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Fiscal decentralization and devolved healthcare service availability outcomes in Kenya: Evidence from panel dynamic approach

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ABSTRACT

The study examined the effect of fiscal decentralization on healthcare availability outcomes from 23 Kenyan counties during the 2013–2022 devolution period. The results from different robust non-endogeneity econometric methods indicate a significant deleterious effect of fiscal decentralization on the availability of human and technical healthcare resources (number of medical personnel and number of hospital beds per 10,000 people). The study also reveals the significant beneficial role of county gross domestic product in enhancing the availability of healthcare resources. Nevertheless, the paper demonstrates that county revenue impedes realizing adequate availability of healthcare resources in Kenyan counties. The study results point to the need to implement proactive decentralized fiscal policy interventions to realize an efficient healthcare system where human and technical healthcare resources are available. Specifically, enacting policy interventions that target effective financial allocation toward infrastructural development and building human resource capacity could enhance overall healthcare availability at the grassroots level.

1. Introduction

Fiscal decentralization (FD) involves allocating the national government's resource-sharing and spending mandate to the nation's lower cadre of governance (Rotulo et al., 2022). Accordingly, in recent years, FD and health sector outcomes have gained prominence in healthcare policy advocacy, stakeholder, and scholarly discourses as significantly effective mechanisms for realizing allocative and technical effectiveness at the local level (Rotulo et al., 2022). In this regard, the rationale is that when resources are pooled at sub-national levels, regional leadership and stakeholders are tasked to account for their funds, optimizing the efficiency of local resource allocation (Christl et al., 2020; Martínez-Vázquez et al., 2017). However, the disintegration of the pooling mechanism that occurs under FD may decrease equitable redistribution. In other words, it is based on resource allocation criteria that target demographic demands and needs instead of regional wealth and income resources. Consequently, it promotes regional healthcare inequalities (Akita et al., 2021; Brock et al., 2015). Additionally, FD may abate the efficiency of state policies under different situations, including if the policy initiatives encounter spillovers, if it results in inequitable access to shared resources across regional jurisdictions if the accountability systems are frail, and if the local leadership is more susceptible to capturing distinct interests (Arends, 2020; Ferraresi et al., 2021).

Previous studies on the impact of FD on healthcare outcomes in developing and developed nations have suggested that development policies generally aim to reduce maternal and mortality rates (Jiménez-Rubio, 2011; Martínez-Vázquez et al., 2017). However, the degree to which healthcare is accessed or the availability of healthcare facilities and personnel can differ according to the study designs and country settings (Cantarero and Pascual, 2008). Healthcare availability entails the concentration of human resources (number of medical personnel per 10,000 people) and technical resources (number of hospital beds per every 10,000 people) in a particular region (Rotulo et al., 2022). Conversely, studies from Uganda, Indonesia, and China have shown that FD may cut healthcare resource provision, negatively affecting healthcare funding and general quality (Huang et al., 2017). In tandem, the impact of FD on spatial differences has indicated that FD can raise inequitable availability of healthcare facilities/services between rural and urban populations and between different socioeconomic (Sanogo, 2019).

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Over recent decades, FD has been operationalized by several economies in the form of devolution, becoming an integral component in public sector reforms (Manor, 1999; Cavalieri and Ferrante, 2016). In this broader process, healthcare services have occupied a pivotal position (Costa-Font and Greer, 2016). In general, the devolution of healthcare functions to the lower cadre of governance occurs under diverse forms. For example, there are National Health Service systems in Scandinavian countries, the United Kingdom, Spain, and Italy; those for federal states in countries such as Australia, Canada, and Switzerland; and those for counties/administrative provinces in developing nations such as Kenya, Tanzania, China, India, and the Philippines (Cavalieri and Ferrante, 2016). Although intriguing reasons for devolution and decentralization are fully country-specific, the overall persuasion is that transfers of functions, responsibilities, and powers to the regional government can enable an ideal match between people's priorities and state policies (Oates, 1972). In other words, such actions are entrenched in the inherent rationale of improving welfare mobility (Weingast, 2009; Zhang and Hewings, 2018).

The devolution of healthcare, among other functions in Kenya, came into effect after the proclamation of the New Constitution in 2010, ushering in 47 county governments. It was described as the most progressive way of ensuring improved accessibility and availability of social services such as healthcare to citizens (GoK, 2010; Ngundo, 2014). According to Kobia and Bagaka (2014), Kenyan citizens' right to equitable health and crisis services was granted through this proclamation. In addition, this process ensured the transfer of health service management and provision functions, the mechanism through which county and national governments would have shared responsibility (GoK, 2010). In particular, county governments acquired healthcare functions, such as promotive services, preventive services, and the management of healthcare facilities, following the successful 2013 general election and the subsequent institution of county government systems (Muchomba, 2015).

Although decentralization has a long history in Kenya, the distinctive factor between the New Constitution in 2010 and the Lancaster House Constitution in 1962 includes the people's active participation (Kimathi, 2017). Specifically, the New Constitution in 2010 envisions the thorough involvement of grassroots citizens in policymaking. In particular, Article 174 elaborates that the critical aims of devolution are to foster accountable and democratic exercise and to promote enhanced public participation in decision-making (Kimathi, 2017). Moreover, Article 43 states that every Kenyan is entitled to the highest realizable healthcare standards, including the right to reproductive healthcare services (Mwangi, 2013). Nevertheless, the created counties differ significantly in socioeconomic and healthcare development, geographical coverage, and population size (Thapa et al., 2024). For instance, counties like Nairobi and Kiambu lead in socioeconomic development indicators. In contrast, arid and semi-arid (ASAL) counties like Mandera, Turkana, and Wajir occupy the bottom ladder (Thapa et al., 2024). ASAL counties are the most socially and economically disadvantaged and, hence, are provided with additional equalization funds for improved public service provision such as healthcare and education (McCollum et al., 2018). This signifies significant differences in healthcare availability resulting from regional socioeconomic differences brought about by dynamic climate change shocks (Schulz-Antipa et al., 2024).

Notwithstanding the argument for FD and devolution of resources to ensure enhanced availability of healthcare services, as can be appreciated in many studies conducted in Kenya (Kimathi, 2017; Mwangi, 2014; Mbogori and Iravo, 2019; Kibui et al., 2015), there has been varied evidence concerning the effect of FD on healthcare outcomes. One striking gap is that most studies have focused on qualitative approaches, with only a handful employing decentralization indicators, including the effectiveness of county governments as part of the regressor variables (Gitonga and Keiyoro, 2017; Wagana, 2017). For instance, Tsofa et al. (2017) used a qualitative case study design and semi-structured interviews in Kilifi County, Kenya. They observed that the implementation of devolution created a way for local community involvement in the planning and implementation of the healthcare budget, hence enhancing the equitable availability of healthcare facilities and personnel. Similarly, Wanjohi (2019) applied key informant interviews (KIIs) to assess the effect of devolved health services on the availability of non-communicable disease medicine in Makueni County, Kenya. In another study, Masaba et al. (2020) systematically reviewed the literature to evaluate the progress and challenges in the Kenyan devolution of the healthcare system. They noted that inadequate healthcare resources at the grassroots level. While these studies point out the evident effect of fiscal decentralization in the Kenyan healthcare system, there is a need to quantify the impact. For instance, applying a difference-in-difference method in examining the effect of intergovernmental fiscal transfers on healthcare outcomes in 47 Kenyan counties, Thapa et al. (2024) concluded that their study filled the gap of providing causal linkages between fiscal transfers and healthcare outcomes in the context of newly decentralized low-middle-income countries like Kenya. Similarly, using a quantitative approach, Kairu et al. (2021) deduced that a lack of financial autonomy in Kenyan county hospitals resulted in frequent stockouts of essential health goods.

Therefore, against this backdrop, this present study builds on the scantily available literature quantitatively linking fiscal decentralization and healthcare availability outcomes in the context of a decentralized low-middle-income countries based on two key measures (technical resource indicator measured by number of hospital beds per 10,000 people and human resource indicator measured by the number of medical doctors per 10, 000 people) in 23 Kenyan counties during the 2013–2022 devolution period using panel dynamic approach. The contributions to the existing literature are two-fold. First, it provides an empirical analysis of the effect of FD on two healthcare availability outcomes rather than focusing on only one. Specifically, it analyzes the link between FD and the availability of non-financial healthcare facilities and the extent to which human capital is available. Second, it analyzes how the effect of FD on healthcare outcomes varies according to the county's revenue level. Finally, to the best of the authors' knowledge, this is the first attempt to perform an empirical analysis from a county perspective in a developing country such as Kenya, where heterogeneity analyses are unavailable. From this viewpoint, this study is related to a new growing literature strand on the distributional effects of FD across country-specific heterogeneous regions (Cavalieri and Ferrante, 2020; Das and Guha, 2023; Di Novi et al., 2019; Thapa et al., 2024).

The remainder of this paper is organized as follows: Theoretical and empirical literature is explored in Section 2 to identify striking notions and glaring gaps to be filled. Section 3 covers the data, sources, and empirical model specification. Data analysis and discussion of the key findings are presented in Section 4. Lastly, Section 5 presents the study's summary, conclusion, policy implications, and limitations as avenues for future studies.

2. Literature review

FD has been theorized as transferring powers/duties and resource spending from the central government to regional governments (Schneider, 2003). In this regard, most theoretical concepts of FD are generally based on Musgrave's (1996) allocation duties of government (comprised of assigning resources to the local government) to maximize the social welfare of the people. Additionally, FD is critical in efficiently allocating resources and enhancing economic, political, and social activities (Oates, 2004). Several reasons affirm the potential benefits of the FD of health resources. On the one hand, some scholars have posited that local (county) governments are more influential in providing social services than the national government since they can initiate, implement, and monitor policies to meet regional development demands (Oates, 2004).

Meanwhile, the theory of fiscal federalism suggests that FD spending

power can enhance effective and efficient public service delivery at the smallest local unit through public participation, thereby creating policy initiatives for the devolved government to improve their revenue and expenditure decisions (Oates, 2004). Moreover, this theory points out that FD can significantly influence social development through easier access to healthcare and general poverty alleviation through enhanced pro-poor policies at the local level (Oates, 2004). Thus, FD signifies greater local government autonomy, which warrants local development by attracting capital and foreign direct investment (Liu et al., 2019). This can also increase household incomes and improve people's capabilities and opportunities to validly access social amenities such as healthcare services (Das, 2025).

Other scholars have argued that FD (as a policy mechanism) can contribute to the improved quality of accessing public services such as healthcare since it includes active participation of citizens in policy-making and critical decision-making processes (Scott, 2006). However, FD has been touted as ineffective in providing adequate and quality social services, such as healthcare, due to externalities associated with asymmetric information and self-centered officials' political rent-seeking behaviors (Oates, 2005). Decentralization can also quickly shift resource control from the central to the sub-national government, limiting the former from addressing critical programs such as redistribution and poverty alleviation (Diaz-Serrano and Rodriquez-Pose, 2015; Ochi and Saidi, 2024).

Aligning with the theoretical notions, the empirical literature has extensively explored the link between fiscal decentralization and healthcare availability outcomes. Several studies have established that fiscal decentralization significantly improves the availability of healthcare services (Cavalieri and Ferrante, 2016; Cobos Muñoz et al., 2017; Jiménez-Rubio et al., 2017; Xu and Lin, 2022). For instance, using panel data from 1996 to 2012 in 20 Italian regions, Cavalieri and Ferrante (2016) observed that FD improves health outcomes. The authors also found that the effectiveness of FD in enhancing healthcare outcomes depends on contextual attributes such as regional wealth. Similarly, Cobos Muñoz et al. (2017) demonstrated a significantly positive nexus between fiscal decentralization and healthcare availability outcomes in 26 low- and middle-income economies. Corroborating the findings, Abrigo et al. (2017) observed a positive link between devolution on developing state health expenses and healthcare outcome indicators such as facility demand and the infant mortality rate in the Philippines. Focusing on 30 Chinese mainland provinces using a two-way fixed effect and threshold regression model to 2008–2019 panel data, Xu and Lin (2022) found that fiscal decentralization positively affects regional healthcare availability. Additionally, the authors observed a significant non-linear effect of fiscal decentralization on public healthcare availability.

In Kenya, applying difference-in-difference and fixed effect techniques and focusing on 47 devolved counties, Thapa et al. (2024) deduced that targeted intergovernmental fiscal transfers effectively enhance subnational healthcare outcomes and thus reduce within-country health disparities. Still, in the Kenyan devolution context, Tsofa et al. (2017) applied a qualitative approach to analyzing fiscal decentralization's effect on health sector planning in Kilifi County. The authors noted that the devolution of healthcare financial planning enhances equity in healthcare availability. On the contrary, applying the fixed-effect model to 2001–2017 panel data from Italian regions, Rotulo et al. (2022) observed that fiscal decentralization reduces the availability of medical personnel and hospital beds and increases interregional healthcare disparity. However, Jiménez-Rubio et al. (2017) observed no significant effect of FD on healthcare outcomes in Spain. Additionally, Dwicaksono and Fox (2018) found mixed empirical evidence on the impact of FD on healthcare outcomes. In particular, the authors recommended that future studies include the definitive measures of institutional factors and FD and determine how they impact healthcare outcomes within decentralized governance contexts. Similarly, Sumah et al. (2016) systematically reviewed the effects of FD on health-related equities. The authors observed that FD can result in healthcare equity or aggravate healthcare inequalities. Holding a similar view, using a mixed methods approach, Nyawira et al. (2022) noted that inadequate financing of healthcare human resources results in compromised healthcare quality and efficiency in Kenyan counties.

The aforementioned literature highlights the existence of glaring gaps that require urgent harmonization. First, the review paints a picture of inconclusive research focusing on newly decentralized low-middle-income countries that explores the link between fiscal decentralization and healthcare availability outcomes. Secondly, the reviewed literature indicates mixed findings, where one strand of literature documents a significantly positive link between fiscal decentralization and healthcare availability outcomes, and another shows a decreasing nexus. Lastly, another strand shows no significant link between the two variables. Lastly, although both qualitative and quantitative studies somewhat agree, there is a need to quantify the effect of fiscal decentralization on healthcare availability outcomes. Addressing these gaps, the study seeks to answer the following critical questions: to what extent does budgetary decentralization influence healthcare availability outcomes? How does the effect of fiscal decentralization on healthcare availability outcomes vary across different socioeconomic levels? To what extent do regional revenue-related factors influence the impact of fiscal decentralization on healthcare availability outcomes?

3. Materials and methods

3.1. Data and variable description

This study relies on balanced panel data from 23 Kenyan counties over the 2013–2022 devolution period. The data for fiscal decentralization (FDEC) and healthcare availability outcomes (HAOs) was obtained from different government organizations, such as the Kenya Institute of Public Policy Research and Analysis (KIPPRA), the Commission for Revenue Allocation (CRA), and the Kenya National Bureau of Statistics (KNBS), published as statistical abstracts, fact sheets, and program-based budget reports. In this study, FD is included as the main independent variable and is defined as the shift in the spending and management responsibility from the national government to the county governments within a country. It is measured by the ratio of the county healthcare expenditure to the gross national healthcare expenditure (Rotulo et al., 2022). From this perspective, FD is considered from the revenue side because the ongoing devolution process mainly impacts Kenya's financing frameworks on social expenditures such as health expenditures (Ministry of Devolution and National Planning, 2015). In line with the supposition of Grisorio and Prota (2015), the FDEC variable is continuous, capturing the extent of fiscal decision-making autonomy among counties and over a specific devolution time. Hence, it quantifies how much the county healthcare expenditure is financed and independently managed.

Healthcare availability outcomes (HAOs) were included as the dependent variable. This study considers two indicators of healthcare availability: human resources and technical resources. The availability of technical resource indicators is measured by the number of total hospital beds per 10,000 people (*TRI*) (Rotulo et al., 2022). The human resource indicator is measured by the number of medical personnel per 10,000 people (*HRI*) (Kimathi, 2017). This study also considers FD difference variables to control for regional disparities in governance effectiveness, county gross domestic product (*CGDP*), and county revenues (*REV*) from taxes. In this case, devolution governance effectiveness is measured by the fiscal imbalance indicator (FISC), calculated by subtracting the total county healthcare expenditure from the county tax revenue. This indicator measures the extent to which counties depend on the national government's revenues (Rotulo et al., 2022). From a political economy standpoint, greater dependence on transfers from the national government can cause derailed local service provisions (Fisher, 1982). The CGDP is measured in current prices (*CGDP*), while the annual

collected tax revenues within a county are measured according to county revenue (*REV*). County revenue measures the extent to which counties are self-sufficient, in that greater revenue collection can help reduce the central government's transfer problems, such as fiscal imbalances (Liberati and Sacchi, 2013). Table 1 presents the variable descriptions and measurements.[1]

3.2. Econometric model specification

The study examines the effect of fiscal decentralization on healthcare availability outcomes using devolution panel data from 2013 to 2022 from 23 Kenyan counties. The estimation model is built from health production function as applied in recent literature focusing on panel analysis (Das, 2025; Jiménez-Rubio et al., 2017; Rotulo et al., 2022; Santana and dos Santos, 2024; Schulz-Antipa et al., 2024; Thapa et al., 2024):

$$HAOs_{it} = \beta_0 + \beta_1 HAOs_{it-1} + \beta_2 \mathrm{FDEC}_{it} + \gamma_i RDC + \varepsilon_{i,t}) \quad (1)$$

where $HAOs_{it}$ denotes healthcare availability outcomes in county i in year t, $HAOs_{it-1}$ indicates the healthcare availability outcomes lagged to 1 year to eliminate the possible endogeneity problem arising from the feedback effect, FDEC_{it} denotes the fiscal decentralization, i indicates the county ($i = 1,\ldots, 23$), and t is the devolution period (in years) ($t = 2013, \ldots, 2022$). $\beta_0 - \beta_2$ indicate the coefficient estimates of the constant, of the lagged dependent variable included as part of regressor and that of fiscal decentralization and γ_i represents the unknown parameters of the selected regional control variables.

RDC is the vector of the control variables included in the estimation. Accordingly, the control variables, such as gross county product (*CGDP*), are measured in current terms to account for any differences in county tax revenues, the veracity of healthcare quality shocks, and general living standards in respective counties (Cavalieri and Ferrante, 2020). Additionally, the county revenue measured by annual county-collected taxes (*Revenue*) is included to account for the degree of allocation toward achieving quality healthcare outcomes and reduced dependence on the national government's allocation. Another control variable is the devolution governance effectiveness measured by fiscal imbalance (*FISC*). Specifically, *FISC* is anticipated to control the extent to which resources are devoted to healthcare, hence the quality of healthcare services with minimal waste and bureaucracies. Lastly, to capture the healthcare differences occasioned by natural shocks, such as drought, which exacerbates regional socioeconomic differences, this study includes the dummy variable (arid or semi-arid land (*ASAL*)), which takes the value of 0 in year t if a county is not classified as drought-prone and a value of 1 in year t if a county is drought-prone and poverty vulnerable (Ochi and Saidi, 2024). Accordingly, we argue that healthcare coverage may differ significantly due to the uneven socioeconomic conditions between Kenyan counties. This has been empirically justified by previous studies such as Santana and dos Santos (2024). Lastly, ε_{it} is the random error term.

Table 1
Variable description and measurements.

Variable Name	Measurement Indicator	Data Source
Fiscal Decentralization (FDEC)	The ratio of county healthcare expenditure to gross country and county healthcare expenditure	KNBS County Statistical Abstracts; KIPPRA Reports
Healthcare Availability Outcomes (HAOs)	Number of hospital beds per 10,000 people (technical resource indicator) (*TRI*)	KNBS County Statistical Abstracts; KIPPRA Reports
	Number of medical personnel per 10,000 people (human resource indicator) (*HRI*).	KNBS County Statistical Abstracts; County websites
Regional Disparity Controls (RDC)	Fiscal imbalance is computed by subtracting county health expenditure from county revenue (*FISC*)	CRA County Fact Sheets
	County gross domestic product measured in current terms in million Kshs (*CGDP*)	KNBS County Economic Performance Reports
	Total collected county tax revenue in Kshs (*REV*)	CRA County Fact Sheets
	ASAL Dummy variable (1 = ASAL county; 0 =non-ASAL county)	National Drought Management Authority (NDMA)

[1] All variables are log transformed except FDEC and ASAL as they are already averaged between 0 and 1.

3.3. Estimation techniques

This paper conducts different estimations. First, in the first step, this paper performs summary statistics, correlation, and multicollinearity tests, consisting of measures of central tendency to characterize the collected data. In the second step, cross-sectional dependence was conducted to ascertain cross-sectional dependence (Pesaran, 2021). Consequently, second-generation panel unit root tests are performed to evaluate the stationarity level, cross-sectional dependence, and slope heterogeneity. Accordingly, cross-sectional augmented Dicky-Fuller (CADF) and Im, Pesaran, and Shin (CIPS) were used to ascertain the integration level of all the study variables due to their flexibility in enabling cross-section dependence in the panel data (Nguea and Fotio, 2024; Pesaran, 2021).

In step three, the econometric model in Eq. (1) is estimated using the Driscoll-Kraay Fixed Effect technique as the benchmark model (Nguea and Fotio, 2024; Maket, 2024). This technique is considered because of its robustness in short panels with a higher likelihood of cross-sectional dependence (Driscoll and Kraay, 1998; Nguea, 2023). However, this technique is limited in that it may not address endogeneity issues arising from reverse causality caused by measurement errors and omission of key variables. To overcome this shortcoming, the Eq. (2) model is reestimated using a two-step instrumental variable Generalized Method of Moments (2SIV-GMM) specified in Driscoll-Kraay standard errors. 2SIV-GMM is preferred due to its ability to control for cross-sectional dependence and endogeneity issues that easily arise in short-panel models, as is the case in this study (Apergis et al., 2022; Hoechle, 2007; Nguea, 2023; Maket, 2024; Maket et al., 2024). 2SIV-GMM techniques entail evaluation of the Hansen test, first-order AR (1), and second-order AR (2) tests, which are used as post-estimation measures to ascertain the reliability and validity of the estimation model.

Lastly, for robustness checks and alternative estimation, the paper applies the alternative instrumental variable estimator method, the panel-corrected error (PCSE) technique, which is considered robust in dealing with cross-sectional dependence and endogeneity issues more robustly (Chen et al., 2024). Additionally, the paper extends the robustness checks by using an instrumental variable two-stage least squares (IV-2SLS) estimator as an alternative instrumental variable estimator, capable of addressing endogeneity problems by internally generating instruments using heteroscedasticity in the panel data (Chen et al., 2024).

4. Analysis and discussions

4.1. Summary statistics

Table 2 shows the preliminary statistical mean value of healthcare availability indicator 1 (TRI) as 0.968 hospital beds per 10k people with a standard deviation of 0.143 hospital beds per 10k people, indicating variability of healthcare availability across different Kenyan counties. On the other hand, healthcare availability indicator 2 (HRI) has a mean value of 1.698 medical personnel per 10k people with a standard

Table 2
Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
lnTRI	230	.968	.143	.193	1.389
lnHRI	230	1.693	.516	−3.488	2.338
FDEC	230	.099	.293	−.029	.989
lnCGDP	230	.153	.07	−.089	.392
lnREV	230	−.505	.158	−1.027	−.065
lnFISC	230	1.972	.089	1.366	2.133
ASAL	230	.522	.501	0	1

Source: Author's Construction (2025)

deviation of 0.516, affirming substantial variation of medical personnel across the selected Kenyan counties. Regarding fiscal decentralization (FDEC), the selected 23 Kenyan counties recorded a mean value of 0.099 with a standard deviation of 0.293 and −0.029 and 0.989 as minimum and maximum values. This denotes that some selected Kenyan counties are still highly centralized after 10 years of devolution. Concerning the county gross domestic product (CGDP), the selected 23 Kenyan counties recorded a mean value of 0.153 million Kshs with a standard deviation value of 0.070, implying significant variability in the productive capacity of the Kenyan counties. Similar characterization applies to county revenue (REV) and fiscal imbalance (FISC), where a mean value of −0.505 Kshs with a standard deviation of 0.158, signifying significant differences in the selected Kenyan counties' revenue and a mean value of 1.972 with a standard deviation of 0.089, implying higher fiscal imbalance in the selected Kenyan counties. Lastly, the ASAL dummy variable denoting the socioeconomic differences recorded a mean value of 0.522 with a standard deviation of 0.501, signifying the somewhat different socioeconomic status of the selected Kenyan counties.

Table 3 presents the correlation analysis depicting the relationship between the healthcare availability indicators and fiscal decentralization and the selected regional disparity control variables. The correlation coefficient between TRI and FDEC on the upper panel is 0.025, implying a weakly positive relationship between the two variables. Regarding the regional disparity controls, there is a generally weak positive correlation between TRI and the selected controls, except fiscal imbalance (FISC), which exhibits a weak negative association with TRI. On the lower panel, the results show a correlation coefficient value of −0.077, implying a weak negative relationship between HRI and FDEC. This also applies to fiscal imbalance (FISC) and ASAL dummy, which all indicate a weak negative relationship with HRI. On the other hand, there is a weak positive relationship between HRI and county revenue (REV) and between HRI and county gross domestic product (CGDP).

Before conducting empirical estimation, it is important to examine the presence of the multicollinearity problem. This is because multicollinearity may result in unreliable and spurious results. In line with these arguments, this paper carried out a multicollinearity analysis using the Variance Inflation Factor (VIF), which measures the extent to which the estimated regression coefficients can vary due to the multicollinearity problem (Studenmund, 2014). Table 4 indicates VIF values of less than 5 and tolerance factor (1/VIF) values greater than 0.1. These findings indicate the absence of multicollinearity among the independent variables, hence ideal for subsequent empirical analysis of the set regression model in Eq. (1) (Nguea, 2023; Maket et al., 2024).

Table 3
Matrix of correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) lnTRI	1.000					
(2) FDEC	0.025	1.000				
(3) lnCGDP	0.168	0.136	1.000			
(4) lnREV	0.177	−0.013	0.837	1.000		
(5) lnFISC	−0.121	−0.032	−0.084	−0.195	1.000	
(6) ASAL	0.052	−0.000	−0.380	−0.334	0.134	1.000
(1) lnHRI	1.000					
(2) FDEC	−0.077	1.000				
(3) lnCGDP	0.070	0.131	1.000			
(4) lnREV	0.154	−0.032	0.843	1.000		
(5) lnFISC	−0.134	−0.025	−0.082	−0.192	1.000	
(6) ASAL	−0.094	0.005	−0.374	−0.331	0.126	1.000

Source: Author's Construction (2025)

4.2. Empirical estimation

4.2.1. Cross-sectional dependence and unit root test

The presence of cross-sectional dependence (CD) can result in unreliable results. Thus, before carrying out model estimation, it is essential to evaluate whether there is CD or independence among the study variables with the aid of Pesaran tests (Pesaran, 2021). Table 5 shows CD findings that significantly reject the null hypothesis of cross-sectional independence at a 1 % significance level, implying the presence of CD.

Drawing from the CD estimations in Table 5, second-generation unit root tests (CIPS and PESCADF) were used to ascertain the integration order of the study variables. CIPS and PESCADF were applied due to their ability to control for serial heterogeneity and CD. Table 6 shows the CIPS and PESCADF findings, indicating that all variables are stationary at first differencing. Therefore, using the unit root results, the subsequent estimations, including regression analyses, are based on the first differencing level of the variables for consistent results.

4.2.2. Baseline model estimation: effect of FDEC on HAOs (TRI and HRI)

In this part, the baseline model specified in Eq. (1) is estimated using the Driscoll-Kraay Fixed Effect estimator. Table 7 presents the baseline model results, where column 1 shows the results with TRI (number of hospital beds per 10,000 people), which is included as the dependent variable. The results show a significant impact of lagged TRI to one year on TRI, whereby a 1 % increase in lagged TRI results in a 1.766 % decline in TRI at a 1 % significance level. The results also indicate a significant effect of county revenue (lnREV) on TRI, whereby a 1 % increase in county revenue (lnREV) results in a 0.253 % decline in TRI at a 5 % significance level. On the other hand, the results indicate a significant impact of fiscal imbalance (lnFISC), whereby a 1 % increase in fiscal imbalance (lnFISC) increases TRI by 0.288 % at a 5 % significance level. Regarding the model's quality, the significant F-statistic value of 311.080 indicates that the obtained findings are reliable and consistent.

Column 2 indicates the effect of FDEC and selected regional disparity control variables on the second indicator of healthcare availability outcomes (HRI). Accordingly, the results show a significant impact of lagged HRI to 1 year on HRI, where a 1 % rise in lagged HRI lagged to 1 year leads to a decline in HRI by 2.639 % at a 1 % significance level. Additionally, the results indicate a significant effect of fiscal decentralization (FDEC) on HRI, whereby a 1 % rise in FDEC leads to an increase in HRI by 0.774 % at a 10 % significance level. Similarly, the significant F-statistic value of 46.860 indicates that the obtained findings are reliable and consistent.

However, while the results are somewhat reliable, Baum and Lake (2003), Nguea (2023), and Maket (2024) argue that the Driscoll-Kraay estimator may produce biased, unreliable results due to the

Table 4
VIF test results.

Variables	Model 1		Model 2	
	VIF	1/VIF	VIF	1/VIF
lnCGDP	3.891	.257	4.059	.246
lnREV	3.762	.266	3.943	.254
ASAL	1.188	.842	1.18	.848
FDEC	1.09	.918	1.106	.904
lnFISC	1.083	.924	1.081	.925
Mean VIF	2.203		2.274	

Source: Author's Own Construction (2025)

Table 5
Cross-sectional dependence test results.

Variable	CD-Statistic	P-value
lnTRI	3.490*	0.000
lnHRI	26.770*	0.000
FDEC	50.250*	0.000
lnCGDP	26.610*	0.000
lnREV	7.600*	0.000
lnFISC	16.920*	0.000
ASAL	0.000*	0.000

Note: H_0: Cross-sectional independence; * denotes significance at% level.

Table 6
Stationarity test results.

Variables	CIPS		PESCADF	
	Level	1st Diff	Level	1st Diff
lnTRI	−3.319**	−4.992***	−5.695**	−2.820
lnHRI	−3.358**	−3.977**	−4.453**	−2.677
FDEC	−2.676	−3.862**	−2.366	−3.231**
lnCGDP	−2.572	−3.279*	−2.087	1.904**
lnREV	−1.963	−3.226**	−1.189	.−2.670**
lnFISC	−2.596	−2.523	−2.670	−3.100*
ASAL	1.700	1.700	1.700	−2.820**

Note: *<0.1; **p < 0.05; ***p < 0.01

Table 7
Baseline regression results based on Driscoll-Kraay estimator.

Dependent Variable	TRI	HRI
	(1)	(2)
TRI (−1)	−1.766***	
	(0.113)	
HRI (−1)		−2.639***
		(0.429)
FDEC	−0.008	0.774*
	(0.013)	(0.391)
lnCGDP	−0.001	3.732
	(0.386)	(5.029)
lnREV	−0.253**	−4.311
	(0.102)	(2.594)
lnFISC	0.288**	−1.367
	(0.090)	(1.677)
ASAL	0.076	1.001
	(0.005)	(0.006)
Constant	4.696***	13.247***
	(0.317)	(1.765)
F-stat	311.080	46.860
Prob > F	0.000	0.000
Observation (N)	184	184

Note: * $p < .1$; ** $p < .05$; *** $p < .01$. Driscoll-Kraay non-parametric covariance estimators produce robust standard errors enclosed in the parenthesis.

endogeneity issues inherent in short panels, which are prone to CD issues as it is in this study. Second, the outcomes of healthcare availability are persistent over time and, hence, may have a weak correlation with their first lag values, which are lower than the threshold for establishing a robust relationship (Asongu and Aca-Anyi, 2019). Thus, to contain this shortcoming arising from endogeneity bias induced by the present CD, the specified model in Eq. (1) is reestimated using the 2SIV-GMM estimation method as it is robust in dealing with cross-sectional dependence, endogeneity, serial correlation, and unknown heterogeneity (Nguea, 2023; Tchmyou et al., 2019). The 2SIV-GMM estimations are presented in the subsequent robustness checks in the 4.2.3 subsection below.

4.2.3. Robustness checks using instrumental variable estimator

In this section, we conduct robustness checks by employing the Two-Step Instrumental Variable-Generalized Method of Moments (2SIV-GMM) with standard errors specified in the Discroll-Kraay estimator as a corrective measure of endogeneity bias. 2SIV-GMM uses orthogonality conditions in producing efficient coefficient estimates in the presence of cross-sectional dependence, variable omission, serial correlation, and heteroscedasticity in an unknown manner (175). Accordingly, this paper applies a maximum of three-year lags of the quadratic term of county revenue as the instruments. It includes FDEC and the rest of the regional disparity control variables as external instruments in the estimation. For instance, utilizing fiscal imbalance and county gross domestic product and ASAL dummy helps in capturing the effectiveness of the county fiscal policies in targeted public social provisions.

The lag structure of the selected instruments helps build an association between endogenous variables and the instrument (Scholl and Klasen, 2019). Following standard practice by recent studies such as Amponsah et al. (2023) and Sovey and Green (2011), we carried out validity, under-identification, weak identification, and over-identification analyses of the selected instrument using Hansen J-statistic test, Kleibergen-Paap rk LM test and Cragg-Donald Wald F-statistics. Table 8 indicates 2SIV-GMM results where the model quality tests Kleibergen-Paap rk LM ($p\text{-value} < 0.05$) confirm the rejection of the null hypothesis of under-identification and weak identification, implying the appropriateness of the selected instruments. An insignificant Hansen J-statistics ($p\text{-value} > 0.05$) confirms the non-rejection of the null hypothesis of instrument validity, indicating that the used instruments are valid and fulfill the orthogonality requirement in that they can be excluded and distributed independently (Ahmed et al., 2021). Moreover, insignificant AR (1) and AR (2) across the two models imply correct model specification and affirm reliable and valid model estimates.

Column 1 indicates the estimated results of FDEC alongside the selected regional disparity control variables on the first indicator of healthcare availability outcome (TRI measured by the number of hospital beds per 10,000 people), whereby, unlike the Discroll-Kraay estimator results, a 1 % increase in FDEC results in a decline in TRI by 0.016 %, holding all other factors constant. In column 2, the findings indicate a significant effect of FDEC on the second indicator of healthcare availability outcomes (HRI measured by the number of medical personnel per 10, 000 people), where a 1 % rise in FDEC leads to a decline in HRI by 0.252 % holding all other factors constant. These

Table 8
Robustness check results based on 2SIIV-GMM estimator.

Dependent Variable:	TRI	HRI
	(1)	(2)
TRI (−1)	−0.036**	
	(0.029)	
HRI (−1)		−0.252***
		(0.072)
FDEC	−0.016*	−0.533**
	(0.009)	(0.228)
lnCGDP	0.464*	−5.727
	(0.244)	(3.817)
lnREV	−0.453**	1.777
	(0.214)	(1.578)
lnFISC	−0.015	−0.340
	(0.013)	(0.213)
ASAL	0.023	−0.159
	(0.017)	(0.455)
Constant	2.667***	2.848***
	(0.055)	(0.717)
F-stat	1.440**	5.890**
Hansen J-stat *p*-value	0.877	0.222
Kleibergen-Paap rk LM *p*-value	0.002	0.000
AR(1)	0.072	0.543
AR(2)	0.249	0.000
Observation (N)	161	161

Note: * $p < .1$; ** $p < .05$; *** $p < .01$. Driscoll-Kraay non-parametric covariance estimators produce robust standard errors enclosed in the parenthesis.

findings unpack several deductions on the deleterious effect of FDEC on the availability of healthcare outcomes. One, the gradual expansion of private healthcare facilities within local regions accounts for the declining availability of technical and human resource indicators in publicly funded facilities (Brenna, 2011; Pavoli and Vicarelli, 2012). Secondly, the difficulty of Kenyan counties in absorbing localized development budgets is associated with lower efficiency of technical and human resources at the devolved county health facilities (Barasa et al., 2021; Blom et al., 2025). Aligning to this view, FDEC may facilitate the dwindling or massive move by medical personnel from public to private facilities at regional levels due to the misalignment and the dominance of informal consideration in healthcare development decision-making (Waithaka et al., 2028). More precisely, new financing methods introduced by FDEC encourage varying regional adoption of market-based frameworks of healthcare service delivery, mainly comprising of the public-private mix, affirming that FDEC may easily degenerate into alternative private outsourcing paths (Tanzi, 2008). Similarly, FDEC perpetuates regional differences in the availability of healthcare services, as observed by Hodge et al. (2015), Lago et al. (2012), and Sanogo (2019). These findings align with previous literature that documented the deleterious effect of FDEC on healthcare availability outcomes (see, for example, Barasa et al., 2022; Masaba et al., 2020; Nyawira et al., 2022; Rotulo et al., 2022; Tsofa et al., 2017). On the other hand, the study findings contradict the beneficial effect of FDEC in enhancing the availability of healthcare services, as observed by Cavalieri and Ferrante (2020), Di Novi et al. (2019), and Thapa et al. (2024).

Regarding the regional disparity control variables, the findings show that county gross domestic product (CGDP) and county revenue (REV) significantly influence healthcare availability outcomes in Kenyan counties. Accordingly, a 1 % rise in CGDP leads to a 0.464 % increase in TRI. This observation aligns with the conclusion made by Rotulo et al. (2022) who noted that higher regional per capita GDP promotes the development of healthcare infrastructure and hiring more specialized medical personnel. On the other hand, a 1 % increase in REV results in a 0.453 % decline in TRI. This can be attributed to the probable regional fiscal imbalance, where an increase in revenue to a surplus level may perpetuate increased income levels in some expenditures or reduced income in other spending. Therefore, this can suggest that higher revenue is linked to reduced availability of healthcare services and trained human resources, as can be depicted in differential county spending per capita as well as in proportion to the gross county budget (Rotulo et al., 2022; Thapa et al., 2024).

4.2.4. *Extended analysis using alternative instrumental variable estimator*

In this part, we extend the robustness checks in two ways: alternative estimation technique and alternative instrumental variable estimator. To begin with, the baseline model in Eq. (1) is reestimated using the panel-corrected standard error (PCSE) method, which alternatively deals with cross-sectional and endogeneity issues robustly (Chen et al., 2024). We also employ an instrumental variable two-stage least squares (IV-2SLS) estimator as an alternative instrumental variable estimator that is ideal for addressing endogeneity issues by internally generating instruments (Chen et al., 2024). As shown in columns 1 and 2 and columns 3 and 4 of Table 9, the IV-2SLS and PCSE estimators are consistent with the findings of 2SIV-GMM presented in Table 8, where an increase in FDEC leads to a significant fall in healthcare availability outcomes at 1 % and 10 % significance level. Overall, the consistency of the results across different econometric estimations improves the reliability and credibility of the results for policy formulations and implementation.

Table 9
Extended analysis results based on PCSE and IV-2SLS estimators.

Dependent Variable:	IV-2SLS		PCSE	
	(1)	(2)	(3)	(4)
TRI (−1)	−0.045		−0.412***	
	(0.029)		(0.130)	
HRI (−1)		−0.266***		−1.169***
		(0.078)		(0.037)
FDEC	−0.019*	−0.057*	−0.041	−0.331***
	(0.010)	(0.313)	(0.057)	(0.102)
Constant	2.674***	2.465***	−0.007	0.020
	(0.060)	(0.764)	(0.016)	(0.018)
Controls	YES	YES	YES	YES
Wald/ F-stat	7.620**	35.540**	13.130**	12.311**
Observation (N)	161	161	161	161

Note: * $p < .1$; ** $p < .05$; *** $p < .01$. Robust standard errors are enclosed in the parenthesis.

5. Conclusion and policy implications

By analyzing the effect of fiscal decentralization on healthcare availability outcomes in 23 Kenyan counties over the 2013–2022 devolution period, the study provides deducible evidence that although theoretically, FDEC is accepted as a policy option employed to spur regional balanced socioeconomic development in terms of equitable distribution of public social services such as healthcare, without proper implementation frameworks, it can exacerbate regional healthcare availability differences further. The overall trend from the Kenyan devolution case reveals that FDEC has a deleterious effect on the healthcare availability indicators of human and hospital resources. Therefore, our contribution to the literature affirms that FDEC may result in widened socioeconomic gap as evidenced by reduced availability of healthcare resources. In addition, the study reveals that county revenue and county gross domestic product play a critical role in influencing the availability of healthcare resources, where better county economic productivity is beneficial in improving the availability of healthcare resources, and county revenue acts as an impediment. Therefore, this study's results indicate the need to implement proactive decentralized fiscal policy interventions to realize an efficient healthcare system where human and technical resources are available. Specifically, enacting policy interventions that target technical and human efficiency in terms of financial allocation toward infrastructural development and building human resource capacity will enhance overall healthcare availability and cut the fiscal imbalance and overdependence on national healthcare spending and grants.

While the study provides an in-depth analysis of the FDEC-healthcare availability nexus, more contributions to the field are still needed. Additional research should be strongly encouraged to provide more credible generalizability of these findings. Notably, future studies should divert attention to more generalizable evidence on the effect of FDEC on the availability of healthcare resources comparatively between regions with different income levels. Secondly, within the precincts of Kenyan devolution, heterogeneity analysis in terms of poverty vulnerability index should be conducted to ascertain whether the effect of FDEC varies by poverty vulnerability level. This can be effected through policy analysis from different operationalization settings. Thirdly, future studies can evaluate the extent to which hospital locational differences reflect differences in FDEC implementation.

Notwithstanding the exhaustive efforts to ensure in-depth usage of robust econometric methods, this study is somewhat limited. First, the study is limited by the existing short time series, which thus provides an avenue for further inquiry. Secondly, the absence of an indicator measuring the value of county revenue directed to healthcare guided our decision to compute the FDEC indicator using the county and national health expenditure estimates. Although the indicator has been widely used in literature, it is essential to mention that it may suffer from endogeneity and cross-sectional dependence issues (Fisman and Gatti, 2002; Rotulo et al., 2022).

CRediT authorship contribution statement

Remmy Naibei: Writing – review & editing, Writing – original draft,

Investigation, Data curation, Conceptualization. **Isaiah Maket:** Writing – review & editing, Writing – original draft, Validation, Methodology, Formal analysis, Data curation, Conceptualization.

Ethical approval

No ethical approval is required in our case.

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Declaration of Competing Interests

The authors declare no competing interests.

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Data availability

Data will be provided upon reasonable request.

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