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Smart cities: effects on health, work and governance

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Abstract

Purpose – This study investigates the effects of smart technologies in urban management on the economic and social dimensions of Brazilian Smart Cities, with a focus on fiscal governance, health, and work. Smart Cities are defined as those that integrate systems, processes, and services through enabling and inclusive technologies that benefit the community.

Design/methodology/approach – Grounded in Smart City literature, this empirical study examines the influence of smart technologies on health and work indicators, mediated by fiscal governance. Secondary data from 93 Brazilian Smart Cities were analyzed using structural equation modeling, incorporating mediating effects.

Findings – The results indicate that smart technologies positively influence work indicators but do not directly affect health indicators. A positive relationship with health indicators emerges only when mediated by fiscal governance, underscoring the limitations of merely providing technology in Smart Cities.

Social implications – Cities with stronger fiscal capacity are better equipped to invest in the tools, personnel, and infrastructure necessary for the effective implementation of health technologies. These findings can help policymakers allocate resources more strategically to benefit the population.

Originality/value – This study provides empirical evidence on key social components that must be developed for a Smart City to truly serve its citizens. It demonstrates that technology alone has limited impact, but when combined with effective public policy, it can significantly enhance critical indicators such as public health.

Keywords Smart cities, Health, Work, Urban management, Fiscal governance

Paper type Research article

1. Introduction

Numerous initiatives have been implemented in urban management to address social, organizational, and infrastructural challenges. In recent years, the concept of Smart Cities has gained significant traction and has become a growing area of academic research (Mora, Bolici, & Deakin, 2017; Yigitcanlar *et al.*, 2018). What transforms a collection of buildings, streets, and people into a Smart City is the integration of systems, processes, infrastructure, and services – enabled by inclusive and adaptive technologies. These technologies are embedded within innovative environments, institutional frameworks geared toward innovation, and virtual collaborative platforms that engage and empower citizens (Kobayashi, Kniess, Serra, Ferraz, & Ruiz, 2017; Komninos, 2009).

The primary goal of Smart Cities is to promote the social development of communities, rooted in principles of sustainable development. Achieving this involves reinforcing investments in social infrastructure, human capital, communication systems, and physical infrastructure, ensuring synergy among these elements and their effective uptake by society, all

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supported by a robust technological foundation (Duran & Pérez, 2015). This interplay of emerging technologies and innovative practices underpins the concept of "smart government" – a model of governance capable of sensing and responding to societal needs by collecting data and converting it into actionable knowledge to improve public-sector decision-making (Melati & Janissek-Muniz, 2020).

Initially, the concept of Smart Cities emphasized the use of information and communication technologies (ICTs) to address local challenges (Chourabi *et al.*, 2012). Over time, it expanded to incorporate human capital development and environmental sustainability (Brandão & Joia, 2018). Today, Smart City research spans a wide array of urban management dimensions, including technological innovation, social development, and fiscal governance (Abdullah Kaiser, 2024; Heaton & Parlikad, 2019; Pinochet, Romani, Souza, & Rodríguez-Abitia, 2019; Mathew & Bangwal, 2024; Yigitcanlar *et al.*, 2018).

Smart technologies significantly contribute to improving various aspects of urban life, such as economic development, social inclusion, security, sustainability, infrastructure, transportation, and housing (Alves, Dias, & Seixas, 2019). Their integration – alongside citizen engagement, environmental awareness, and communities' adaptive and resilient capacities – plays a critical role in enhancing urban sustainability and delivering tangible benefits to the population (Anthony, 2024). Consequently, efficient community management is expected to ensure that smart technologies have a meaningful impact on essential social dimensions, such as public health and labor conditions.

The management of available community resources is geared toward addressing local challenges. Within this context, smart technologies – particularly when implemented through state-led initiatives – can directly or indirectly support improvements in basic living conditions and overall quality of life (Bittencourt & Faria, 2021). This study investigates how smart technologies influence the economic and social dynamics of Brazilian Smart Cities, specifically regarding fiscal governance, health, and employment.

The research framework adopts smart technologies for urban management and fiscal governance as core analytical variables. Fiscal governance reflects a city's capacity for public management and investment and is measured through indicators such as revenue generation, personnel expenditure, liquidity, investment levels, and debt servicing costs.

The benefits of smart technologies are observed at both organizational and individual levels, from enhancing public management to improving citizens' quality of life – particularly in the domains of health and employment. Health outcomes are evaluated using indicators such as prenatal care coverage, deaths from ill - defined causes, preventable infant mortality, and hospitalizations avoidable through primary care. Employment is assessed through indicators such as job creation rates, formal employment, income generation, average wages, and the Gini coefficient of income inequality. This analysis is based on data from 93 Brazilian cities ranked among the top 100 Smart Cities in the country (Telebrasil, 2020). The central hypothesis is that smart technologies, fiscal governance, and health and employment indicators are positively correlated.

This research offers empirical insights into how these variables interrelate and how they can guide public and private stakeholders in identifying human and capital investment needs. The COVID-19 pandemic, which created a paradox between maintaining economic activity and preserving public health through social isolation, has underscored the urgency of understanding these dynamics. The substantial financial strain placed on public institutions (Lazzarini & Musacchio, 2020) highlights the need for evidence-based strategies capable of addressing health and economic challenges simultaneously.

Furthermore, this study contributes to the Smart Cities literature, which often centers on the role of ICTs in enhancing traditional infrastructure. It also emphasizes the importance of developing human and social capital and improving key economic and social indicators (Anthony, 2024). In this context, the research explores whether the presence of smart technologies has a measurable effect on local health, employment, and fiscal governance outcomes.

2. Literature review

The concept of Smart Cities was introduced in the early 1990s by Gibson, Kozmetsky, and Smilor in their book *The Technopolis Phenomenon – Smart Cities, Fast Systems, Global Networks*. They portrayed a technological-urban phenomenon, envisioning a 21st – century infrastructure that would not only enhance quality of life but also expand access to global markets (Marsal-Llacuna, 2015). The authors emphasized that academia, government, and industry would collaboratively introduce information, ideas, programs, and initiatives through more technologically advanced means – accelerating the emergence of smart cities, fast systems, and global networks (Marsal-Llacuna, 2015).

This vision partially unfolded as anticipated; however, the concept of Smart Cities gained widespread recognition after 2009. Today, Smart Cities are seen as having evolved from livable, creative, digital, and knowledge-based urban models – each rooted in the principle of sustainability and unified by a strong technological foundation (Abdullah Kaiser, 2024; Mathew & Bangwal, 2024; Silva, Santos, Maier, & Rosa, 2019). From a practical standpoint, Smart Cities seek to enhance urban performance by leveraging data, information, and ICTs to deliver more efficient public services, monitor and optimize infrastructure, foster cross-sector collaboration, and promote innovative business models in both public and private sectors.

Currently, Smart Cities are embedded within a modern paradigm of public management and governance (Esposito, Terlizzi, Guarino, & Crutzen, 2024), which aims to generate more effective and equitable outcomes for citizens. Mechanisms of transparency and accountability enable participatory governance, thereby contributing to economic, political, technological, and social cohesion (Duran & Pérez, 2015). Consequently, the impacts of Smart Cities extend to multiple domains, including mobility, digital public services, housing, logistics, behavioral patterns, production systems, and environmental sustainability (Kobayashi *et al.*, 2017). They are increasingly regarded as platforms for ensuring access to fundamental rights – such as healthcare, education, and employment – through more efficient and inclusive channels of interaction (Marsal-Llacuna, 2015).

Smart Cities tend to attract more residents due to their association with improved quality of life and enhanced economic opportunities (Pinochet *et al.*, 2019). Yigitcanlar *et al.* (2018) argue that a creative society that values and invests in its urban environment promotes broader social development. Accordingly, Yigitcanlar (2023) emphasized that Smart City projects must deliver balanced and sustainable outcomes across economic, social, environmental, and governance dimensions. Local development – measured through a range of indicators – plays a pivotal role in improving citizens' well-being and remains a central objective of social organization in urban communities.

Smart technology initiatives typically aim to enhance economic growth and quality of life (Afzalan, Sanchez, & Evans-Cowley, 2017; Duran & Pérez, 2015), often through flexible, innovation-driven labor structures (Neirotti, Marco, Cagliano, Mangano, & Scorrano, 2014). These cities are shaped by a data-centric approach, with a strong emphasis on technological infrastructure aligned with social needs (Yigitcanlar *et al.*, 2018).

Urban wealth has been associated with the presence of a creative class, higher levels of education, urban environmental quality, and access to ICTs for public administration (Caragliu, Del Bo, & Nijkamp, 2011). Smart Cities are shown to boost productivity and broaden economic opportunities, contributing to reductions in unemployment (Angelidou, 2015). Hence, the modernization of urban areas – including their infrastructure and service delivery – through ICT integration can promote more efficient resource use and sisgnificantly improve residents' quality of life (Abdullah Kaiser, 2024; Duran & Pérez, 2015; Mathew & Bangwal, 2024). At the same time, efficient public spending – supported by strategic policies and income redistribution – can enhance municipal development indicators. In this study, we apply indicators of connectivity and smart public services to assess the significance of smart service implementation.

Deakin (2014) advocates for strengthening interconnections among elements of urban governance to overcome developmental constraints. Such linkages can promote participatory

action and civic engagement, ultimately supporting social cohesion (Duran & Pérez, 2015). Rapidly expanding cities are often better positioned to adopt technological solutions aimed at improving quality of life, particularly in sectors such as health and employment (Neirotti *et al.*, 2014).

In the context of the COVID-19 pandemic, the influence of technology on public health and economic policy has become increasingly evident. Fariniuk (2020) highlights several technological strategies adopted in Smart Cities, including virtual consultations for infected patients, online platforms for psychological support, case mapping, telemedicine, and digital vaccine scheduling systems. These innovations, alongside initiatives to stimulate economic development and entrepreneurship via digital platforms, helped mitigate the pandemic's impact.

In the healthcare sector, organizations have expanded their operational capacity and efficiency by integrating advanced technologies powered by artificial intelligence (Lee & Yoon, 2021). In the labor market, although many traditional roles have been displaced by automation, new technology-based occupations have emerged – often offering higher value-added income. These include platform-based jobs such as food and parcel delivery, ride-sharing, and other services that connect consumers and entrepreneurs through digital means (Vrontis *et al.*, 2022).

Given this context, the following hypotheses are proposed:

H1. There is a positive relationship between smart technologies and health indicators.

H2. There is a positive relationship between smart technologies and work indicators.

A central pillar in the Smart Cities literature is the strategic use of ICTs, which, when applied to human capital, can improve urban processes and address city-level challenges, ultimately enhancing citizens' quality of life (Camero & Alba, 2019; Pinochet *et al.*, 2019). Smart Cities employ a range of digital tools and applications – such as traffic management systems, citizen monitoring, public healthcare platforms, safety systems, economic services, and urban planning technologies – to support their development (Angelidou, 2017; Qasem & AlMobaideen, 2019). These systems are underpinned by vast datasets and structured frameworks for data utilization (Lim, Kim, & Maglio, 2018; Mora *et al.*, 2017).

ICTs are primarily focused on enhancing the functionality of urban systems and expanding networks of knowledge and innovation (Angelidou, 2017; Müller, Silva, & Ribeiro, 2020). The advancement of smart technologies, particularly in the realm of urban management, has prompted institutional reforms in Brazil, including the integration of tools for management, governance, and oversight. These reforms have also fostered a culture of administrative responsibility, transparency, and improved municipal performance (Klering, Kruel, & Stranz, 2012).

Smart fiscal governance is rooted in principles of transparency, citizen engagement, cooperation, and open data access. Governance-focused Smart Cities involve an interconnected ecosystem of individuals, policies, practices, resources, norms, technologies, and data that collectively support governmental operations (Chourabi *et al.*, 2012). In this regard, Marsal-Llacuna and Segal (2016) propose a collaborative framework to coordinate the complex governance tasks associated with Smart Cities.

Effective fiscal governance enhances financial capacity, granting local governments greater autonomy through improved revenue generation, investment levels, liquidity, personnel expenditure, and debt management (Cunha, Przeybilovicz, Macaya, & Burgos, 2016; Khatoun & Zeadally, 2016; Pinochet *et al.*, 2019). This financial strength enables cities to invest in public policies that foster comprehensive development (Silva *et al.*, 2019) and contributes to better outcomes in areas such as public health (Schnake-Mahl, Jahn, Purtle, & Bilal, 2022) and employment (Luce, Luff, McCartin, & Milkman, 2014).

Accordingly, the following hypotheses are also proposed:

H3. There is a positive relationship between smart technologies and fiscal governance.

H4. There is a positive relationship between fiscal governance and health indicators.

H5. There is a positive relationship between fiscal governance and work indicators.

This framework aligns with Alves *et al.* (2019), who conceptualize communities as systems driven by interaction and synergy. However, it advances this notion by proposing that smart technologies act not only as mediators but also as catalysts – or even determinants – of more dynamic and responsive systems.

3. Research method

This study adopts a descriptive and exploratory approach, utilizing bibliographic and documentary research methods. To operationalize the investigation and achieve the proposed objectives, datasets were collected for the three primary variables under analysis: smart technologies, health and work indicators, and fiscal governance within public administration.

Data were sourced from cities listed in the ranking of the 100 Smart Cities in Brazil (Telebrasil, 2020), as well as from the Fiscal Management Index (IFGF) and the Municipal Development Index (IFDM), both published by the Federation of Industries of the State of Rio de Janeiro (Firjan, 2020). Due to data unavailability for seven municipalities, the final sample comprises 93 cities.

Brazil, as a populous and resource-rich country, continues to face challenges commonly associated with developing nations, including violence and social inequality. These issues are present in both technologically advanced cities with ample public services and in under-resourced municipalities lacking adequate technological infrastructure. This variability in urban contexts provides a valuable foundation for analyzing empirical relationships among smart city factors, as grounded in the international literature.

The sample size meets the minimum requirements for statistical analysis, and statistical power was validated using G*Power software (Faul, Erdfelder, Buchner, & Lang, 2009), with a significance level set at 5%. The analysis considered two explanatory latent variables: smart technologies and fiscal governance.

The elements comprising the variables – smart technologies, fiscal governance (FG), and health and work indicators – are presented in Table 1.

Table 1. Elements of variables and indicators

Variable	Indicator	Element
Smart technologies (ST)	Smart services	Weighted availability of intelligent services for citizens and public management, as well as local connectivity
	Smart public services	Smart services available to citizens (urban mobility, e-government, education and health) and to public management
	Connectivity	Radio stations and telecommunications networks
Fiscal governance (FG)	Other revenues	Total revenue generated by the municipality as a proportion of current net revenue (CNR)
	Personnel expenses	Total municipal personnel expenses as a proportion of CNR
	Liquidity	Total municipal savings as a proportion of CNR
	Investments	Total municipal infrastructure investments as a proportion of CNR
	Cost of debt	Total interest and amortization expenses as a proportion of actual net income, reflecting budget commitments
Health (HEA)	Proportion of prenatal care coverage, deaths from not defined causes, preventable infant mortality, and hospitalizations sensitive to primary care	
Work (WOR)	Employment generation, labor market formalization rate, income generation, average wages, and Gini index of income inequality	

Source(s): Prepared by the authors based on Telebrasil (2020) and Firjan (2020)

The Smart Technologies variable is constructed from a weighted combination of two technology-related indicators – smart public services for citizens and for public administration – as well as a connectivity indicator. These smart technologies encompass a broad range of ICT-based applications, including intelligent traffic lights, surveillance systems, public safety information databases, integrated medical records, energy-efficient public lighting, sanitation monitoring systems, parking space sensors, online bicycle rental services, real-time traffic guidance, public transport schedules, and online platforms for administrative tasks such as license issuance, certificate requests, medical appointments, hospitalizations, and educational services (e.g. classroom tablet use, online enrollment, and remote learning platforms) (Telebrasil, 2020).

The Fiscal Governance, Health, and Work indicators were derived from indices developed by Firjan (2020), with values normalized on a scale from 0 to 1. The respective average scores were 0.77 for fiscal governance, and 0.74 for work. Within fiscal governance, the sub-dimensions scored 0.57, 0.46, 0.40, while the health sub-indices averaged 0.85 and 0.64.

To analyze the complex and interdependent relationships among these variables – encompassing technology, services, and investments – Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed. This method allows for the simultaneous estimation of multiple direct and indirect relationships (Hair *et al.*, 2016). The analysis followed a two-step approach: first, the measurement model was evaluated; second, the structural model was assessed. Ths analysis was conducted using SmartPLS version 3.3.

The measurement model was assessed based on the criteria of convergent and discriminant validity. Convergent validity was evaluated using Composite Reliability (CR), Cronbach's Alpha (CA), and Average Variance Extracted (AVE), following the recommendations of Fornell and Larcker (1981). Acceptable levels of convergent validity were achieved after the exclusion of indicators with low factor loadings – specifically, Cost of Debt and Liquidity under the Fiscal Governance construct, and Connectivity under Smart Technologies. The structural model was evaluated using the following criteria:

(1) The size and significance of the path coefficients;

(2) Pearson's coefficient of determination (R^2), estimated using the Bootstrapping technique;

(3) Predictive relevance (Q^2) assessed via the blindfolding procedure; and

(4) Effect size (F^2) (Hair *et al.*, 2016).

4. Results

4.1 Structural relations

The application of PLS-SEM followed the sequential validation of both the measurement model and the structural model. Discriminant validity, assessed using the Fornell-Larcker criterion, was found to be satisfactory. The highest factor loadings were observed along the main diagonal of the correlation matrix, indicating that the constructs were sufficiently distinct from one another.

The values for Composite Reliability (CR) and Cronbach's Alpha (CA) confirmed the reliability of the measurement model, indicating that the constructs demonstrated internal consistency and that the sample was free from significant bias (Hair *et al.*, 2016). Following this validation, the structural model was analyzed to statistically evaluate the hypothesized relationships among the latent constructs, in accordance with the theoretical framework. The estimated path coefficients and *p*-values for each tested relationship are summarized in Table 2.

Table 2. Measurement and structural model validity, and hypothesis testing

Constructs	CA	CR	AVE	Discriminant validity WOR	FG	HEA	ST	R^2
Work (WOR)	1.000	1.000	1.000	1.000				
Fiscal governance (FG)	0.765	0.857	0.667	0.324	0.817			0.102
Health (HEA)	1.000	1.000	1.000	0.192	0.578	1.000		0.341
Smart technologies (ST)	0.974	0.987	0.974	0.284	0.320	0.261	0.987	0.141

Path	β	p-value	Hypothesis
Smart technologies → Health	0.085	0.352	$H1_{direct}$
Smart technologies → Work	0.201	0.014*	$H2_{direct}$
Smart technologies → Fiscal governance	0.320	0.000**	H3
Fiscal governance → Health	0.551	0.000**	H4
Fiscal governance → Work	0.260	0.021*	H5
Smart technologies → Fiscal governance → Health	0.176	0.000**	$H1_{indirect}$
Smart technologies → Fiscal governance → Work	0.083	0.059	$H2_{indirect}$

Note(s): Tabulated coefficients and variable indicators of the variables. CA = Cronbach's Alpha; CR = Composite Reliability; AVE = Average Variance Extracted. $p < 0.05$ (*); $p < 0.01$ (**). Q^2 values: Work = 0.123; Fiscal Governance = 0.052; Health = 0.322. Effect size (f^2): Smart Technologies = 0.042 (Work), 0.114 (Fiscal Governance), 0.100 (Health); Fiscal Governance = 0.070 (Work), 0.413 (Health)

4.2 Discussion of results

The first hypothesis (H1) tested whether there is a positive relationship between smart technologies and health indicators. This relationship was not statistically confirmed ($\beta = 0.085$; p-value = 0.352), suggesting that the mere availability of smart technologies does not directly lead to improved health outcomes for citizens.

This result indicates that the benefits of smart technologies are not inherently tied to their presence, but rather to how effectively they are integrated into everyday life. For example, the availability of ICT-enabled services – such as online scheduling for medical appointments and exams – does not ensure accessibility or responsiveness to citizens' needs.

One possible explanation lies in the limited digital access among certain segments of the population, stemming from factors such as financial barriers, technological literacy, or resistance to innovation. As Fariniuk (2020) points out, the implementation of smart technologies often prioritizes process automation over the enhancement of public services, thereby overlooking social outcomes.

In contrast, the second hypothesis (H2) – which proposed a positive relationship between smart technologies and work indicators – was statistically supported ($\beta = 0.201$; p-value = 0.014). This finding affirms that the adoption of technology contributes to job creation and efficiency gains (Angelidou, 2015).

Smart technologies streamline urban management by reducing inefficiencies such as time lost at traffic signals or searching for parking spaces. Increased efficiency enables the emergence of new businesses and services, resulting in increased employment opportunities. Moreover, the expansion of ICTs has led to the creation of new occupations – particularly in digital services such as delivery platforms, ride-hailing, and remote customer support – that help bridge the gap between service providers and end-users.

The third hypothesis (H3), which posited a positive relationship between smart technologies and fiscal governance, was also confirmed ($\beta = 0.320$; p-value = 0.000). This finding underscores the role of smart technologies in enhacing fiscal performance through tools that promote transparency, citizen engagement, and social oversight. These findings support prior research highlighting the contribution of ICTs to more participatory and

accountable governance (Chourabi *et al.*, 2012; Duran & Pérez, 2015; Neirotti *et al.*, 2014; Yigitcanlar *et al.*, 2018).

The fourth hypothesis (H4) examined the relationship between fiscal governance and health indicators and was strongly supported ($\beta = 0.551$; p-value = 0.000). Higher levels of fiscal governance are associated with greater public investment capacity, which in turn facilitates the implementation of health policies and the expansion of service coverage (Yigitcanlar, 2023; Lima, Caldarelli, & Camara, 2014; Esposito *et al.*, 2024).

Finally, the fifth hypothesis (H5) – which addressed the relationship between fiscal governance and work indicators – was validated ($\beta = 0.260$; p-value = 0.021). Increased fiscal capacity allows municipalities to invest in infrastructure and create public sector jobs, thereby stimulating employment and potentially increasing wages (Lima *et al.*, 2014; Yigitcanlar, 2023).

Additionally, indirect relationships were analyzed to assess whether fiscal governance mediates the impact of smart technologies on health and work outcomes. Regarding H1 (indirect), the relationship between smart technologies and fiscal governance, coupled with the influence of fiscal governance on health, revealed a significant mediating effect – indicating full mediation ($\beta = 0.176$; p-value = 0.000). This suggests that smart technologies alone do not lead to improved health outcomes; rather, their impact is realized when fiscal capacity exists to support investments in infrastructure and human resources (Leite & Awad, 2012). In other words, the adoption of smart solutions must be guided by local needs and priorities, rather than by a generic pursuit of technological advancement (Fariniuk, 2020).

Smart technologies enable faster and more efficient services – such as online appointment booking and test scheduling – by enhancing access to information and streamlining procedures. However, these benefits only materialize when there is adequate infrastructure and staffing in place to deliver services promply. Without sufficient healthcare personnel, for instance, technology-enabled scheduling may simply lead to long virtual queues, further delaying care.

Telemedicine, recently regulated in Brazil, exemplifies this issue. It can only improve health outcomes if citizens have access to ICTs and public healthcare systems can provide medical professionals for remote consultations. This underscores the critical role of fiscal governance in bridging the gap between technology and service delivery (Pinochet *et al.*, 2019).

The indirect effect proposed in H2 – linking smart technologies to work indicators via fiscal governance – was not statistically confirmed ($\beta = 0.083$; p-value = 0.059). Although smart technologies positively influence fiscal governance, and fiscal governance impacts employment outcomes, the mediation effect was not strong enough to establish an indirect relationship. These variables appear to function independently in this context.

5. Conclusions

The aim of this study was to analyze the effects of smart technologies on the economic and social dimensions of urban management in Brazilian Smart Cities, with a particular focus on fiscal governance, health, and work. The findings highlight the importance of effective smart technology management in advancing urban development, especially when supported by robust public administration, as evidenced through fiscal governance.

In the pursuit of improved fiscal governance, smart technologies for urban management demonstrated statistically significant relationships that generate economic value for communities. This underscores the role of digital tools in fostering economic development – enhancing revenue generation through technology-enabled services, and improving the efficiency, transparency, and oversight of fiscal processes. Furthermore, smart technologies were shown to positively influence labor conditions by contributing to the creation of new, more specialized jobs, ultimately improving the quality of life as reflected in work-related indicators.

However, the study also reveals the limitations of simply providing smart technologies, particularly in relation to health outcomes. The availability of digital health services – such as online scheduling and telemedicine – did not correlate with improved health indicators. A positive impact on health became evident only through the mediating role of fiscal governance, as investments in infrastructure and human resources enabled the effective delivery of health services to citizens.

From a practical standpoint, the results suggest that smart technologies must be strategically integrated with public management practices to truly benefit citizens and promote social development. The absence of a direct relationship between technology and health indicators highlights the need for greater investment in both the implementation and effective use of these systems.

One limitation of this study is its restricted sample size, focused exclusively on 93 Brazilian Smart Cities. Future research could benefit from expanding the dataset to include additional municipalities and incorporating a broader set of mediating, moderating, and influencing variables related to Smart City dynamics. Despite this limitation, the findings are well-grounded in theoretical literature and supported by robust quantitative analysis. These insights offer both academic and practical contributions and open avenues for further investigation in diverse urban contexts and along new dimensions of Smart City development.

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