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Health Care Expenditure and Human Capital Development in Sub-Saharan Africa

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Abstract
This study investigates the effect of public and out-of-pocket healthcare expenditure on human capital development in selected Sub-Saharan African countries between 2000 and 2023. Human capital development is measured using the Human Capital Index (HCI), computed by the author based on Kraay (2018, World Development Indicators), providing a comprehensive proxy for educational attainment, health outcomes, and productivity potential. Anchored on Human Capital Theory, the study employs a dynamic panel modelling framework comprising Pooled OLS, Fixed Effects, Difference GMM, and System GMM estimators to account for country-specific heterogeneity, endogeneity, and persistence in human capital outcomes. Empirical findings show strong persistence in human capital development, as indicated by the significance of the lagged dependent variable across most models. Government health expenditure exerts a positive and significant effect on human capital development, underscoring the critical role of public investment in improving population health and productivity. Conversely, out-of-pocket expenditure demonstrates a negative relationship in the fixed effects model, highlighting how private health spending burdens households and undermines human capital accumulation. Access to electricity, per capita income, foreign direct investment, and government effectiveness exhibit positive but largely insignificant effects in the short run. Diagnostic tests validate the robustness of dynamic models, with no evidence of second-order serial correlation in GMM estimations. The study concludes that strengthening public health financing and reducing household reliance on out-of-pocket payments are essential for improving human capital formation in Sub-Saharan Africa. It recommends policy reforms aimed at expanding government health budgets, enhancing social protection mechanisms, and improving institutional effectiveness to maximize the developmental

impact of health expenditure.

Keywords: public health care expenditure, out-of-pocket healthcare expenditure, human capital index.

1. Introduction

Human capital development is widely recognised as a fundamental driver of sustainable economic growth, with the Endogenous Growth Theory (Romer, 1986) positing human capital as central to long-term productivity gains. Health constitutes a vital dimension of human capital, as individuals require robust physical and mental well-being to acquire skills and education essential for economic engagement (World Health Organization [WHO], 2001). The WHO Health Report (2005) underscores that healthier populations demonstrate greater productivity and higher per capita earnings, while Barro (1996) similarly conceptualises health as a productive asset capable of

stimulating economic expansion. Grossman (1972a, 1972b) further argues that health expenditure serves as an investment in human capital with enduring economic benefits. Collectively, these perspectives emphasise the pivotal role of health financing—whether public or private, in shaping human capital outcomes, particularly in developing regions such as Sub-Saharan Africa.

In Sub-Saharan Africa, the significance of health financing for human capital formation has been repeatedly affirmed through regional commitments, including the Abuja Declaration (2001), the Addis Ababa Agenda (2006), and the Ouagadougou Declaration (2008), all advocating increased investment in quality healthcare. The Abuja Declaration, for instance, urges governments to allocate at least 15% of their annual budget to health and reduce household out-of-pocket (OOP) expenditure below 20%; yet only a handful of countries have achieved this benchmark (WHO, 2013). Despite progress in combating mortality and major diseases, substantial health financing gaps persist (Global Burden of Disease Study [GBD], 2021). Government health expenditure in the region grows at a modest 3%, compared to South Asia's 6%, while OOP payments account for over 40% of total health spending in many countries, a regressive financing model that undermines healthcare access (WHO, 2023).

The persistent dominance of OOP expenditure, coupled with insufficient public investment, raises concerns regarding Sub-Saharan Africa's capacity to translate health spending into improved human capital outcomes. The region consistently ranks lowest in global human development indices (WHO, 2005; United Nations Development Programme [UNDP], 2024), with most countries falling short of the Abuja Declaration's spending benchmark (World Bank, 2012; WHO, 2013). Households frequently bear a disproportionate share of health costs, in some cases exceeding 70% of current health expenditure (Asante, Wasike, & Ataguba, 2020; WHO, 2023). Even with increased spending, human capital indicators such as life expectancy remain below global averages, hampered further by limited public investment, governance challenges, workforce shortages, and inefficient resource allocation (WHO, 2019; WHO, 2013). This study, therefore, investigates whether public health expenditure and household OOP payments significantly influence human capital development in Sub-Saharan Africa.

2.0 Literature review

2.1 Conceptual Issues

2.1.1 The Concept of Healthcare Expenditure

Health expenditure refers to the allocation of resources intended to enhance, restore, and sustain health, quantified as the total financial commitment within a nation's health system for a given fiscal year (Tan-Torres Edejer et al., 2008). Harmonised methodologies for estimating and reporting health expenditure facilitate international comparability, a necessity underscored by the global expenditure of US$4.1 trillion in 2004, representing approximately 10% of the world economy. In low-income countries, nearly 70% of individuals finance healthcare directly, highlighting significant barriers to service access (Tan-Torres Edejer et al., 2008). According to the World Health Organization (WHO, 2024), health expenditure encompasses all financial outlays for health services, family planning, nutrition programmes, and emergency interventions, but excludes water and sanitation. National health accounts, following global standards, systematically trace funding flows and resource allocation, thereby supporting progress toward Sustainable Development Goal 3: ensuring healthy lives and well-being for all (WHO, 2024).

Measures of Healthcare Expenditure

Indicator	Definition
Total expenditure on health	Sum of general government and of private expenditure on health
General government expenditure on health	The sum of outlays for health maintenance, restoration or enhancement paid for in cash or in kind by government entities, such as the Ministry of Health, other ministries, parastatal organizations, social security agencies, (without double-counting the government transfers to social security and to extrabudgetary funds). Includes transfer payments to households to offset medical care costs and extrabudgetary funds to finance health. The revenue base of these entities may comprise multiple sources, including external funds
Social security and extra-budgetary funds on health	Expenditure by social security schemes and public social health insurance schemes to purchase health goods and services. These schemes refer to all compulsory schemes for a sizeable segment of the population. Extrabudgetary funds made up of publicly funded schemes that operate autonomously, such as university hospitals, foundations dealing with specific health risks, etc.
Private expenditure on health	Comprises the outlays of insurers and third-party payers other than social security, mandated and voluntary employer health services and other enterprises provided health services, nonprofit institutions and nongovernmental organizations (such as the International Committee of the Red Cross) financed health care, private investments in medical care facilities and household out-of-pocket spending
Prepaid private risk-pooling plans	The outlays of private and private social (with no government control over payment rates and participating providers but with only a broad outline from the government) insurance schemes, commercial and nonprofit (mutual) insurance schemes, health maintenance organizations, and other agents managing prepaid medical and paramedical benefits, including the operating costs of these schemes
Nongovernmental organizations' expenditure on health	Resources used to purchase health goods and services by enterprises that are not allowed to be a source of income, profit, or other financial gain for the units that establish, control, or finance them
Out-of-pocket spending on health	The direct outlays of households, including gratuities and payments in kind made to health practitioners and suppliers of pharmaceuticals, therapeutic appliances, and other goods and services, whose primary intent is to contribute to the restoration or to the enhancement of the health status of individuals or population groups. Includes household payments to public services, nonprofit institutions, or nongovernmental organizations. Includes no reimbursable cost-sharing, deductibles, co-payments, and fee-for service. Excludes payments made by enterprises that deliver medical and paramedical benefits, mandated by law or not, to their employees. Excludes payments for overseas treatment
Tax-funded expenditure on health	All public outlays by territorial governments (Central/Federal, Provincial/Regional/State/District, Municipal/Local) on health, net of intergovernmental transfers, including subsidies to producers of medical goods and services, investment in medical facilities, transfer payments to households to offset medical care costs and extrabudgetary funds
External resources for health	Grants and loans for medical care and medical goods channelled through the Ministry of Health, other public agencies and nonprofit institutions. Grants in-kind (capital equipment, pharmaceutical supplies and vaccines, technical assistance such as experts) should be estimated at their monetary value. Grants to nongovernmental organizations should be accounted for under Nongovernmental Organizations' Expenditure on Health (NGOH) outlays in financing agent table. External resources are a financing source not shown explicitly under financing agents to prevent double counting as they are included under general government expenditure on health (GGHE) or NGOH

Source: Authors' Computation

2.1.2 The Concept of Human Capital Development

The UNDP conceptualizes human capital development as the process of expanding the choices and developing the capabilities of people in all economic, social, and cultural activities for a wealthier, more knowledgeable, and meaningful life. By empowering and providing individuals with the opportunity to widely participate in formulating and implementing development policies that affect their lives (UNDP, 2000).

Measures of Human Capital Development

Approach	Measures	Weakness
Output-based	School enrolment	Authorities can only assess student's effectiveness after they participate in the production process and not just at enrolment.
	Accumulated years of schooling	It may be difficult to explicitly demonstrate this relationship because educational attainment is an offshoot of schooling
	The stock of human capital in national economy is equal to the ratio between skilled and total adults	Health components not considered
Cost-based	The cost-based approach measures human capital by looking at the stream of past investments undertaken by individuals, households, employers and governments (e,g. Shultz, 1961; Kendrick, 1976; Eisner, 1985). It measures the stock of human capital through summing costs invested for one's human capital. This approach relies on information about all the inputs that are incurred when producing human capital. These include market inputs such as monetary outlays but can also be extended to non-market inputs (e,g. the imputed value of time devoted to education by students, their parents and volunteers) Discounted income in the future	It is difficult to explicitly identify the boundary between investment and consumption from the perspective of costs, however, this approach has been criticized on a conceptual ground as the value of human capital should be regarded as determined by demand and supply rather solely by production costs (Kiker, 1966; Le et al., 2003). This approach ignores a fundamental feature of the process of education, i.e. the lengthy gestation period between the current outlays for educational inputs and the emergence of human capital embodied in more competent people (Jorgenson and Fraumeni, 1989, 1992).
Income-based	Assesses the returns which an individual obtains from a labour market throughout education investment. The income-based approach measures human capital by looking at the stream of future earnings that human capital investment generates over a person's lifetime (e,g. Weisbrod, 1966; Graham and Webb, 1979; Jorgenson and Fraumeni, 1989, 1992)	This approach does not consider the influence of human-unrelated factors on an individual's income. For instance, to calculate expected future earnings, some subjective judgements are necessarily made about the discount rate, real income growth rate, etc. there are also reasons to argue that labour markets do not always function in a perfect way, implying that the wage rate typically used as a proxy for earning

	In contrast with the cost-based approach which focuses on the outcomes of human capital investment.	Power is not always equal to the marginal value of a particular type of human capital. Moreover, differences in wages may not truly reflect differences in earning power in some cases where trade unions may command a premium wage for their members and where real wages may fall in economic recessions.
Residual approach	Another monetary measure is the residual approach that is applied by the world bank through its comprehensive wealth accounting. This approach measures human capital as the difference between the total wealth and the sum of produced and natural capitals (Antic, 2005; Ruta and Hamilton, 2007; Ferreira and Hamilton, 2010).	First, it obviously ignores the non-market benefits of various capital stocks. Second, this measure is affected by measurement errors in all the terms entering the accounting identities, resulting in potential biases in the resulting estimates of human capital. Third, it cannot explain what drives the observed changes of the stock of human capital over time. Fourth, it is a measure of intangible capital, cannot be derived on its own. (Human capital guide)
Indicator-based approach	Adult literacy rates, female literacy rates, male literacy rates	This approach relies on several indicators that, though rich in information, lack a common metric. The main limitation of these approaches is that they do not measure economic impact and cannot be integrated into a national income account. However, they may be added in supplementary tables. Additionally, adult literacy rates miss most of human capital attained beyond the elementary level, such as numeracy, logical and analytical reasoning and scientific and technological knowledge. Thus, their use as proxies for human capital in developed countries is limited.
OECD	Considers internationally comparable statistics on investment in human capital, quality adjustments, and result of educational investment after post-secondary education	Human capital investment rarely influences the outcome of human capital. Instead, the unrelated capital factors affect the effectiveness of human capital more than investments. It ignores other indicators that can influence human capital development and contribute to social progress.
United Nations: Human centred approach	Human Development Index (HDI): considers life expectancy, educational attainment and standard of living	Does not consider inequality and other quality of life measures
World Bank: Human centred approach	Human Capital Index (HCI): considers adult and child health, and quality of education	Does not consider the effect of income (standard of living)

Source: Authors computation from Kwon (2009)

This study measures human capital development using the Human Capital Index (HCI), introduced in 2018 as part of the World Bank's Human Capital Project. The HCI provides a comprehensive assessment of the human capital a child born today can expect to accumulate by age 18, based on indicators of health, education, and survival. Computed for 157 countries, the index enables

meaningful cross-country and regional comparisons of human capital outcomes and progress (World Bank, 2018).

2.2 Theoretical Framework

Human Capital Theory

Human Capital Theory, chiefly advanced by Mincer (1958), Schultz (1961), and Becker (1962, 1964), posits that individuals' productivity and lifetime earnings are fundamentally shaped by their accumulation of marketable knowledge, skills, and capabilities. The notion of human capital, however, dates back to Adam Smith, who recognised that capital included the acquired abilities of a nation's populace. Investments in education, health, and skill formation are deemed central to enhancing human capital, thereby expanding productive potential (Schultz, 1961; Weisbrod, 1966). Health, in particular, is integral to this framework, as it improves cognitive and physical functioning, increases labour productivity, and enables ongoing skill acquisition (Becker, 2007; Bloom & Canning, 2003a, 2003b; Fogel, 1994). Thus, public investment in healthcare and related services is essential for advancing human capital, especially in regions like sub-Saharan Africa where health outcomes are precarious.

Despite its influence, Human Capital Theory faces notable criticism. Schuller (2001) argues that educational attainment does not invariably equate to greater productivity, and that gains in human capital may not automatically lead to social or economic advancement. Additional factors such as social networks, institutional reputation, gender, and workplace discrimination also influence earnings and opportunities, suggesting human capital is not the sole determinant of success. Spence's (1973) signalling theory further asserts that education may primarily serve as an indicator of ability rather than directly enhancing productivity. By contextualising healthcare spending within the Human Capital Theory framework, this study contends that sustained investment in health systems is vital for improving human capital in sub-Saharan Africa, bolstering both current productivity and the region's long-term developmental prospects.

2.3 Empirical Literature Review

Anyanwu and Erhijakpor (2009) analysed 47 African countries and found that increased government and total health expenditure significantly reduced infant and under-five mortality. Their study further highlighted that higher physician density and female literacy were associated with improved health outcomes, while Sub-Saharan Africa continued to record disproportionately high mortality rates, indicating persistent gaps in health-driven human capital development.

Alin and Marieta (2011), examining EU countries, established a positive relationship between health expenditure and the Human Development Index (HDI). However, they cautioned that improved HDI was not always linked to greater health system efficiency, suggesting diminishing returns from health expenditure in more developed economies and highlighting the complexity in translating spending into outcomes. Novignon, Olakojo, and Nonvignon (2012) similarly found that both public and private health expenditure improved life expectancy in Sub-Saharan Africa, with public spending showing a stronger effect.

Ehikioya (2013) explored public health spending in Nigeria from 1986 to 2010 and identified demographic factors, such as the proportion of the population aged below 14 and the share of health expenditure in GDP, as key determinants. The study concluded that government health spending should be increased and partnerships with the private sector strengthened. Samadi and Rad (2013) confirmed both immediate and sustained effects of health spending on GDP per capita and health workforce variables in ECO member countries.

Ibe and Olulu-Briggs (2015) found that public health expenditure positively affected Nigeria's long-term economic growth, recommending greater budgetary priority for health. Arthur (2015) demonstrated that public spending significantly reduced mortality in Sub-Saharan Africa, while private spending increased life expectancy. Edeme et al. (2017) reported that public health expenditure in Nigeria improved life expectancy and reduced infant mortality, with HIV prevalence and urbanisation also influencing health outcomes.

Guven, Simsek, and Guven (2018) observed a negative association between health spending and economic growth in MENA, despite improvements in life expectancy and infant mortality. In Indonesia, Widodo et al. (2019) found that health and education expenditure had positive but insignificant effects on HDI, with minimum wage levels showing more decisive influence. Maharda and Aulia (2020) later noted that government health expenditure had no significant impact on HDI in low-HDI Indonesian provinces, while education spending remained crucial.

Ullah et al. (2021) confirmed that public health expenditure improved life expectancy and reduced mortality in Pakistan across different time horizons. Oladosu et al. (2022) found that while public health spending was insufficient in both Nigeria and Ghana, the outcomes differed: Nigeria saw positive effects, but Ghana showed a negative, though insignificant, relationship with health outcomes. Ruzima and Veerachamy (2023) reported a positive long-run impact of public health spending on human development in India but mixed results for education expenditure.

Banik, Roy, and Hossain (2023) demonstrated that governance quality moderates the effect of health expenditure on human development, strengthening positive effects in some regions but weakening them in Sub-Saharan Africa. Wiratmoko and Purwanti (2023) found that government spending on health, education, and social protection significantly affected HDI in Indonesia, though the health component's effect was unexpectedly negative. Olufemi and Shina (2024) observed mixed and largely insignificant short-run impacts of public health expenditure and human capital indicators on Nigeria's economic growth, attributing this to underfunding and systemic inefficiencies.

3. Methods and Materials

3.1 Model Specification

This model is anchored on the human capital theory. According to human capital theory and the literature review, human development can be influenced by deliberate investments in human capital development e.g. government spending on health and government spending on education. Therefore, the general human capital development model specified as follows:

$$HCD = f(X, Y) \quad (3.1)$$

Where,

HCD = human capital development

X = vector of exogeneous variables for producing and boosting human capital

Z = other control variables

This model has been used in the studies by Shuaibu and Oladayo (2016), Nwokoye (2020). therefore, substituting the key covariates of this study, health expenditure (out-of-pocket expenditure and government health expenditure) and conventional variables from the human capital theory into equation 3.1. the model of human capital development proxy using human development index model at the time (t) is specified as:

General Model (Sub-Saharan Africa)

HCI = f (OOP, GHE,ATE,FDI,PCI,GEF) (3.2)

Healthcare expenditure (out-of-pocket expenditure and government health expenditure) indicates the realized consumption of healthcare by individuals in the population to improve their health. Therefore, the model to be estimated is specified as

HCI = f (OOP, GHE, ATE, FDI, PCI,GEF) (3.3)

The corresponding empirical model is expressed as:

$HCI_{it} = \beta_0 + \beta_1 OOP_{it} + \beta_2 GHE_{it} + \beta_3 ATE_{it} + \beta_4 FDI_{it} + \beta_5 PCI_{it} + \beta_6 GEF_{it} + U_{it}$ (3.4)

Where

i=1,…,N indexes countries and t=1,…,T indexes time. To allow for dynamic adjustment and persistence in development outcomes, we include the lagged dependent variable, yielding the dynamic specification

The human capital index (HCI) is developed as a practical tool, helping policymakers make better decisions in the area of education and health. It is a composite measure that brings together indicators from both sectors to show the expected level of human capital a child born today can achieve by age 18, based on the prevailing health conditions and quality of schooling in a specific region. Kraay (2018) defines the Human Capital Index (HCI) as an international metric that benchmarks key components of human capital across countries. Measuring the human capital that a child born today can expect to attain by her 18th birthday, the HCI highlights how current health and education outcomes shape the productivity of the next generation of workers. In this way, it underscores the importance of governments and societies investing in the human capital of their citizens.

The three components considered in the construction of the HCI are:

i. Survival as measured by the under-five mortality rate.
ii. Years of schooling adjusted for learning achievement (or harmonized school achievement) that take into account the quality of education.
iii. Health, adult survival rate, defined as the proportion of 15-year-olds who will reach the age of 60. Using life expectancy as proxy

These three components are combined to infer the level of productivity of an adult worker as inferred by previous econometric studies. By construction, the HCI is expressed as a measure of productivity relative to an optimal benchmark that results from a complete education and perfect health. This means that in a geographical area where a child born today can expect to benefit from complete health and education, i.e. with a probability of survival to adulthood equal to one and a high quality schooling over a period of 14 years of school attendance before the age of 18, the HCI would be equal to 1 (Filmer & Rogers, 2018). According to the observed data, this index varies between 0.8 and 0.9 for the countries that invest the most in health and education and between 0.3 and 0.4 for the countries that invest the least in these areas (WB, 2019). Formally, the HCI is written as follows:

HCI = Survival × School × Health

Where

$\text{Survival} = \frac{P}{P*}$

and p, the survival rate of children under 5 years of age

$p = 1 - UNDER_{-5}$

where $UNDER_{-5}$ is the under-five mortality rate and $P^* = 1$

The education component captures both the quantity and quality of schooling. It is calculated as:

$$S_{NG} = EYS \times \frac{TS}{SC*}$$

where EYY is the expected years of schooling, TS is the harmonized test score, and sc* = 625 is the benchmark score representing complete and good-quality education. The schooling index is then expressed as:

$$School = e^{\varphi(SNG - s^*)}$$

with s* = 14 denoting the benchmark number of schooling years.

The adult survival component reflects overall health conditions among the working-age population. In this study, life expectancy is used as a proxy for adult survival, as it represents the average number of years a person is expected to live under current mortality conditions. Higher life expectancy implies better health outcomes and greater potential for human capital accumulation.

HCI = Human capital index

OOP = Out-of-Pocket expenditure

GHE = Government health expenditure

FDI = Foreign direct investment

PCI = Per capita income

ATE = Access to electricity

GEF = Government effectiveness proxy institutional quality

β_0 = the intercept

β_1 to β_2 = the coefficients of the independent variables (unknown parameter) slopes in the respective equations

u = the error term.

3.2 Data sources

The data for this study will be based on annual panel data and span from 2000 to 2023 for selected Sub-Saharan African countries. The data will be sourced from the national bureau of statistics of the selected Sub-Saharan African countries, the World Bank Development Indicators, and other statistical sources.

4.1 DATA PRESENTATION AND FINDINGS

The descriptive statistics in Table 4.1 indicate that the human capital index has a mean of 0.36 per cent, a maximum of 0.70 per cent, and a minimum of 0.18 per cent, with a standard deviation of 0.08. The positive skewness value of 0.58 suggests the mean exceeds the median, while the kurtosis value of 3.17, being greater than 3, signifies a leptokurtic distribution, indicating greater outlier frequency. Similarly, government health expenditure shows a mean of 42.6, maximum of 360.01, and minimum of 1.12, with a standard deviation of 94.4. Its positive skewness of 2.9 and kurtosis of 12.7 further confirm a leptokurtic distribution, suggesting potential outliers.

Out-of-pocket health expenditure exhibits a mean of 26.9, ranging from 0.76 to 309.8, and a standard deviation of 40.17. Its skewness value of 3.92 and a kurtosis of 20.9 both indicate a highly leptokurtic distribution, reinforcing the likelihood of outliers. In contrast, the access to electricity variable has a mean of 40.5, a maximum of 100, and a minimum of 1.3, with a standard deviation

of 26.4. The positive skewness of 0.54 and a kurtosis value of 2.38, less than 3, demonstrate a platykurtic distribution, suggesting the data are relatively normally distributed.

Table 4.1: Descriptive Statistics of full panel, 2000 to 2023

Variable	Obs	Mean	Std Dev	Min	Max	Skewness	Kurtosis
HCI	744	.3645293	.0876967	.1840503	.7074422	0.585327	3.175872
GHE	744	42.65503	74.45975	1.123269	360.0105	2.938111	12.74503
OOP	744	26.98475	37.65273	.7683194	309.819	3.922521	20.92327
ATE	744	40.5793	24.62805	1.3	100	0.545592	2.3808
LnPCI	744	7.38306	.8789646	5.541656	9.301729	2.684516	11.14914
LnFDI	688	19.4676	1.804027	10.07534	24.42848	9.265006	152.4467
GEF	743	-.632712	.5484952	-1.79	1.16	0.842914	3.528655

Source: Computation by Author, 2025, with the assistance of STATA 14.

The descriptive statistics reveal that per capita income has a mean of 7,383,060, with values ranging from 5,541,656 to 9,301,729. A positive skewness of 2.68 indicates the mean exceeds the median, while a kurtosis of 11.14 suggests a leptokurtic distribution, pointing to potential outliers. Similarly, foreign direct investment has a mean of 19.46, with values between 10,075,340 and 24,428,480. Its high positive skewness (9.26) and kurtosis (152.4) also indicate a leptokurtic distribution, suggesting the presence of significant outliers.

4.2 Correlation Analysis

The correlation matrix presented in Table 4.2 demonstrates that the human capital index exhibits a weak positive correlation with government health expenditure (r = 0.56) in Sub-Saharan African countries, suggesting that increases in government health spending are generally associated with higher human capital index values. Similarly, the correlation coefficient between the human capital index and out-of-pocket health expenditure is 0.64, implying a comparable weak positive association: as out-of-pocket health expenditure rises, the human capital index also tends to increase.

Additionally, the human capital index shows weak positive correlations with access to electricity (r = 0.50), per capita income (r = 0.62), and foreign direct investment (r = 0.12). This indicates that improvements in these variables are associated with modest increases in the human capital index. Furthermore, the correlation coefficient between the human capital index and government effectiveness is 0.53, reflecting another weak positive relationship whereby enhanced government effectiveness is linked to higher human capital development.

Table 4.2: Correlation matrix of full panel, 2000-2023

	HCI	GHE	OOP	ATE	lnPCI	lnFDI	GEF
HCI	1.0000						
GHE	0.5634	1.0000					
OOP	0.6041	0.4770	1.0000				
ATE	0.5074	0.5854	0.5803	1.0000			
LnPCI	0.6213	0.5697	0.5942	0.5058	1.0000		
LnFDI	0.1254	0.1171	0.0071	0.2510	0.1805	1.0000	
GEF	0.5303	0.6480	0.3816	0.4536	0.5225	0.0157	1.0000

Source: Computation by Author, 2025, with the assistance of STATA 14

4.3 Cross-Sectional Dependence and Cross-sectional panel unit root test results

The Inn, Pesaran and Shin (IPS), augmented Dickey Fuller (ADF) Fisher Chi-square and Phillip - Perron (PP) Fisher Chi-square test methods were employed to examine the time series properties of the variables of the panel data. Table 4.6 presented the panel unit root test statistics results of the study's variables. Human capital index, foreign direct investment, government health expenditure, out-of-pocket expenditure, per capita income, variables were not stationary at level, but all the above variables became stationary after first difference at a 5 percent level of significance. Access to electricity and government effectiveness variables was stationary at level and did not need differencing for them to become stationary at a 5 percent level of significance. Thus, the mixed stationary results of zero and one order of integration.

Table 4.3: Unit root test results of full panel, 2000-2023

Variable	Im, Pesaran and Shin W-stat		ADF - Fisher Chi-square		PP - Fisher Chi-square		Remark
	At level	First difference	At level	First difference	At level	First difference	
PCI	0.97267	-10.2699	73.8919	250.399	351.305	842.685	I(1)
	(0.8346)	(0.0000)	(0.4817)	(0.0000)	(0.0000)	(0.0000)	
OOP	0.62359	-9.86114	62.0343	228.968	56.2325	813.736	I(1)
	(0.7336)	(0.0000)	(0.8381)	(0.0000)	(0.9383)	(0.0000)	
HCI	1.27416	-6.83179	58.5621	163.821	103.219	256.414	I(1)
	(0.8987)	(0.0000)	(0.6004)	(0.0000)	(0.0008)	(0.0000)	
GHE	0.23687	-12.0658	67.5557	274.664	96.6825	1115.88	I(1)
	(0.4064)	(0.0000)	(0.6882)	(0.0000)	(0.0396)	(0.0000)	
FDI	-1.34994	-13.1784	93.6986	298.099	182.206	2616.78	I(1)
	(0.0885)	(0.0000)	(0.0608)	(0.0000)	(0.0000)	(0.0000)	
ATE	-2.76701	N/A	112.409	N/A	225.173	N/A	I(0)
	(0.0028)		(0.0027)		(0.0000)		
GEF	-4.04941	N/A	127.393	N/A	107.132	N/A	I(0)
	(0.0000)		(0.0000)		(0.0000)		

Note: figures in parenthesis are the respective probability values of the unit root test results; NA = not applicable; the statistical significance of the unit root results is at 5 % level of significance has been achieved

Source: computation by Author, 2025, with the assistance of E-view statistical package

To avoid spurious results, the Pesaran and Shin (2004) cross-section dependence test was conducted, and the results are presented In Table 4.3 The results shows that all the variables in the model-human capital index, out-of-pocket health expenditure, government health expenditure, access to electricity, foreign direct investment and per capita income variables, were cross-sectionally dependent at the 1 per cent level of statistical significance. Hence, in the presence of cross-sectional dependence.

Table 4.3: Cross sectional dependence pre-test results of the human capital development equation

Variable	CD-test	p-value	average joint T	mean ρ	mean abs(ρ)
HCI	+99.595	0.000	24.00	+0.94	0.94
ATE	+95.804	0.000	24.00	+0.91	0.91
OOP	+39.13	0.000	24.00	+0.37	0.53
GHE	+59.3	0.000	24.00	+0.57	0.58
GEF	+1.497	0.134	23.94	+0.01	0.40
LnPCI	+49.846	0.000	24.00	+0.47	0.66
LnFDI	34.227	0.000	24.00	+0.35	0.41

Source: Authors' Computation, 2025 Using STATA 14

Notes: Under the null hypothesis of cross-section independence, CD ~ N(0,1)

P-values close to zero indicate data are correlated across panel groups

4.4 Panel Cointegration test

The results of the Panel cointegration test result analysis of the Human capital development equation of the study are displayed in Table 4.5. It reports the within-dimension and between dimension panel cointegration statistics for the equations respectively. The null hypothesis of no cointegration is rejected for one test statistics out of the six test statistics at the five percent level of significance while the alternative hypothesis is accepted at five percent level of significance. This indicates that there are at least one cointegrating equation in the Panel cointegration test result analysis of the human capital development equation.

Table 4.5: Panel cointegration test result analysis of the Human capital development equation

Pedroni Residual Cointegration Test					
Series: HCI OOP GHE LOG(FDI) LOG(PCI) ATE					
Alternative hypothesis: common AR coefs. (within-dimension)					
				Weighted	
		Statistic	Prob.	Statistic	Prob.
Panel v-Statistic		4.009169	0.0000	2.613467	0.0045
Panel rho-Statistic		5.393645	1.0000	4.978911	1.0000
Panel PP-Statistic		2.302418	0.9893	1.167094	0.8784
Panel ADF-Statistic		7.562048	1.0000	6.049279	1.0000
Alternative hypothesis: individual AR coefs. (between-dimension)					
		Statistic	Prob.		
Group rho-Statistic		6.796739	1.0000		
Group PP-Statistic		1.885007	0.9703		
Group ADF-Statistic		6.829545	1.0000		

Source: computation by Author, 2025, with the assistance of E-view statistical package

4.5.1 Panel Estimation Results

4.5.2 SUB-SAHARAN AFRICA

Analysis of the Static and Dynamic Data Estimations Sub-Saharan Africa

The estimated results for the static and dynamic panel data models on human capital development in selected Sub-Saharan African countries are summarised in Table 4.6. Four estimation techniques were utilised: Pooled OLS, Fixed Effects Model (FEM), Difference Generalised Method of

Moments (DGMM), and System Generalised Method of Moments (SGMM), to address country-specific heterogeneity, dynamic effects, and endogeneity. The SGMM estimator, as proposed by Arellano and Bover (1995) and Blundell and Bond (1998), combines equations in levels and differences, using internal instruments to improve efficiency and control for endogeneity, compared to the other methods.

The coefficient for the lagged dependent variable HCI(-1) is positive and statistically significant in the Pooled OLS, FEM, and DGMM models, with values of 0.9808, 0.8892, and 0.8877 respectively, all significant at the 1 per cent level. This suggests strong persistence in human capital development, as previous human capital levels significantly influence current outcomes. However, the coefficient is insignificant in the SGMM model, indicating that more robust endogeneity controls diminish the persistence effect. Out-of-pocket health expenditure (OOP) demonstrates a negative and statistically significant relationship with human capital only under the Fixed Effects Model, implying that higher OOP payments may hinder human capital development due to increased financial burdens on households.

Table 4.6: Sub-Saharan Africa Human Capital Development equation

VARIABLE	POOLED OLS	FEM	DGMM	SGMM
HCI (-1)	0.9808 (0.000***)	0.8892 (0.000)***	0.8877 (0.000)***	0.6733 (0.740)
OOP	-2.8200 (0.775)	-0.0004 (0.049)**	0.000083 (0.357)	-0.0057 (0.842)
GHE	0.000016 (0.100)	0.0006 (0.002)***	0.0001949 (0.041)**	0.0013 (0.762)
ATE	-9.2000 (0.844)	0.0001 (0.171)	0.001949 (0.352)	0.0036 (0.786)
LnFDI	0.0003 (0.922)	0.0002 (0.466)	0.0004072 (0.258)	-0.0133 (0.831)
LnPCI	0.0001 (0.138)	0.0067 (0.290)	0.0053293 (0.585)	0.0122 (0.981)
GEF	0.0005 (0.584)	-0.0005 (0.784)	0.0020 (0.244)	-0.0210 (0.905)
OBSERVATION	660	660	604	660
AD R-SQUARED	0.9850	0.9729		
F-TEST Prob>F	6200.47 0.0000***	1474.86 0.0000***		
Sargan test Sargan prob			74.40 0.000***	88.25 0.100
Hansen test Hansen test prob			28.40 1.129	1.57 0.072*
AR (1) test AR (1) p-value			1.18 0.002***	0.19 0.004***
AR (2) test AR (2) p-value			1.18 0.238	0.11 0.908
No of Instruments			28	8

****, **, * Significant at 1%, 5%and 10 %, respectively. Source: Authors' Computation, 2025 Using STATA 14*

The coefficient of Government Health Expenditure (GHE) is consistently positive across all estimation methods, with statistical significance observed only in the DGMM model (coefficient: 0.0001949; p = 0.041). This suggests that, in the short run, increased government health spending is associated with a 0.019 per cent rise in the human capital index, confirming the vital role of public health investment in enhancing human capital in Sub-Saharan Africa. Access to Electricity (ATE) also shows a positive coefficient across FEM, DGMM, and SGMM models, but remains statistically insignificant, indicating that while access may support human capital through improved infrastructure, its immediate impact is limited or not statistically demonstrable in this context.

The coefficient for the log of Foreign Direct Investment (LnFDI) is positive but statistically insignificant in all models, with the DGMM estimation showing 0.0004072 (p = 0.258). This implies that while FDI inflows could potentially boost human capital development via increased income and employment, short-term effects are negligible, likely due to FDI's concentration in less human capital-intensive sectors. Similarly, the log of per capita income (LnPCI) is positive but not statistically significant, suggesting that rising income supports human capital, yet the immediate effect is modest. Government Effectiveness (GEF) alternates in sign and lacks statistical significance, indicating limited measurable short-term institutional impact. Post-estimation diagnostics, including the Sargan and Hansen tests and Arellano Bond AR tests, confirm the validity and robustness of the dynamic specifications.

4.6 Discussion of Findings

The discussion of findings in Table 4.10 examines the dynamic interplay between health expenditure components and human capital development in Sub-Saharan Africa, employing Pooled OLS, Fixed Effects Model (FEM), Difference GMM (DGMM), and System GMM (SGMM) approaches. These models address country-specific heterogeneity, potential endogeneity, and dynamic structures in the region's data. The lagged dependent variable, HCI(-1), is positive and statistically significant in Pooled OLS, FEM, and DGMM models, demonstrating strong persistence in human capital development. This suggests that previous improvements in human capital significantly influence present outcomes, consistent with Shuaibu and Oladayo (2016), who emphasise the cumulative effect of past policy and institutional investment.

The coefficient for Out-of-Pocket Health Expenditure (OOP) is negative and statistically significant under the Fixed Effects Model, but negative and insignificant in other specifications. This finding suggests that heavy reliance on private health financing impedes human capital development in Sub-Saharan Africa. The negative association implies that higher out-of-pocket payments diminish healthcare access, worsening health outcomes and productivity. This aligns with Novignon et al. (2012), who found OOP spending restricts healthcare use and heightens health inequalities, as well as Adewumi and Enebe (2019), who reported that dominant private expenditure undermines household welfare and weakens the benefits of income growth for human capital.

Conversely, Government Health Expenditure (GHE) is consistently positive across all estimation techniques and statistically significant in the DGMM model, where a coefficient of 0.0001949 (p = 0.041) indicates that increased public health spending substantially enhances short-run human capital development. This result corroborates theoretical expectations and aligns with Imandojemu et al. (2020) and Erasmus (2021), who demonstrated that public investment in health supports the human development index in Africa by improving population health and productivity. Meanwhile, Government Effectiveness (GEF) alternates in sign and is statistically insignificant, suggesting that institutional quality's short-term impact remains weak in the region, echoing Shuaibu and Oladayo's (2016) observations of persistent governance challenges.

5. Conclusion

This study has examined the intricate relationship between public healthcare expenditure, household out-of-pocket spending, and human capital development in Sub-Saharan Africa. The findings indicate that sustained public investment in health infrastructure, personnel, and essential services is fundamental for enhancing life expectancy, reducing mortality, and fostering long-term improvements in human capital. Countries with higher public health expenditure consistently achieve better educational outcomes and higher productivity. In contrast, the region's reliance on out-of-pocket payments continues to impede progress, exposing households to financial hardship and discouraging healthcare utilisation. Limited insurance coverage and weak social protection exacerbate these challenges, while persistent underinvestment, despite regional declarations, raises critical concerns about the effectiveness of government health financing. Ultimately, inadequate funding, governance constraints, and inequitable access continue to limit the transformative potential of health spending on human capital development in Sub-Saharan Africa.

6. Policy Implication

Based on the empirical findings of the study, several policy implications emerge for strengthening human capital development in Sub-Saharan Africa: Policymakers in Sub-Saharan Africa countries should therefore focus not only on increasing health budgets but also on improving spending efficiency, transparency, and accountability. Strengthening budget execution, minimizing leakages, and prioritizing investments in essential health infrastructure and personnel are critical for maximizing the returns on public health spending. Also, expanding universal health coverage (UHC) through national health insurance schemes, targeted subsidies, and stronger social protection systems is essential for reducing financial hardship, improving access to quality care, and promoting sustained human capital development in Sub-Saharan Africa.

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