042)	(0.030)	(0.099)	(0.089)
lnMOBILE	0.011	-0.024***	0.003	-0.022***
	(0.008)	(0.005)	(0.006)	(0.006)
lnDOCT	-0.374***	0.253***	-0.060	0.165
	(0.122)	(0.088)	(0.128)	(0.114)
lnHEXPR_sq	-0.130**	0.116**	0.049	0.066
	(0.062)	(0.045)	(0.068)	(0.061)
Constant	-0.507	5.191***	2.984**	4.219***
	(0.737)	(0.531)	(1.090)	(0.974)
Observations	31	31	31	31
R-squared	0.990	0.916	0.994	0.921

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

From the quadratic results, we obtain sustainable thresholds or turning points beyond which public health expenditure exerts a significant impact on health outcomes. From equation 1, the public health expenditure turning point for the child mortality rate is computed as follows:

$$\widehat{HLTEXP} = exp\,(0.5\,\frac{0.072}{0.130}) = exp\,(0.27692) = 1.31$$

From equation 2, the public health expenditure turning point for longevity is computed as follows:

$$\widehat{HLTEXP} = exp\;exp\,(\,0.5\,\frac{0.081}{0.116}) = exp\;exp\,(\,0.27692) = 1.42$$

The results showed that the models are shaped, suggesting that beyond 1.31 per cent of public health expenditure will significantly reduce the child mortality rate. On the other hand, beyond 1.42 per cent of public health expenditure will contribute significantly to increasing the child mortality rate.

Having established the quadratic effects, the study estimated the moderating model to establish the minimum thresholds at which the quality of education could improve the health outcome. The coefficients of HEXPR

and HLTEXPt *EDUCt are used in computing the turning points. We observe that an inverted U-shaped curve exists between public health expenditure, quality of education and child mortality. The same U-shape is also observed between public health expenditure and longevity.

Following equation 7, the threshold point for lnEDUC for child mortality is $-\frac{1.392}{2.59} = 0.59768$. Converting to real terms, educational quality is given by $EDU = exp\,(0.59768) = 1.81$. Following the equation, the threshold point for lnEDUC for life expectancy is $lnEDUC - \frac{0.448}{0.6903} = 0.6903$. Converting to real terms, educational quality is given by:

$$EUC = -\frac{0.448}{0.6903} = exp\,(0.6903) = 1.99.$$

This means educational quality beyond 1.81 and 1.99 will reduce the child mortality rate and improve longevity in Kenya, respectively.

Conclusion and policy implications

The study makes a conclusion that public health expenditure and education quality are important in realising changes in CMR and longevity in Kenya. The results from the quadratic model support the presence of a non-linear relationship between public health expenditure and the health outcome indices. Therefore, the quadratic results reveal the sustainable government expenditure in the health sector as a share of total government spending thresholds that can lead to better health outcomes, as 1.31 and 1.42 for CMR and longevity, respectively. The results of the interaction term of government expenditure in the health sector and education quality on health outcomes reflect that an inverted U-shaped curve exists between public health spending, quality of education and the child mortality rate model. In contrast, a U-shaped curve holds for the longevity model. Since the shape of the parabola for the CMR model is an inverted U-shape, it suggests that beyond 1.31, government expenditure in the health sector share in total government expenditure will contribute significantly to reducing child mortality. In the same vein, following the U-shape relationship, it follows that beyond the threshold point of 1.42, government expenditure in the health sector share in total government spending will contribute significantly to enhancing longevity. The conditional result reflects the point where education quality negatively affects the impact of public health spending on the child mortality rate, as 1.81. The results for moderation revealed that the educational threshold points of 1.99 will induce an improvement in longevity.

Based on the findings, the study makes the following policy recommendation. First, the government of Kenya and stakeholders should take measures that can improve government expenditure in the health sector and the education quality because enhancing these variables will bring about

a meaningful impact on health outcomes, child mortality rate and longevity. Secondly, it is essential not only to increase government expenditure in the health sector but also to ensure it meets the sustainable thresholds identified in this study, which serve as benchmarks for the Kenyan government to operate effectively within the Universal Health Coverage standards. Third, education should be recognised as a complementary factor to health, given its moderating effect on the relationship between health expenditure and health outcomes. Finally, the government and health sector stakeholders should work to achieve the minimum educational quality thresholds needed to maximise the benefits of public health spending and improve health outcomes in Kenya.

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

Funding Statement: The authors did not obtain any funding for this research.

References:

1. Adegoke, Y. O., Mbonigaba, J., & George, G. (2022). Macro-economic determinants, maternal and infant SDG targets in Nigeria: Correlation and predictive modelling. *Frontiers in Public Health*, *10*, 999514.
2. Bein, M. A., Unlucan, D., Olowu, G., & Kalifa, W. (2017). Healthcare spending and health outcomes: evidence from selected East African countries. *African health sciences*, *17*(1), 247-254.
3. Houeninvo, H. G. (2022). Effects of health expenditures on infant and child mortality rates: A dynamic panel data analysis of 37 African countries. *African Development Review, 34*(2), 255–267.
4. Kiross, G. T., Chojenta, C., Barker, D., & Loxton, D. (2020). The effects of health expenditure on infant mortality in sub-Saharan Africa: Evidence from panel data analysis. *Health Economics Review, 10*(1), 5.
5. Manda, D. K., Mugo, M. G., & Murunga, J. (2020). Health expenditures and health outcomes in Kenya.
6. Matthew Oluwatoyin, A., Adegboye Folasade, B., & Fasina Fagbeminiyi, F. (2015). Public health expenditure and health outcomes in Nigeria. *Public Health*, *4*(1), 45-56.
7. Murunga, J., Mogeni, G. E., & Kimolo, D. N. (2019). Public health spending and health outcomes in Kenya. *European Scientific Journal*, *15*(1), 125-138.

8. Oladosu, A. O., Chanimbe, T., & Anaduaka, U. S. (2022). Effect of public health expenditure on health outcomes in Nigeria and Ghana. *Health Policy OPEN, 3*, 100-115.
9. Raghupathi, V., & Raghupathi, W. (2020). The influence of education on health: an empirical assessment of OECD countries for the period 1995–2015. *Archives of Public Health*, *78*, 1-18.
10. Rana, R. H., Alam, K., & Gow, J. (2018). Health expenditure, child and maternal mortality nexus: a comparative global analysis. *BMC international health and human rights*, *18*, 1-15.
11. Republic of Kenya (2003). *Economic Recovery Strategy for Wealth and Employment Creation 2003-2007*. Nairobi: Government Printer.
12. Republic of Kenya (2022). *Economic Survey*. Nairobi: Government Printer.
13. United Nations (2015). Sustainable Development Goals. Geneva: UN
14. World Bank (2022). World Development Indicators. Washington, D.C: WB
15. Xue, X. (2020). The Education-Health Nexus: A Meta-Analysis. *Health, Econometrics and Data Group (HEDG) Working Papers*, *20*(01).