**Disability-Inclusive Health-care Financing and Sustainable Development in Sub-Saharan Africa: Evidence from Dynamic Panel Models**

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1Adewale Mathew Adekanmbi, 2Oladimeji Abeeb, Olaniyi, 3Oluwole Olugbenga Joseph, 4Adenike Dorcas Olugboyega, 5Oluwabobi Feranmi Oladigbo

1Department of Economics, Dominion University, Ibadan. Nigeria

2,5Department of Economics, University of Ilesa Nigeria

3Department of Criminology and Security Studies, Dominion University, Ibadan. Nigeria

4Peace Building Development Consultancy, Abuja, Nigeria

1a.[adekanmbi@dominionuniversity.edu.ng](mailto:adekanmbi@dominionuniversity.edu.ng), [2](mailto:2oladimeji_olaniyi@unilesa.edu.ng,)[oladimeji\_olaniyi@unilesa.edu.ng,](mailto:2oladimeji_olaniyi@unilesa.edu.ng,) 3[olugbenga.oluwole@dominionuniversity.edu.ng,](mailto:olugbenga.oluwole@dominionuniversity.edu.ng,)4 [adenike.olu@pbdc.org.ng ,](mailto:o.olupona@jointheirseworld.com,)

**Abstract**

This study analyses the economic and developmental implications of disability inclusion in healthcare by exploring the long- and short-term relationships among disability-inclusive policies, healthcare expenditure, and sustainable development in Sub-Saharan Africa (SSA) from 1984 to 2023. Utilising annual panel data from 46 Sub-Saharan African nations, we initially implement the Levin–Lin–Chu (LLC), Im–Pesaran–Shin (IPS), and ADF–Fisher unit root tests, which verify that the variables are integrated of order one. This confirms the utilisation of the Autoregressive Distributed Lag (ARDL) framework, computed by the Pooled Mean Group (PMG) approach. Four principal consequences arise: A stable long-term equilibrium exists among disability inclusion, healthcare expenditure, and economic performance in Sub-Saharan Africa. Secondly, public healthcare expenditure continuously fosters economic growth, whereas out-of-pocket (OOP) and private healthcare expenditure (PRHE) have nonlinear impacts; specifically, OOP expenditure becomes detrimental to growth when beyond around 24.9% of total health expenditures. Third, in the short term, increased out-of-pocket expenditures substantially detract from economic performance, underscoring the susceptibility of households to exorbitant healthcare expenses. Fourth, disability-inclusive policies yield quantifiable long-term advantages by alleviating systemic healthcare burdens and promoting Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being) and SDG 10 (Reduced Inequalities). The findings highlight the imperative for SSA governments to integrate disability-sensitive measures into health sector reforms, mitigate excessive out-of-pocket expenses, and implement adaptive, evidence-based policies to promote equal welfare outcomes and sustainable economic growth.

**Keywords:** Disability-inclusive, Healthcare expenditure, Sustainable Development, Sub-Saharan Africa.

**JEL:** I14, I15, O15, C23, O55

**Introduction**

When individuals with disabilities receive equitable access to healthcare, education, and employment opportunities, society reaps extensive economic benefits through increased productivity and decreased dependency (Iezzoni et al., 2021; Fortea et al., 2021). Moreover, the inclusion of individuals with disabilities directly facilitates the achievement of various Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequalities) and SDG 13 (Climate Action). Sub-Saharan Africa (SSA) confronts a confluence of climate-induced health hazards, vulnerable health infrastructures, and persistent socio-economic disparities that jeopardise the realisation of the United Nations Sustainable Development Goals (SDGs) by 2030. The World Health Organization's World Report on Disability (2011) indicates that more than 1 billion individuals worldwide have disabilities, with 80% living in low- and middle-income nations, where climate-related health issues disproportionately impact marginalised groups. Similarly, the UN Convention on the Rights of Persons with Disabilities (CRPD) emphasises the duty to provide inclusive health systems. In Sub-Saharan Africa, less than 50% of healthcare facilities are resilient to climate change or inclusive of those with disabilities. Increasing temperatures, severe weather phenomena, and disease epidemics intensify maternal and child health risks, with under-five death rates in the region almost 14 times greater than those in high-income nations. Proactively addressing the needs of individuals with disabilities within healthcare systems yields a triple benefit: enhancing population health outcomes, diminishing income inequality, and expediting advancement towards the Sustainable Development Goals.

This research amalgamates health, environmental, and socio-economic datasets to pinpoint scalable solutions consistent with SDG 3, SDG 10, and SDG 13 (Climate Action). This approach integrates climate adaptation strategies with disability-inclusive public health policy, offering practical solutions for governments, NGOs, and international organisations to enhance resilience, protect at risk populations, and address health disparities in a highly climate-vulnerable region.

**Background**

Despite the fact that disability is not in ability, yet, persons with disabilities (PWDs) often experience significant barriers in accessing equitable health-care services, barriers that persist even in developed countries. In several highly developed nations, larger proportion of persons with disabilities are unable to obtain necessary treatment owing to exorbitant fees, remote facilities, or protracted waiting periods. These differences illustrate extensive structural exclusions within public health systems, where heightened healthcare requirements, indirect expenses, and the necessity for specialised treatments frequently remain unaddressed. The United Nations Convention on the Rights of Persons with Disabilities defines individuals with long-term physical, mental, intellectual, or sensory impairments, who encounter societal barriers that restrict their full and equal participation in society, as persons with disabilities (UN, 2006, as cited in Kuper et al., 2024). This comprehensive description includes those with visual and auditory problems, as well as those with less apparent or internal health concerns, among others. In developing nations, particularly among students in educational institutions, persons with disabilities frequently encounter substantial obstacles in accessing services and opportunities, including education and healthcare, compared to their non-disabled peers (Akila & Zagi, 2024). Moreover, inclusive public health programs, including nutrition education, routine screenings, and preventive treatment, often do not adequately reach this vulnerable group, with coverage disparities between those with and without disabilities varying from 5% to 45% (UN, 2024). Inadequate healthcare systems, insufficient policy focus, and deficient infrastructure exacerbate the marginalisation of persons with disabilities, hindering their well-being and full societal involvement (Ajuwon, et al., 2023).

Interestingly, people with disabilities have historically been excluded from society and treated unfairly; this trend has shown some progress recently, but discrimination still exists in many important areas. Their involvement in public life and decision-making processes is disproportionately minimal, constraining their impact on policies and actions that directly influence their welfare. This exclusion is especially concerning during crises (Pettican et al., 2024; WHO, 2020). In non-emergency contexts, persons with disabilities face stigma and bias from healthcare providers, inaccessible services, insufficient transportation to medical facilities, and exorbitant out-of-pocket costs (MBI & CHAI, 2022). The COVID-19 pandemic exacerbated several pre-existing challenges, amplifying health disparities (Kuper et al., 2020; Shakespeare et al., 2022). During the COVID-19 pandemic, the worldwide response predominantly neglected the unique requirements of individuals with disabilities, particularly in the initial phases (Goyal, et al., 2023). Discriminatory treatment methods, inadequate access to health information, and restricted testing availability disproportionately impacted this demographic. Forty-one percent of individuals with disabilities were unable to obtain COVID-19 testing, in contrast to twenty-eight percent of individuals without disabilities (UN, 2024). Disturbingly, individuals with disabilities represented over fifty percent of COVID-19-related fatalities and experienced more significant employment and income reductions. This exclusion in healthcare services damages the health and dignity of those with disabilities, leading to decreased life expectancy and deteriorated socioeconomic results. Ensuring equal treatment, especially within health systems and emergency responses, is essential not just as a matter of rights but also as a vital measure for attaining sustainable and inclusive development (SDGs 3).

As the world works harder to achieve the Sustainable Development Goals (SDGs), particularly those pertaining to equality, social inclusion, and health, it is still vitally important to address the particular health issues that people with disabilities experience. Given basic five years remaining until the 2030 Agenda deadline, significant disparities endure between individuals with and without disabilities, particularly in domains such as food insecurity and health access, where differences surpass 10 percentage points, and in multidimensional poverty and employment, where gaps exceed 20 percentage points, as reported by the United Nations (UN, 2024). These disparities are even worse for women alongside impairments members of indigenous groups with some disabilities, people with intellectual or mental disorders, and people who live in rural areas. At the rate things are going now, it is unlikely likely that the world will meet the Sustainable Development Goals (SDGs) for people who have impairments by 2030.

Recent global evaluations indicate that individuals with disabilities persistently encounter substantial obstacles in obtaining essential services, especially healthcare (WHO, 2020). In numerous developing nations, these challenges are anticipated to intensify, potentially leading to elevated out-of-pocket health expenditures, diminished access to essential health services, and deteriorating health outcomes, including increased rates of infant and maternal mortality. The UN Disability and Development Report (2023) indicates that individuals with disabilities continue to be disproportionately marginalised from advancements in various SDG targets, especially those pertaining to health (SDG 3), reduced inequalities (SDG 10), and poverty (SDG 1).

It is essential to recognise that disability inclusion in healthcare systems transcends human rights and social justice; it is also a vital catalyst for sustainable development, particularly in Sub-Saharan Africa, where health disparities and structural inequalities persist (Zuurmond, et al., 2019). Incorporating disability-inclusive strategies into healthcare delivery can substantially decrease long-term healthcare costs by facilitating early intervention, preventive care, and community-based support methods, which are frequently more economical than institutional responses. This approach offers a chance to tackle the persistently inadequate budgetary allocations for the health sector in Sub-Saharan Africa (SSA) as well as the inefficiencies in public resource management. Poor health outcomes in Sub-Saharan Africa are not solely attributable to insufficient funding; they also stem from ongoing mismanagement and inefficiency within public health systems (Akinlo and Sulola, 2019). Furthermore, the financial ability to enhance inclusive health services has been limited by inadequate tax revenues throughout the region (Olaniyi et al, 2025), underscoring the urgent need to implement cost-effective, inclusive, and sustainable healthcare models. Disability-inclusive health interventions offer a strategic approach to enhance outcomes while maximising scarce resources.

According to earlier research, individuals with impairments worldwide report comparable obstacles when trying to get healthcare (Fortea et al., 2021; Kuper et al., 2024). Attitudinal obstacles can obstruct the pursuit of treatment and the acquisition of suitable services, including exclusion from reproductive health care. (Iezzoni et al., 2021). Individuals with disabilities frequently lack autonomy in health-related decision-making, which can hinder or obstruct the pursuit of care (Casebolt MT 2020; Adugna et al., 2020). The affordability of healthcare is a prevalent issue, worsened by the sometimes elevated expenditures for those with impairments (Mitra et al., 2017). These indicate significant deficiencies in health systems' performance regarding disability inclusion. For example, hardly 50 (26%) of the national constitutions of 193 UN member states specifically provide the health rights of individuals with disabilities (Raub, et al., 2016; Waddington, 2021). Moreover, among the 27 EU Member States, just 14 possess legislation that outlaws disability discrimination and mandates adequate accommodation for individuals with impairments in healthcare, while five states have no measures in either area (Waddington, 2021). Deficiencies are evident in the training of healthcare professionals regarding disability globally, particularly in Sub-Saharan Africa, notably Nigeria, despite the clear lack of knowledge, skills, and attitudes necessary to deliver acceptable and quality healthcare for individuals with disabilities (Ajuwon et al., 2020; Ihegihi et al., 2022; Adekanmbi & Olaniyi, 2025).

Despite the expanding literature on disability and healthcare access, considerable gaps persist in comprehending the interplay between healthcare expenditure, disability inclusion, and sustainable development outcomes in Sub-Saharan Africa (SSA).

This study primarily aims to reevaluate the impact of government healthcare expenditure, specifically on disability-inclusive initiatives, on health and developmental outcomes in Sub-Saharan Africa. The research focusses on sixteen representative countries that have similar socioeconomic and institutional characteristics, owing to the region's diversity and constraints in data availability. While existing research has explored the relationship between government spending and health outcomes, few studies have focused on this issue in the unique context of Sub-Saharan Africa, particularly regarding the mediating effect of disability inclusion in public health care delivery. Research including government efficacy as a variable influencing the link between health expenditure and health outcomes is incredibly few. This research seeks to bridge critical gaps and enrich the literature by providing empirical insights that link disability-inclusive health financing to sustainable development goals in the region.

Also, there is little research on how national and sub-national health budgets address the unique needs of people with disabilities and whether these investments are producing equitable health outcomes in line with the Sustainable Development Goals (SDGs), regardless of the fact that physical accessibility and attitudinal barriers have received a lot of attention. Moreover, comprehensive monitoring of disability-inclusive expenditures and policy execution is predominantly lacking in most Sub-Saharan African nations, complicating the evaluation of progress and the accountability of institutions. There is a deficiency of evidence-based models or frameworks that assist policymakers in structuring healthcare systems to be both inclusive and economically efficient.

This paper addresses these gaps by creating a contextual framework that connects disability inclusion in health expenditure to quantifiable SDG results, utilising data and policy analysis from specific SSA countries. Emphasising the role of inclusive health expenditure in enhancing development metrics, such as increased life expectancy, diminished health disparities, and poverty reduction, offers pragmatic insights that can guide national policy reform, budgetary priorities, and forthcoming initiatives to ensure equitable participation in the region's development agenda.   
Worldwide, individuals with disabilities persistently encounter structural obstacles in obtaining equal healthcare, resulting in worse health outcomes and escalating health costs. In high-income nations, more than 10% of individuals with disabilities indicate that they cannot obtain necessary treatment owing to financial constraints or prolonged wait periods (UN, 2024). In Sub-Saharan Africa, the issue is exacerbated by fragile health systems and insufficient disability inclusion. Despite increasing acknowledgement of the necessity for inclusive health systems, there is limited understanding of how disability-sensitive health finance facilitates tangible advancements towards the Sustainable Development Goals, which serves as the impetus for this study.

**Review of the Related Literature**

The World Health Organisation (WHO, 2022) defines disability as covering those with long-term physical, mental, intellectual, or sensory impairments that, when interacting with different barriers, may limit their full and effective involvement in society on an equal footing with others. The notion of disability is complex and nuanced. The Worldwide Classification of Functioning, Disability, and Health (ICF) describes disability as problems that arise in one or more of three domains: impairments in bodily functions, limits in activities, and restrictions in participation. The Persons with Disabilities (PWDs) Act 2008 (Sec 2) in Malaysia defines PWDs as those with mental, intellectual, or sensory impairments that may impede their full and effective participation in the economy when faced with different hurdles. An individual with a disability registered with the Department of Social Welfare (DSW) obtains a coloured disability identification card. The hue of these PWD cards denotes various disabilities: blue for visual impairment, purple for auditory impairment, green for physical disability, yellow for learning disabilities, red for cerebral palsy, and orange for other long-term physical conditions.Disability-Inclusive refers to the process that actively seeks to ensure the full involvement of individuals with disabilities as empowered self-advocates in all developmental projects and emergency responses (WHO, 2022). Moreover, it aims to remove the barriers that hinder their access and participation.

A robust theoretical foundation underpins the claim that inclusive government health expenditure for disability is essential for achieving improved health and developmental outcomes. Musgrove (1996) contends that a basic level of investment in the healthcare sector is crucial for the development of positive health indicators. Nevertheless, these expenditures must be comprehensive, including addressing the often overlooked health needs of persons with disabilities (PWDs), to ensure equitable outcomes. In Sub-Saharan Africa (SSA), inadequate and exclusive health spending exacerbates the marginalisation of persons with disabilities (PWDs), amplifying health disparities and obstructing socioeconomic advancement.

Keynes' (1936) theory of public intervention emphasises the importance of comprehensive government spending in invigorating economic activity and promoting social advancement. This theory posits that investment in accessible healthcare services, disability support programs, and inclusive infrastructure improves the well-being of persons with disabilities (PWDs) and yields broader economic benefits through reduced dependency and increased productivity. However, these benefits mostly remain unrealised in Sub-Saharan Africa due to persistent underfunding and restricted legislative frameworks. Despite global and regional commitments, including the Abuja Declaration of 2001, which urged African Union member states to devote at least 15% of their national budgets to health, the majority of Sub-Saharan African countries have failed to follow this guideline, with Tanzania being the only country that has consistently met this criterion. Persistent underinvestment has serious ramifications for disability inclusion: when health systems struggle to meet the needs of the general population, it becomes increasingly difficult to provide resources, particularly for the healthcare of people with disabilities. The result is ongoing exclusion, insufficient services, and rising health-related financial burdens for people with disabilities, which contradicts both human rights obligations and developmental goals.

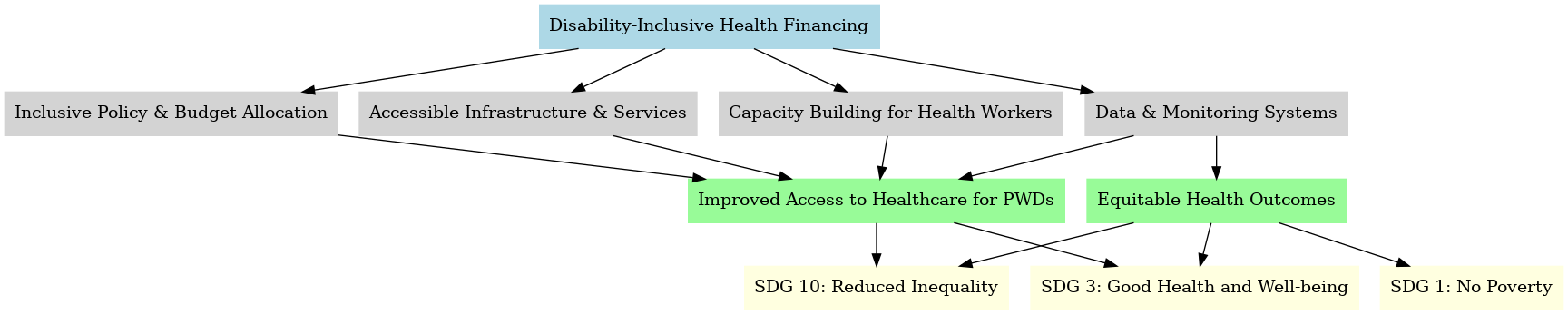
The benefit theory of public finance (Samuelson, 1954; Musgrave & Musgrave, 1973) holds that public spending must provide tangible benefits to the populace, particularly taxpayers. In this framework, government spending on health must be justified by its effects on all people, including those with disabilities, who typically face higher healthcare costs and more access barriers. However, the current health finance framework in Sub-Saharan Africa does not reflect this inclusion, as services tailored to disabilities are largely absent or severely underfunded.

The SDGs stress the importance of inclusive health systems. SDG 3 (Good Health and Well-being), SDG 10 (Reduced Inequalities), and SDG 4 (Quality Education) all emphasise the importance of equitable access to services, particularly for marginalised populations. The inability of SSA countries to meet their health finance obligations under the Abuja framework stymies progress towards these goals, particularly for PWDs who require additional assistance and customised care. Without proactive disability-inclusive budgetary planning, the area risks perpetuating discrimination and impeding long-term growth.

Institutional ideas, such as Wagner's Law (1883), argue that as the economy grows, public spending should rise, particularly in the social sector. However, in some Sub-Saharan African countries, rising GDP has not resulted in greater or more equitable health investment. The persistent exclusion of people with disabilities from national health agendas reflects structural inefficiencies and misplaced priorities. According to Peacock and Wiseman's (1967) displacement effect, crises can result in increased public spending; however, even during disruptions like the COVID-19 pandemic, disability inclusion remains low on the list of policy priorities in the area.

This study fills a theoretical and empirical gap: while existing literature recognises the importance of health expenditure for development, it largely ignores the critical intersection of disability inclusion, government efficacy, and sustainable development in Sub-Saharan Africa. This study intends to give novel insights into how targeted, inclusive health investments could promote the accomplishment of the SDGs, particularly in resource-limited African contexts.

**Conceptual Framework**

Figure 1: Disability-Inclusive Healthcare Financing Framework

Source: Author’s Computation, 2025.

Figure 1 demonstrates how disability-inclusive health financing may contribute to better health outcomes and accelerate progress toward the Sustainable Development Goals (SDGs), notably in Sub-Saharan Africa. It illustrates that when governments provide appropriate and targeted health expenditures, particularly for people with disabilities (PWDs), they improve service delivery, expand access to treatment, and reduce imbalances in the health system. These improvements lead to better health outcomes, such as lower infant and maternal mortality rates, higher quality of life for those with impairments, and overall healthier populations.

The paradigm promotes disability inclusion as both a moral imperative and a developmental strategy. Incorporating people with disabilities into health planning, budgeting, and service delivery allows countries to progress many Sustainable Development Goals at once, including SDG 1 (No Poverty), SDG 3 (Good Health) and SDG 10 (Reduced Inequalities). The diagram shows that government efficacy, enough funding, and detailed policy design are critical links in the cycle. The full benefits of health spending, particularly for disadvantaged groups like those with disabilities, cannot be realised without their involvement.

**Material and Methods**

This empirical study utilises a panel dataset compiled from a number of sources, covering the period from 1984 to 2023 for 18 Sub-Saharan African countries: Ghana, Côte d’Ivoire, Burkina Faso, Nigeria, Mali, South Africa, Senegal, Zimbabwe, Mauritania, Togo, Niger, Madagascar, Cameroon, Benin, Sudan, Kenya, Zambia and Lesotho. The selection criterion for candidate countries was predicated on data availability, specifically concerning the proxies employed for Sustainable Development Goals (SDGs); information regarding real GDP per capita and other macroeconomic variables is sourced from World Development Indicators and African Development Indicators informational databases. Basically, the study focuses on establishing a relationship between health expenditure (HEXP) and SDGs in the context of health outcomes (RGDP) expressed thus:

*RGDPit = ait + OOPit + INFMOTit + HEXPit + εit* (1)

where RGDPit represents the natural logarithm of sustainable health outcomes; OOP represents the out of pocket expenditure, HEXPit represents health expenditure disaggregated into total health expenditure as in public health expenditure per capita (PUHS) and private health expenditure (PRHE). The variables are described in Table 1 and the model is presented in full functional and estimable forms.

**Table 1 Description of Variables**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Description(s)** | **Sources** |
| Out of pocket expenditure (OOP) | **(% of Current Health Expenditure)** High out-of-pocket (OOP) costs indicate limited public health coverage and greater barriers to accessing care, especially for PWDs who often require frequent and specialized health services. | World Bank |
| Mortality rate, (INFMOT) | **under-5 infant mortality rate** is used, representing the **number of children who die between the ages of 1 and 5 per 1,000 live births.** This variable serves as a key indicator of healthcare system performance and the effectiveness of health-related public spending. In the context of disability inclusion, high under-5 mortality rates may reflect insufficient access to inclusive maternal and child health services, particularly for children born with or at risk of disabilities. | World Bank |
| Public health spending (PUHS) | **Public Health Spending (PUHS):** This variable, measured as **current health expenditure as a percentage of general government expenditure**, captures the priority a government places on health within its overall budget. In the context of disability inclusion, increased public health spending is critical to expanding equitable access for persons with disabilities (PWD), particularly in areas such as assistive devices, rehabilitation, specialized care, and inclusive health infrastructure. Low public investment may limit such targeted services, deepening exclusion and health inequalities for PWD. | World Bank |
| Private Health spending (PRHE) | **Private Health Spending (PRHE):** It reflects the extent to which individuals and families bear the cost of healthcare. In contexts where disability-inclusive services are limited, higher private spending can increase the financial burden on persons with disabilities and their families, potentially limiting access to essential care and widening health inequalities. | World Bank |
| SDGs attainments based on economic performance (RGDP) | **Real Gross Domestic Product (GDP)** is utilized as the dependent variable to assess the economic outcomes related to disability-inclusive development.  It serves as a core indicator of economic performance and is directly linked to **SDG 8 (Decent Work and Economic Growth.** Real GDP is included to capture the broader economic impact of health spending and disability-inclusive policies. Improved health outcomes—especially for persons with disabilities—can lead to higher productivity, reduced dependency, and stronger economic growth, reinforcing the role of inclusive health investment in sustainable development. | World Bank |

Source: Author’s Computation, 2025

Table 2 points out that the average real RGDP per person for the countries in the study is US$533.6. This reflects that many countries in the region have low income levels. This corresponds with the economic conditions of various Sub-Saharan African nations, where constrained fiscal capacity can hinder investments in inclusive social services, especially for persons with disabilities (PWD). While real GDP per capita may be affected by population size, the low average indicates that a considerable segment of the population, including those with disabilities, may have limited access to economic opportunities, healthcare, and education. These restrictions can impede advancement towards the attainment of many Sustainable Development Goals (SDGs), including SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequalities). The standard deviation of real GDP per capita indicates minimal difference across the chosen nations, further highlighting the common economic issues in the area. This homogeneity underscores the pressing necessity for targeted, disability-inclusive policies that foster economic involvement, productivity, and equitable opportunity to guarantee that persons with disabilities are not marginalised in the quest for sustainable and inclusive growth. During the research period, out-of-pocket (OOP) health expenditures averaged 24.9% across the sample. The recorded minimum and highest values were 11.8% and 31.6%, respectively.

**Table 2 Summary statistics of the variables**

Variable Obs Mean S. Dev. Min Max

RGDPPC 720 533.65 679.57 82.7 3796

OOP 720 24.88 4.13 11.8 31.6

INFMOT 720 61.77 30.36 6.3 187.7

PRHE 720 475.92 287.25 1 4433 H

PUHS 720 19.07 9.32 1.6 76.7

Source: Author’s Computation, 2025

These figures highlight the varying degrees of financial burden placed on individuals, particularly persons with disabilities (PWD) to access healthcare services. High OOP spending can act as a barrier to healthcare access for PWD, potentially exacerbating health inequities and undermining progress toward achieving SDG 3 (Good Health and Well-being) and SDG 10 (Reduced Inequalities). Private health expenditure further illustrates the disparities in healthcare financing across countries in the sample. The average private health expenditure was 475.92 units (e.g., USD per capita), with significant variation across time and space. The maximum recorded was 4433 units, while the minimum was just 1 unit annually. This wide variation signals uneven levels of private sector engagement in healthcare and indicates that in some countries, access to essential health services—particularly disability-inclusive services—may be disproportionately influenced by an individual’s ability to pay. The relatively low levels of public health expenditure suggest that many SSA governments **lack adequate fiscal commitment** to deliver inclusive and accessible healthcare services, particularly for marginalized groups such as PWD. This underinvestment poses a significant barrier to the realization of **disability-inclusive development** and undermines efforts toward achieving **Sustainable Development Goals (SDGs),** especially **SDG 3 (Good Health and Well-being)** and **SDG 10 (Reduced Inequalities).** In terms ofapriori, the expectation is that **RGDP and OOP** are expected to have a **negative relationship** with infant mortality; PRHE is mixed / ambiguous.

**Estimating the long-run connection**   
When cointegration is present among nonstationary variables, accurately estimating their long-term economic links becomes very difficult. As a result, numerous panel estimators have been suggested in the existing literature. A significant distinction is that the panel OLS estimator of the (long-run) static regression model is inconsistent, unlike its time series equivalent (Baltagi 2008). Pesaran et al. (1999) propose a pooled mean group (PMG) estimator utilising maximum likelihood for dynamic heterogeneous panels. The approach applies an autoregressive distributed lag (ARDL) model to the data, which may be reformulated as an error correction equation for enhanced economic interpretation. To examine the subsequent error correction representation of an ARDL model:

*∆yit = φi∆yi,t-1 + β’iiXit + ∆yi,t-j + 1ij ∆Xi, t-j + μi + εit* (2)

If X is a vector of explanatory factors, βi explains long-term effects, φi is the error correction term (which comes from normalisation), as well δij is the short-term information. PMG here functions as intermediary method that sits between the mean group (MG) estimator and the dynamic fixed-effects (DFE) technique. To get the MG estimator, it is necessary to estimate N independent variables. Regressions are conducted followed by the averaging of the unweighted coefficients, but the DFE necessitates data pooling and assumes uniformity in slope coefficients and error variances. The PMG, however, restricts the long-run coefficients to be uniform (βi = βi for all i), while permitting changes in the short-run coefficients and error variances among nations (Pesaran et al. 1999). According to Pesaran et al. 1999, this methodology is appropriate regardless of the level of stationarity of regressors.

**Results**

This section highlights the findings and discuss regarding the influence of government healthcare spending particularly with disability-inclusive measures on health and development results in Sub-Saharan Africa (SSA). Given that we are primarily addressing macroeconomic variables that extend over a considerable duration and are frequently nonstationary, we initially perform panel unit root tests to ascertain their order of integration. Furthermore, we estimate both long-run and short-run relationships employing appropriate and efficient methodologies. This analysis, however, employs three separate panel unit root analyses on the variables for this time frame from 1984 - 2023, utilising Levin–Lin-Chu’s (LLC) t\*, Im-Pesaran-Shin’s W, and ADF-Fisher v2 statistics, as illustrated in Table 3. Nonetheless, the IPS and ADF-Fisher v2 tests are predicated on the individual unit root process assumption, which posits that autocorrelation coefficients differ over cross sections. We always include a deterministic time trend in all of the test specs. In the LLC, IPS, and ADFFisher tests, cross-sectional means are subtracted to mitigate issues stemming from cross-sectional dependence.

**Table 3: Panel unit root test results**

|  |  |  |  |
| --- | --- | --- | --- |
| Panel 1: levels  Series | LLC t\*-stat  H0: unit root | IPS W-t-bar stat  H0: unit root | ADF-Fisher v2  H0: unit root |
| lnRGDP | -8.4045 [0.4338] | -0.3599 [0.3594] | 43.9097 [0.1714] |
| lnOOP | 2.2914 [0.9890] | -2.8507 [0.0022] | 79.0921\*\*\* [0.0000] |
| lnIMFMOT | -0.2311 [0.4086] | -0.9161 [0.1798] | 37.9964 [0.3785] |
| lnPHRE | 2.7373 [0.9969] | -4.0689\*\*\* [0.0000] | 76.0237\*\*\* [0.0000] |
| lnPUSH | 0.6920 [0.7555] | 0.2613 [0.6031] | 28.2928 [0.8166] |
| Panel 2: first differences |  |  |  |
| *∆*lnRGDP | -10.9288\*\*\* [0.0000] | -6.4770\*\*\* [0.0000] | 127.3653\*\*\* [0.0000] |
| *∆*lnOOP | -12.9053\*\*\* [0.0000] | -9.3756\*\*\* [0.0000] | 185.8590\*\*\* [0.0000] |
| *∆*lnIMFMOT | -11.9205\*\*\* [0.0000] | -5.3102\*\*\* [0.0000] | 101.3284\*\*\* [0.0000] |
| *∆*lnPHRE | -12.3109\*\*\* [0.0000] | -13.4401\*\*\* [0.0000] | 295.9278\*\*\* [0.0000] |
| *∆*lnPUSH | -9.8149\*\*\* [0.0000] | -4.1601\*\*\* [0.000] | 81.6705\*\*\* [0.0000] |

\*, \*\*\* Significance at 10 and 1 % levels, respectively.

Source: Author’s Computation, 2025

The findings from the test indicate non-stationarity in all model variables at their levels. The LLC test presents compelling evidence of non-stationarity across all variables. In contrast, the IPS and ADF-Fisher tests reveal that all variables are non-stationary, except for private health spending. It is crucial to note that cross-sectional averages were deducted from each series (demeaning) before conducting the LLC, IPS, and ADF-Fisher tests. The first difference of all variables demonstrated stationarity, suggesting that the series are integrated of order one, thus justifying the use of the ARDL technique.

**Table 4 Long and short-run estimation results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Model 1 PMG | MG | Model 11 PMG | MG |
| Convergence coefficients | -0.058\*\*\* (0.012) | -0.2333\*\*\* (0.0431) | -0.052\*\*\* (0.013) | -0.2322\*\*\* (0.0486) |
| Long--run coefficients |  |  |  |  |
| OOP | 0.0970 (0.5411) | 2.1353 (3.5024) | 0.5340\*\* (0.2311) | 4.1716 (11.1487) |
| PHRE | -0.0515 (0.0337) | -1.4148 (1.2890) | -0.0008\*\* (0.0004) | -0.0028 (0.0041) |
| OOP2 |  |  | -0.0117\*\* (0.0048) | -0.0892 (0.2132) |
| PHRE2 |  |  | 3.18e-17 (2.21e-07) |  |
| PUHS | 0.0463\*\*\*(0.0067) | -0.0400 (0.0591) | 0.0549\*\*\* (0.0083) | -0.1583 (0.1511) |
| IMFMOT | 0.0047\*\* (0.0024) | 0.0392 (0.0253) | 0.0039 (0.0023) | 0.0373(0.0562) |
| Short-run coefficients |  |  |  |  |
| *∆*OOP | -0.1278\*\*\*(0.0404) | -0.0730 (0.0863) | -0.1476 (0.1041) | 0.1892 (0.2022) |
| *∆*PHRE | 0.0038 (0.0030) | 0.0043 (0.0053) | 0.00003 (0.00006) | 0.00003 (0.00002) |
| *∆*OOP2 |  |  | 0.0030\* (0.0019) | -0.0031 (0.0027) |
| *∆*PHRE2 |  |  | -2.47e-07(5.48e-07) |  |
| *∆*PUHS | 0.0018\*\* (0.0008) | 0.0008 (0.0008) | 0.0013\*\* (0.0008) | 0.0008 (0.0007) |
| *∆*IMFMOT | -0.0002 (0.0003) | -0.0007 (0.0005) | -0.0002 (0.0006) | -0.0009\* (0.0005) |

Dependent variable: natural logarithm of real Gross Domestic Product (lnRGDP). All equations incorporate a constant, country-specific variable. Values in brackets and brackets denote standard errors and probability values, respectively, with significance levels indicated by \*\*\*, \*\*, and \* at 1%, 5%, and 10%, respectively. The coefficients in Model 2 are regarded as semi-elasticities, while the coefficients in Model 1 are interpreted as elasticities since the disability variables are in their natural logarithmic forms.

Source: Author’s Computation, 2025

**Interpretation and Discussions**

In estimating the short-run and long-run relationship between disability inclusion health-care and economic growth in Sub-Saharan Africa (SSA), we employ the Pooled Mean Group (PMG) estimator, which utilizes the panel extension of the single-equation Autoregressive Distributed Lag (ARDL) model. One major advantage of this technique is that its error correction representation captures both the contemporaneous effects and the speed of adjustment toward equilibrium following an economic disturbance. Importantly, while the long-run coefficients are constrained to be homogeneous (identical across countries), the short-run coefficients vary (country-specific), reflecting heterogeneity across SSA countries.

The long- and short-run estimates, obtained from both the PMG and Mean Group (MG) estimation strategies, are presented in Table 4, with two alternative models. Model 1 reports the impact of disability-inclusive variables on economic growth without accounting for potential nonlinearities. Model 2, however, introduces quadratic terms for Out-of-Pocket (OOP) spending and Private Health Expenditure (PRHE) to capture nonlinear and threshold effects of healthcare spending on Real GDP (RGDP). In Model 1, the long-run coefficients of OOP and PRHE represent elasticities of RGDP with respect to these variables, whereas the other coefficients reflect semi-elasticities. By contrast, in Model 2, the inclusion of quadratic terms implies that all long-run coefficients, including those for OOP and PRHE, are interpreted as semi-elasticities.

Generally, across both estimators and models, the signs of the coefficients are consistent, though not always statistically significant. Nonetheless, as expected, the error correction terms are always negative and important. This signifies that the economies do not revert instantly to equilibrium following a shock, but rather adjust gradually over time. The significance of these terms further confirms the existence of a valid long-run relationship between disability inclusion, healthcare spending, and economic performance. In Model 1, the PMG estimation reveals an unexpected long-run association between out-of-pocket (OOP) healthcare spending and economic growth, though it is not statistically significant. A similar pattern holds for private healthcare spending (PRHE) in the long run. However, when quadratic terms are introduced in Model 2, the coefficients for both OOP and PRHE become statistically significant, indicating the existence of threshold effects.

In the short run, however, OOP spending exerts a more harmful impact on economic performance. Specifically, a 1% increase in OOP spending reduces RGDP by approximately 0.13%, all else being equal. While PRHE is correctly signed in the short-run model, it lacks statistical significance. One possible explanation for the opposing effects in the short and long runs is adaptation. In the long term, SSA countries may adapt to high OOP burdens through policy adjustments or institutional reforms. But in the short term, the burden of high OOP spending is economically damaging. OOP is insignificantly detrimental to economic performance in the short run as revealed in model 2, but the quadratic term for OOP is positive and marginally significant, suggesting that moderate levels of OOP spending may promote growth, up to a certain point, beyond which it becomes harmful. Specifically, the OOP coefficient is positive (0.5340), while its quadratic term is negative (-0.0117), implying a threshold level of OOP spending at approximately 24.9% of total health expenditure, beyond which additional OOP reduces economic performance. This nonlinear pattern highlights the importance of including quadratic terms in assessing the effect of healthcare spending on growth. That is, OOP spending contributes positively to growth up to a point, after which its effect turns adverse. Regarding PRHE, the results indicate no statistically significant impact on economic performance, whether or not the model accounts for nonlinearity. Across both estimation methods and models, PRHE appears neutral in its growth effect. On the other hand, public healthcare spending (PUHS) shows a significantly positive influence on economic growth, emphasizing its critical role in sustainable development. Among the control variables, infant mortality (INFMOT) and others do not appear to significantly influence economic performance in SSA.

**Conclusion and Recommendations**

This study shows that effective disability-inclusive policies in Sub-Saharan Africa not only reduce per capita healthcare expenses associated with environmental health concerns, but also promote more equitable and long-term health outcomes. Governments can reduce long-term fiscal pressures on healthcare systems, strengthen climate resilience, and accelerate progress towards the Sustainable Development Goals particularly SDGs 3 (Good Health and Well-Being), 10 (Reduced Inequalities), and 13 (Climate Action) by ensuring that people with disabilities are systematically integrated into health planning, service delivery, and environmental adaptation strategies.   
The findings provide persuasive evidence that disability inclusion is both a social justice imperative and a cost effective public policy solution. Countries that invest in accessible, climate-resilient healthcare infrastructure, combined with targeted social protection for people with disabilities, are better able to withstand environmental shocks while maintaining positive health outcomes. Moreover, connecting disability sensitive programs with environmental policy frameworks magnifies the co-benefits for economic productivity, poverty reduction, and community resilience.

We advise SSA governments to adopt a comprehensive, multi-sectoral strategy for health and environmental policy formulation that incorporates disability considerations into budgeting, monitoring, and implementation processes. This must encompass: Institutionalising disability-inclusive climate and health policies within national adaption plans. Enhancing investment in accessible healthcare facilities and specialised training for healthcare professionals in disability-responsive care. Developing data systems that amalgamate disability, environmental, and health indicators to inform evidence-based policymaking. Utilising global collaborations with UN agencies, NGOs, and development banks to secure financing for inclusive climate-health initiatives.

By implementing these measures, SSA nations can convert vulnerability into resilience, ensuring that individuals with disabilities are not marginalised but are active participants in sustainable development amidst a rapidly evolving climate. Future research should investigate the long-term effects of disability-inclusive environmental policies, yielding additional insights into their economic and social benefits.

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