

**COVID-19, DIGITALIZATION, HEALTH EXPENDITURE AND LABOUR
PRODUCTIVITY IN SUB-SAHARAN AFRICA: EVIDENCE FROM A PANEL
DATA ANALYSIS (2006 – 2023)****Okogbue, Chijioke¹ Orji, Uka Odum²**¹*Department of Economics, Michael Okpara University of Agriculture, Umudike
and Development Strategy Centre, Enugu*²*Department of Economics, Tansian University, Umunya Anambra State*Emails: ceejaydatabase@gmail.com¹; orjiuka03@gmail.com²*All correspondence to: ceejaydatabase@gmail.com***ABSTRACT**

This study examined the impact of COVID-19, using digitalization and health expenditure, in selected sub-Saharan African countries on the labour productivity in the region. A balanced panel comprising 14 selected countries over 18-year time period from 2006 to 2023 was selected. Using appropriate technique confirmed with the use Hausman test technique, the study found that digitalization had been contributing gradually to the labour productivity in the region. However, this improvement was completely eroded by COVID-19 pandemic. Though, there were improvement in the health expenditure towards improving labour productivity during and after the COVID-19 era, yet health expenditure has been weakening labour productivity in the region. The study further found that countries in the Central Africa needs more attention in the use of digitalization and health infrastructure in improving their labour productivity. Based on the findings of this study, it is recommended that Government should subsidize the cost of acquisition and installation of the digital technology to small scale firms in the countries of the SSA region. Also Health expenditures should be properly monitored to avoid wastages and leakages such that their intended goals would be achieved.

Key words: COVID-19, Digitalization, Health Expenditure, Labour Productivity, Sub-Saharan Africa

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INTRODUCTION

The COVID-19 pandemic poses risks not only for people's health but also for economic well-being. While the full socio-economic consequences remain uncertain, its impact on the labour market has become a key issue of global concern. Especially low-income earners performing jobs in precarious, informal sectors of the economy without unemployment insurance, limited access to healthcare, and no back-up savings are most at risk. This implies that already disadvantaged groups will suffer disproportionately from the adverse effects. Policy makers have responded to the adverse employment and income effects of the pandemic with a range of measures varying from cash transfers to the poor to loans to small enterprises to keep them afloat (Indian J Labour Econ 2020). According to Johns Hopkins University (JHU 2020),

over 9 million COVID-19 cases was confirmed worldwide. Sub-Saharan Africa (SSA) registered 230,116 cases, concentrated particularly in South Africa (101,590), and followed by Nigeria (20,919), Ghana (14,154) and Cameroon (12,041), while around half of the countries had under 1000 confirmed cases.

In face of weak and already overwhelmed health systems, most countries across SSA responded early on with stringent government measures to contain the spread of the virus. According to the Oxford COVID-19 Government Response Tracker (OxCGRT 2020), out of 44 SSA countries, 95% had closed schools for all education levels, 66% had required workplace closures (or work from home) at least for some sectors or categories of workers, 32% had closed public transport (or prohibited most citizens from using it) and 43% had adopted curfew or lockdown policies (required people not leaving house, allowing for exceptions to varying extents), along other response measures. However, countries in SSA lag behind other world regions in terms of the economic support that was provided, and while the measures present an important step in the right direction, the effective provisions in the majority of countries replacing less than 50% of lost salary may not suffice to provide significant relief and secure the livelihoods of the most vulnerable people in the region (Jain, Budlender, Zizzamia & Bassier., [2020](#)).

Balde et al., ([2020](#)). indicate that informal workers are at higher risk, as they generally rely on daily sales for their earnings, lack mechanisms for collective bargaining, and tend to be in activities that are contact intensive and thus, particularly affected by the pandemic response measures—such as restaurants, tourism, small retail shops, hairdressers, and taxi drivers. Poorer Sub-Saharan African (SSA) countries are far less effective than wealthier countries in allocating factors of production such as labor and natural resources, contributing to overall low productivity and slowing economic recovery. Historically, economic growth in the SSA region has been besieged by a series of shocks, among them wars and natural disasters, political instability and epidemics. Both physical and human factors of production have been significantly impacted by these shocks, and the report notes they have also been exacerbated by structural characteristics such as the lack of diverse economic activity and weak governance. Some of these are the outcome of policies and institutions that distort the allocation of resources from their most efficient use (Sefa-Nyarko, 2016).

Policy response currently focuses on emergency relief to save lives and protect livelihoods, but the report recommends that policies also consider measures to protect the future of the region. The level and growth of economic output is one of the important measures of

wellbeing of an economy. The factors of production that are used in generating such economic output, as well as the level of efficiency associated with the inputs are important indicators of the overall economy productivity. The efficiency of inputs is the total quantity of input required to produce an output. It is calculated as a ratio by dividing total output by the input employed in generating the output. While total factor productivity can be calculated this way, it is relatively difficult, and a more commonly used measure of real economic output is productivity of labour measured as the quantity of input of labour required in producing one unit of output (Bousquet, Akdis, Jutel, Bachert, Klimek, Agache, & Brian, 2020).

Labour productivity is therefore the output value each person creates from a given input in the production process. It is the monetary value contributed per worker to the total economic output. Nigeria is well-known for its vast economy, natural resources endowment and large population as well as large workforce which explains why it is branded “the giant of Africa” (UNDP, 2019). During the past years, actions aimed at improving the productivity of labour have been included in various national development plans in the country since the ability to harness its rich-resource endowment depends on the capacity of its labour force. This clearly shows that sustainable economic development in the long run cannot be achieved if available labour is not employed in the production process to add value to the natural resources at its disposal. Human resource has a strategic role for productivity increase of any economy, and this makes labour superior in the industrial competition (Razak, Osman, Yusof, Naseri & Ali, 2014).

Objective

With effective and optimum use of labour, all the merits supplied by the productivity growth can be obtained, it was on this basis this study intend to comparatively analyze the impact COVID-19 pandemic, focusing on digitalization and health expenditure, on labour productivity in the selected Sub-Saharan African Countries. Specifically, the study examines the impact of digitalization and healthcare infrastructure on labour productivity in the selected Sub-Saharan African Countries; and investigates the impact of digitalization and health expenditure on labor productivity across different countries within the region.

Research Question

To guide the study, we asked the following pertinent questions: What was the impact of the COVID-19 pandemic with respect to digitalization and healthcare expenditure on labor productivity in Sub-Saharan Africa? How did this impact vary across different countries within the region?

LITERATURE REVIEW

Theoretical Framework

Technology Adoption Theory

The Technology Adoption Theory, also known as the Diffusion of Innovations Theory, explains how new technologies are adopted and spread within societies or organizations over time. This theory was developed by Everett Rogers in the 1960s and has since been widely applied in various fields, including economics, sociology, and marketing. The Technology Adoption Theory has practical implications for organizations, policymakers, and marketers seeking to introduce new technologies or innovations. By understanding the factors that influence adoption decisions and the dynamics of diffusion, stakeholders can develop strategies to accelerate adoption, overcome resistance to change, and maximize the benefits of innovation. This may involve targeted marketing campaigns, educational efforts, incentives, training programs, or policy interventions aimed at addressing barriers to adoption and fostering a supportive environment for innovation diffusion

The COVID-19 pandemic has accelerated the adoption of digital technologies and remote work arrangements across many industries. Theories related to technology adoption, such as the technology acceptance model (TAM) and diffusion of innovations theory, can help explain how the rapid adoption of digital tools and telecommuting platforms has influenced labor productivity during the pandemic. While technology adoption can enhance flexibility, collaboration, and efficiency in some cases, it may also present challenges related to digital skills gaps, cybersecurity risks, and social isolation, which can affect productivity outcomes

Empirical Review

Karacuka, Myovella and Haucap (2024) used a digitalization composite index from a balanced panel of 40 Sub-Saharan African (SSA) economies, using data from 2006 to 2021, to assess the effect of digitalization on aggregate labor productivity in SSA economies. The study employed generalized least squares (GLS) and system generalized methods of moments (GMM) methods to capture the effects of digitalization on labor productivity levels in

agriculture, manufacturing, and service sectors. Their results showed a weak association between digitalization and overall labor productivity. However, when sectors are analyzed separately, digitalization had a positive effect on labor productivity in agriculture and manufacturing sectors, whereas the study found evidence for the productivity paradox in the service sector, with even a negative effect of digitalization on labor productivity.

Beyene, Beyene and Sore (2023) examined the role of digital technology on labor productivity. The required data for this study was obtained from 33 Sub-Saharan African countries from 2010 to 2020 and employed a one-step systems Generalized Method of Moments of estimation. The findings indicated that digital technology has a significant positive effect on labor productivity in the short run. Besides, the result also revealed that the lag of labor productivity has a significant positive effect on labor productivity in the short run. Unlike other; foreign direct investments, the level of inflation and general government final consumption expenditure had a significant negative effect on economic growth. The finding from the long-run model analysis showed that digital technology has a significant positive influence on labor productivity in the long run. The result also depicted that foreign direct investment, inflation, and general government final consumption expenditure had a long-run negative effect on labor productivity. From a policy point of view, the overall result showed a need for investment in digital technology development and a well-defined guiding principle to manage general government final consumption expenditure, inflation, and foreign direct investment.

Mobosi, Okonta and Nwankwo (2023) investigated the effect of health burdens on labour productivity in Africa's middle and low-income economies in the advent of Covid-19 pandemic. Methodology employed Common Correlated Effects (CCE) estimation of Heterogeneous Dynamic Panel data, Models to estimate a sample of 45 African countries with 30-panel series from 1990 to 2020. The authors discovered that the Covid-19 epidemic has aggravated the catastrophic health burdens (morbidity and mortality rates) in the panel countries. It showed that health burden has dynamic negative long-term spilling effect on labour productivity, such that a 1% increase in health burden, *ceteris paribus*, would reduce labour productivity by 13% in the upper middle income economy, 17% in the lower middle income economy, and 19% in the low-income economy, respectively. The findings also show divergence effects; with low- and lower-middle-income nations bearing the highest brunt of health burden crises due to Covid-19 pandemic and its mitigation measures, even in the face of inadequate health systems, lowering their labour productivity.

Klaas, and [Ark](#) (2023) Examined productivity and the pandemic: short-term disruptions and long-term implication. The study analyses quarterly estimates of productivity growth at industry level for three advanced economies, France, the UK and the US, for 2020. We use detailed industry-level data to distinguish reallocations of working hours between industries from pure within-industry productivity gains or losses. The study found that all three countries showed positive growth rates of aggregate output per hour in 2020 over 2019. However, after removing the effects from the reallocation of hours between low and high productivity industries, only the US still performed positively in terms of within-industry productivity growth. In contrast, the two European economies showed negative within-industry productivity growth rates in 2020. While above-average digital-intensive industries outperformed below-average ones in both France and the UK, the US showed higher productivity growth in both groups compared to the European countries. Industries with medium-intensive levels of shares of employees working from home prior to the pandemic made larger productivity gains in 2020 than industries with the highest pre-pandemic work-from-home shares. Overall, after taking into account the productivity collapse in the hospitality and culture sector during 2020, productivity growth showed no clear deviation from the slowing pre-pandemic productivity trend. Future trends in productivity growth will depend on whether the favourable productivity gains (or smaller losses) in industries with above-average digital intensity will outweigh negative effects from the pandemic, in particular scarring effects on labour markets and business dynamics.

METHODOLOGY

This study adapted the work of Usman and Abubakar (2022). In his study he utilized the Panel data technique to examine the effect of pandemic on productivity of Africa Countries. The model is stated thus:

$$LP_{it} = \beta_0 + \beta_1 COV_{it} + \beta_2 UNP_{it} + \beta_3 GDP_{it} + \epsilon_{it} \dots \dots \dots \text{Eqn 1.}$$

(GDP) here i represent each individual country or each cross section unit and t represent the time period. In the above model β_0 is the constant term which is not correlated with the right hand side variables. His main variable of interest is the COV (COVID-19); the variable UNP = Unemployment) is the control variable and ϵ is the error term.

The above model is therefore modified and technically written by including variables that will capture the objectives this study as follows:

$$LP_{it} = \alpha + \beta_1 CVDIMP_{it} + \beta_2 DIGT_{it} + \beta_3 HETEXP_{it} + \mu_t \quad \dots\dots\dots \text{Eqn 2.}$$

Where:

LP_{it} = Labor productivity in country i at time t.

$CVDIMP_{it}$ = A variable representing the severity of the COVID-19 pandemic in country i at time t.

$DIGT_{it}$ = A variable representing the level of digitalization in country i at time t.

$HETEXP_{it}$ = A variable representing the strength of healthcare infrastructure in country i at time t.

α = Intercept

$\beta_1 \dots \beta_3$ = coefficients of the independent variable

μ_t = Error term

In order to assess fully the overall impact of the COVID-19 pandemic on labour productivity in Sub-Saharan Africa, this study use dummy variable to capture the pre COVID=19 and post COVID-19 effect of labour productivity function, where 0 is for the periods before the COVID-19 effect and 1 for the period after COVID-19 effect. Therefore in our study, 0 is for the period 2006 to 2019 while the period 2020 to 2023 are assigned 1 for the dummy variable model specification.

Hence, equation (3.2) can be re-written as:

$$LP_{it} = \alpha_1 + \alpha_2 Di + \beta_1 DIGT_{it} + \beta_2 HETEXP_{it} + \beta_3 (DiDIGT_{it}) + \beta_4 (DiHETEXP_{it}) + \mu_t \dots\dots \text{Eqn 3.}$$

The expectation of equation 3.3 is that for period 2006 to 2019, the dummy variable is 0, and we have:

$$E(LP_{it}/Di=0) = \alpha_1 + \beta_1 DIGT_{it} + \beta_2 HETEXP_{it} \dots\dots\dots \text{Eqn 4}$$

The expectation of equation 3.3 is that for period 2020 to 2023, the dummy variable is 1, and we have:

$$E(LP_{it} / Di = 1) = \alpha_1 + \alpha_2 + (\beta_1 + \beta_3) DIGT_{it} + (\beta_2 + \beta_4) HETEXP_{it} \dots\dots\dots \text{Eqn 5.}$$

Labour Productivity

Labor productivity is the key outcome of interest in this study. It reflects the efficiency of labor in producing goods and services. Changes in labor productivity during the COVID-19 pandemic are crucial for understanding the broader economic impact of the crisis.

GDP per Worker: This is a common measure of labor productivity, calculated as the ratio of Gross Domestic Product (GDP) to the total number of workers. It provides an overall measure of economic output per worker.

$$\text{Labour Productivity} = \frac{GDP}{\text{Total Number of Workers}}$$

Severity of COVID-19 Impact

The severity of the COVID-19 impact captures how strongly the pandemic affected each country in Sub-Saharan Africa. This variable reflects the extent of health and economic disruptions caused by the pandemic. This variable can be measured through a composite index or individual indicators, such as COVID-19 Deaths per Capita (The number of confirmed COVID-19 deaths per 1,000 people). We used dummy variable (Chow Test technique) in our model to capture the severity of COVID-19 impact because of availability of data.

Digitalization

Digitalization refers to the adoption and integration of digital technologies in economic and social activities. During the COVID-19 pandemic, digitalization became critical for maintaining productivity as it enabled remote work, online education, and digital service deliver. Digitalization can be measured using the Internet Penetration Rate (The percentage of the population with access to the internet).

$$\text{The Internet Penetration Rate} = \frac{\text{Number of Internet Users}}{\text{Total Population}} \times 100$$

Healthcare Infrastructure

Healthcare infrastructure is a critical determinant of a country's ability to respond to the health crisis posed by COVID-19. It influences the resilience of labor productivity by ensuring a healthier workforce and reducing disruptions caused by illness. Healthcare infrastructure can be measured through the Health Expenditure as a Percentage of GDP (The proportion of national income spent on healthcare, indicating the level of investment in the health sector).

$$\text{Health Expenditure} = \frac{\text{Total Health Expenditure}}{GDP} \times 100$$

The measurement of these variables will allow for a robust analysis of the factors influencing labor productivity in Sub-Saharan Africa during and after the COVID-19 pandemic.

Nature and Sources of Data

This study used secondary data to investigate the impact of COVID-19 pandemic on labour productivity in Sub-Saharan Africa. The study typically covered data from 2006 (pre-pandemic era) to 2023 (post-pandemic adjustment), providing a comprehensive analysis of the effects of COVID-19 on labor productivity over time. This time frame captured the full scope of the pandemic's impact, from the initial outbreak to the recovery and adjustment periods. Data collection technique for this research was of panel data in nature, and were sourced mainly from the World Development Indicator (WDI) and Central Bank of Nigeria statistical Bulletin (CBN). The data collected are annual data on the variables stated in the model above.

RESULT AND DISCUSSION

Hence we present the panel fixed effect result of the model in line with the stationarity status to avoid spurious regression.

The result of equation 3 is presented thus:

LP =	161.13	- 319.50	+ 6.6 DIGT	- 208.76 HETEXP	- 7.72 (DiDIGT)	+ 78.24 (DiHETEXP)
t-Sta	(2.5088)	(-3.4402)	(8.5808)	(-5.6738)	(-2.7377)	(4.6346)
p-value	0.0129	0.0002	0.0000	0.0000	0.0067	0.0041
R ²	= 0.99					
DW	= 1.99					
	F-Statistic = 3622.185					
	Prob(F-statistic) = 0.00000					

As shown from the result, the R² is 0.99 which means that about 99% of the total variation in labour productivity for the period under review is explained by the changes in digitalization, health expenditure and their respective dummy variables. Just about 1% of the variation in labour productivity is unexplained in the model. This shows a good fit of the model. More so, the F-statistic is statistically significant implying that the entire model is statistically significant hence the results of the model is robust and can be relied upon for policy measures. The value of the Durbin-Watson (DW) statistic is approximately 2 implying absence of autocorrelation.

Clearly, the result above shows a combined effect of digitalization and health infrastructure on the labour productivity of the selected Sub-Saharan African countries for the period between 2006 and 2023. The result reveals that increase in digitalization in the region has on

the average contributed to increase in labour productivity but shows sign of decline after the COVID-19 period. However, on the contrary, the result reveals that on the average, increase in health infrastructure has not improved the labour productivity in the region but shows sign of improvement after the pandemic era. This is worrisome but not unsurprising owing to the earlier neglect of health sector in the region, even though many countries in the region are beginning to give attention to the sector.

Further, the result of equation 4 is presented thus:

LP =	161.13	+ 6.6 DIGT	- 208.76 HETEXP
t-Sta	(2.5088)	(8.5808)	(-5.6738)
p-value	0.0129	0.0000	0.0000

The result of the equation 4 above shows the segment of the impact of digitalization and health infrastructure before the COVID-19 pandemic. The result reveals that prior to the pandemic, digitalization contributes positively to labour productivity while health infrastructure dampens the labour productivity in the region. Specifically, a percentage increase in internet penetration in the region causes labour productivity to increase by about 6.6%. On the other, a percentage increase in health expenditure as a % of GDP reduces labour productivity in the region by over 200%

The result of equation 5 is presented thus:

LP =	161.13	- 319.50	- 1.12 DIGT	- 130.52 HETEXP
t-Sta	(2.5088)	(-3.4402)	(8.5808)	(-5.6738)
p-value	0.0129	0.0002	0.0000	0.0000

This segment of the result presents the impact of COVID-19 on labour productivity in Sub-Saharan Africa, using selected SSA countries. From the result, contrary to expectation, digitalization suffers a dip in enhancing labour productivity in the region. As opposed to digitalization contributing positively before the pandemic, its impact during and after the pandemic shows declining contribution to labour productivity. During the period, internet penetration dwindles labour productivity by about 1.12%. This represents about represent over 600% decline from its contribution before the pandemic era. On the other hand, health infrastructure continues to show negative impact to labour productivity in the region. Even though health infrastructure shows a negative impact to labour productivity in the post pandemic era, there is an improvement of its contribution compared to the pre pandemic era. Obviously, during the post pandemic era, total health expenditure to GDP improved the labour productivity by about 78.24% (from -208.76% to -130.52%). Yet, the result shows that on the

average, during the post pandemic era, health expenditure has dwindled labour productivity however with some level of improvement as compared with the pre pandemic era.

Table 1: Presentation of Cross-Section Fixed Effects for the Selected Countries

Country	C_ID	Effect	Average	Impact to Average	Rank
Burkina Faso	1	17.60958	161.1320	178.74158	7 th
Cote d'Ivoire	2	219.6158	161.1320	380.7478	2 nd
Senegal	3	12.60279	161.1320	173.73479	8 th
Ghana	4	332.1311	161.1320	493.2631	1 st
Nigeria	5	86.15866	161.1320	247.29066	4 th
Cameroon	6	43.72315	161.1320	204.85515	5 th
Gabon	7	-106.6374	161.1320	54.4946	12 th
Congo	8	-464.6627	161.1320	-303.5307	14 th
DRC	9	-31.01396	161.1320	130.11804	10 th
Chad	10	-170.8396	161.1320	-9.7076	13 th
Tanzania	11	6.025708	161.1320	167.157708	9 th
Uganda	12	-74.17328	161.1320	86.95872	11 th
Rwanda	13	95.33251	161.1320	256.46451	3 rd
Kenya	14	40.08597	161.1320	201.21797	6 th

Source: Author's Compilation from E-Views 10 Output

Table 1 shows the influence of heterogeneous factors of the different countries to labour productivity. This means that keeping digitalization and health expenditure constant, other country specific factors like governance, institutional framework, policy workability and other macroeconomic factors increases labour productivity in the region except for DRC, Uganda, Gabon, Chad and Congo. Notably, Ghana has more robust macroeconomic environment and strong institutional framework that promotes labour productivity. This is shown by their the level of the country-specific effect of over 300% improvement to labour productivity in the country, keeping the average impact of digitalization and health expenditure in the region constant. Following Ghana is Cote d'Ivoire with over 200% country-specific factors that improves labour productivity in their country. Nigeria has country-specific factors that improves labour productivity by about 86% and stood 4th in the 14 selected SSA countries of the study. Regrettably, macroeconomic factors and institutional framework in Congo worsens the country-specific influence on labour productivity of the country by over 400%.

It is observable from the table also that the countries in the cluster of West Africa (Burkina Faso, Cote d'Ivoire, Senegal, Ghana and Nigeria) has better country-specific results as all has positive country-specific effect. This is followed by the cluster of East African countries (Tanzania, Uganda, Rwanda and Kenya) with only Uganda having country-specific negative influence. The Central African country cluster (Cameroon, Gabon, Congo, DRC and Chad)

has the worst performance of all the regional cluster under consideration. It is only Cameroon that recorded positive country-specific positive influence while the other four countries recorded negative country-specific influence to labour productivity.

From the result, it is revealed that digitalization contributed to increase in labour productivity in the region during the pre-COVID-19 pandemic era. The contribution was gradual at about 6% increase in productivity for a percent increase in the number of internet users as a proportion of total population. The gradual appreciation of digitalization in the level of productivity was however not sustained during and few years now after the pandemic as the digitalization was seen to dampen productivity by about 1.12% after the pandemic era. This surprising result of digitalization not sustaining its positive impact even during and after the pandemic era could be attributed to many factors in the region. First, digitalization has not been fully entrenched into the system in SSA region as it has been in the more developed countries. Therefore it became easy to abandon the progress and benefit during the crisis period. Second, in the region, many factors needed for digitalization to work seamlessly are inadequate. The power supply is not efficient with intermittent interruption of network from the internet service providers. These has been a clog in the wheel of labour productivity in the region. Again, the level of productivity in the SSA region is not so dependent on technology but much on manpower. Therefore during the pandemic and lockdown period, it becomes obvious that digitalization alone could not spur productivity. As found by Balde, Boly and Avenyo (2020), informal workers are more likely to lose their jobs and tend to experience decrease in earnings. These findings also hold for those who work in high-risk sectors. The overall output in the SSA are largely from the aggregate of the informal sector.

The findings of this study is further supported by Beyene, Beyene and Sore (2023) who examined the role of digital technology on labour productivity from 33 Sub-Saharan African countries and found that digital technology has a significant positive effect on labor productivity in the short run. Besides, the result also reveals that the lag of labor productivity has a significant positive effect on labor productivity in the short run. The finding from the long-run model analysis shows that digital technology has a significant positive influence on labor productivity in the long run. It is also agree with the findings of Karacuka, Myovella and Haucap (2024) who found a weak association between digitalization and overall labor productivity. However, when sectors are analyzed separately, their result reveals that digitalization has a positive effect on labor productivity in agriculture and manufacturing

sectors, whereas they found evidence for the productivity paradox in the service sector, with even a negative effect of digitalization on labor productivity.

Further the result shows that health expenditure has not been so impressive in improving labour productivity in the region. Prior to the pandemic era, this study found that healthcare infrastructure has on the average dampened labour productivity so much. However, there was an improvement of health infrastructure and expenditure during and after the pandemic era. Though after COVID-19 pandemic, health expenditure has not contributing positively to labour productivity, but its negative impact drastically reduced compared to the post pandemic era. This explains serious neglect in the health sector. The slogan ‘health is wealth’ is not taken serious in the region. Budgetary allocation to health seems not adequate to serve as the needed catalyst for improved labour productivity. The poor performance of the health infrastructure in the region could also be attributed to brain drain. Majority of personnel in the health sector within the region prefers to work in other continent where their services are appreciated more and adequately remunerated.

Contrary to the findings of this study, Mehmood, Siddique and Ali (2022) found that health expenditures significantly and positively influence productivity in South Asian countries. However, studies within Sub-Saharan Africa agrees with our findings. Ayaga, Nomor, Obute & Ngutsav (2023) observed that that in the short run, health expenditure has a positive but insignificant relationship with labor productivity in Nigeria. Further, Adegoke, Mbonigaba and George (2022) reveals a negative relationship between health expenditure and TFP, health expenditure per capita and TFP in SSA countries. Education and other non-health factors, like Information Communication Technology (ICT) and control of corruption equally have significant positive impact on TFP.

CONCLUSION AND RECOMMENDATIONS

Having applied appropriate research technique for this study, we clearly summarize the findings of this study.

- i. Digitalization in SSA region had gradual improvement in contributing to labour productivity in the region before the pandemic era. However, this gradual improvement was eroded away during the pandemic era. This is attributable to the fact that the region is still under developed and their production system is not rooted to digital technology. Again, power supply and internet service provision is not stable in the region.

- ii. Health infrastructure and expenditure has not been effective in improving labour productivity in the region.
- iii. During the pre-pandemic era, health infrastructure had largely and significantly reduced labour productivity in the region.
- iv. During and after the COVID-19 pandemic era, health infrastructure has witnessed some level of improvement towards labour productivity in the region. Though the improvement has not completely eradicated the negative impact of health infrastructure in the region.
- v. Countries in the West African cluster of the region had better improvement on the use of digitalization and health infrastructure to impact labour productivity. This is followed by the countries in the East African cluster of the region. The Central African countries needs more attention in the use of digitalization and health infrastructure in improving labour productivity.

Increase in total factor productivity is becoming increasingly a goal of many countries and regions. To do this labour productivity is paramount. Hence this study proposes that labour productivity is determined by the level of digitalization as well as health factors of the employees. This study examined the impact of COVID-19 in selected sub-Saharan African countries on the labour productivity in the region. A balanced panel comprising selected 14 countries over 18 time period was selected and using appropriate technique, the study found that digitalization had been contributing gradually to the labour productivity in the region. However, this improvement was completely eroded away by COVID-19 pandemic. Though, there were improvement in the health expenditure towards improving labour productivity during and after the COVID-19 era, yet health expenditure has been weakening labour productivity in the region. The study further found that countries in the Central Africa should place serious attention towards the use of digitalization and health infrastructure and expenditure in improving their labour productivity.

Based on the findings of the study, the following recommendations are proffered:

- i. Government should subsidize the cost of acquisition and installation of the digital technology to small scale firms in the countries of the SSA region.
- ii. The internet service providers in the region should strive to acquire state-of-the-art equipment that will be providing uninterrupted internet services to their subscribers.

- iii. Adequate investment in power sector in the region should be given desired attention. Power supply should be made regular, reliable and affordable to enhance the thriving of digital economy.
- iv. Health expenditures should be properly monitored to avoid wastages and leakages such that their intended goals would be achieved.

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