Open Access | Original Research
Sustainability Quest, 1(1), 2024 | PP: 01– 12
https://doi.org/10.36923/SQ.v1i1.240

Financial Digital Inclusion and Women's Empowerment in the Fourth Industrial Revolution: Evidence from Nigeria

Akeju Kemi Funlayo[1], Adeleke, Oluwayemisi Kadijat[2], Ani, Judith Ifunanya[3], Igbolekwu, Chisaa Onyekachi[4]

Article History:

Received: 02-08-2024
Accepted: 25-09-2024
Publication: 03-10-2024

Cite this article as:

Akeju, K. F., Adeleke, O. K., Ani, J.I., & Igbolekwu, C. O. (2024). Financial Digital Inclusion and Women's Empowerment in the Fourth Industrial Revolution: Evidence from Nigeria. *Sustainability Quest*, 1(1), 01-012. doi.org/10.36923/SQ.v1i1.240

Corresponding Author(s):

Akeju Kemi Funlayo
Department of Economics, Ekiti State University, Nigeria. Email: kemi.akeju@eksu.edu.ng

Abstract: The limited influence of African women on resources and decision-making has posed significant challenges to their capabilities and empowerment for decades. The purpose of this study is to investigate the role of financial inclusion in advancing women's economic empowerment within the Nigerian context, drawing on data from the 2018 Nigerian Demographic and Health Survey (DHS). The analysis focuses on women's empowerment in terms of their participation in decision-making related to their own earnings and healthcare. Key financial inclusion variables include the use of mobile money and account ownership. The findings reveal that the odds of women making decisions regarding their earnings and healthcare are approximately 36% and 25% higher, respectively, for those who use mobile phones for financial transactions compared to those who do not. Additionally, women without an account in a financial institution exhibit approximately 42% and 32% lower odds of making decisions about their earnings and healthcare, respectively. This research contributes to the literature on digital financial inclusion and highlights its pivotal role in enhancing women's empowerment and promoting gender equality in Nigeria.

Keywords: Digital Financial Inclusion, SDG 5, Gender equality, Women's Empowerment, Fourth Industrial Revolution, Nigeria

1. Introduction

The empowerment of women has gained substantial attention from policymakers, researchers, and non-governmental organizations in recent years. This growing interest stems from the recognition that women's empowerment not only benefits women individually but also positively impacts their families and communities at large (Adera et al., 2023). Women's empowerment plays a pivotal role in achieving Sustainable Development Goal 5 (SDG 5: gender equality) and has a ripple effect that contributes to overall economic growth and development. The United Nations and Sustainable Development Goals emphasize that empowering women enables them to make informed choices, fostering gender equality and inclusiveness (Abera, 2023; Dhiman, 2023). Moreover, women's empowerment equips them to take control of their finances, safeguard their families, enhance their education and children's welfare, actively participate in the workforce, and alleviate household poverty to a significant extent (Hashemi et al., 1996; Muchomba, 2021).

According to an IMF report (2019), a critical strategy for empowering women is through investments in digital financial inclusion (Esmaeilpour Moghadam & Karami, 2023). With the global shift away from traditional financial practices, such as visiting banks for cash deposits, loans, and checks, toward more digitalized transactions, this transformation is essential. The transition involves embracing digital money transfers through methods like mobile payments, electronic transactions, and automated teller machines (Kabir, 2021; Sebu et al., 2023). Across Africa, stakeholders are working toward establishing digital-based financial systems to reach over 400 million individuals, with women constituting 60%, creating opportunities for environmentally friendly and inclusive community-based development (Bill & Melinda Gates Foundation, 2019). Digital financial transformation, through mobile phone use and e-commerce platforms, helps women overcome social, cultural, and economic barriers (Anakpo et al., 2023; Aziz & Naima, 2021).

The IMF report (2019) highlights that approximately 80 million women in developing economies remain unbanked and still receive government transfers in cash (Hendriks, 2019). Additionally, IMF statistics reveal that four in ten women lack a financial account, limiting their access to formal financial services (Espinosa-Vega et al., 2020). Digital financial inclusion addresses these issues by providing greater access to financial services, facilitating business startups, and improving financial management. Moreover, it creates job opportunities in the fintech sector, helping to reduce gender inequality. However, despite the significant benefits of digital financial

[1] Department of Economics, Ekiti State University, Nigeria. Email: kemi.akeju@eksu.edu.ng
[2] Department of Economics, Redeemer's University, Nigeria. Email: chaudhryisrar@gmail.com
[3] Department of Sociology, Walter, Sisulu University, South Africa. Email: ani.judithifunanya@yahoo.com
[4] Direct Consulting and Logistics, Nigeria. Email: igbolekwuchisaa@yahoo.com

inclusion, the Gender Gap Report (2020) indicates that women still lag behind men in accessing and using mobile and internet services during this digital transformation era.

The workplace is also experiencing a dramatic shift, driven by the Fourth Industrial Revolution (4IR) and advancements in artificial intelligence (AI) and technology. While discussions about 4IR have primarily focused on its implications for emerging economies, particularly in Africa, the role of women in this process has received limited attention. Research shows that access to knowledge and information can play a key role in empowering rural women to thrive in the 4IR era (Jiyane, 2021). The 4IR offers opportunities for women by providing access to training, education, financing, and entrepreneurship. Interventions aimed at closing the gender gap in digital technology, promoting social norm changes, and strengthening educational efforts are essential to overcoming these challenges and maximizing the potential of 4IR for women (Mhlanga, 2024).

In Nigeria, a significant portion of the population faces extreme poverty and high unemployment rates, challenges that are partly linked to the financial exclusion of women. Digital financial inclusion offers a path toward economic opportunity, fostering job creation and a more conducive environment for economic growth. According to EFinA (2019), Nigeria faces a widening gender gap in financial inclusion, with 36% of men having access to financial services compared to 24% of women. This contrasts with Uganda (23% to 22%) and Kenya, where no gender gap exists (11% for both genders). In South Africa, women are more represented in finance and IT management compared to men. However, Nigeria ranks 32nd out of 35 in Sub-Saharan Africa's overall gender gap, with only 31% of women having formal bank accounts compared to 61% of men, and just 3.9% of women having mobile money accounts. Factors contributing to this gap include low levels of education and financial literacy among women.

The Sustainable Development Goals 2030 agenda is a crucial global objective, aimed at reducing disparities, promoting peace, and ensuring decent living standards for all. In alignment with SDG 5 (Gender Equality), this study aims to explore how digital financial inclusion can empower women in Nigeria. Nigeria’s selection is particularly relevant given the significant gender disparities in financial inclusion and the existing literature on the barriers faced by women in accessing financial services.

Using datasets from the 2018 Nigerian Demographic Health Survey, this study analyzes the influence of digital financial inclusion on women’s empowerment, measured by their decision-making regarding earnings and healthcare, using logistic regression estimation techniques within the context of the Fourth Industrial Revolution. The subsequent sections cover the literature review on financial inclusion and women’s empowerment (Section 2), the study’s methodology (Section 3), the results and findings (Section 4), and the conclusions and recommendations (Section 5).

2. Literature Review

2.1. Financial Inclusion: What is it?

Financial exclusion, which denotes the lack of access to financial services, is a critical aspect of social exclusion. Scholars, policymakers, and stakeholders have shown considerable interest in promoting financial inclusion, which seeks to provide financial assistance to those who are poor and struggling to make ends meet (Kanungo & Gupta, 2021; Tay et al., 2022). The financially excluded predominantly consist of marginalized groups such as subsistence laborers, individuals in the informal sector, the displaced, ethnic minorities, and other vulnerable communities (Mahmood, 2021). Many of these individuals come from poor or low-income households and face societal exclusion.

The World Bank (2013) indicates that financial inclusion goes beyond mere access; it involves factors like proximity to an access point (such as a bank branch or ATM), choice (access to multiple providers offering diverse services), and the ability to comprehend and utilize available options. However, increased access and choice do not necessarily lead to higher usage, as emphasized by the World Bank (2013). Financial inclusion encompasses various elements, such as access to payments and savings, and having opportunities to engage in finance and securities markets. The World Bank (2013) outlines four essential components of financial inclusion:

- **Access**: The ability to utilize financial services, factoring in proximity, affordability, and eligibility. Indicators include the proportion of individuals accessing services such as credit, payments, or savings.
- **Usage**: The actual utilization of financial products and services, including the frequency of usage over a given period.
- **Quality**: The suitability of financial products or services to meet consumer needs.
- **Welfare**: The impact of financial services on client well-being, especially changes in expenditure, consumption patterns, and overall living standards.

Financial inclusion transcends mere access; it involves understanding the usage of financial services and their impact on individuals' and communities' quality of life. The World Bank (2014) underscores the need to distinguish between access to and the utilization of financial services.

2.2. Barriers to Financial Inclusion

Effective financial systems offer a wide range of services, including savings platforms, payment systems, credit, and risk management options (Pazarbasioglu et al., 2020). Inclusive financial systems extend these services to a broad segment of the population, significantly contributing to economic and social development, as well as poverty reduction (Tran & Le, 2021). Research indicates that financial exclusion can entrap individuals in poverty, exacerbate inequality, and impede economic growth (World Bank, 2014).

Financial inclusion varies across the globe, with most of the financially excluded living in developing countries (Koomson et al., 2020; Tram et al., 2023). In these regions, gender differences also influence financial behavior, as women are more likely than men to save informally (Akeju, 2022; Mndolwa & Alhassan, 2020). Common reasons for not having a formal financial account include insufficient savings, the inability to afford smartphones, lack of connectivity or internet access, negative perceptions of formal organizations, or limited access to banks. Women tend to borrow money from informal sources such as friends, family, savings groups, and village associations. This highlights the formal financial ecosystem's lack of inclusivity and the absence of appropriate financial products. Wealth and education levels among women have been closely linked to the adoption of banking technology (Dorfleitner & Nguyen, 2024; Tang, 2022). Raising awareness and educating women through IT-based tools and applications, along with creating simplified banking models, is one way to foster financial inclusion.

A FinDev (2022) analysis revealed a 5.3 million increase in the number of individuals in Nigeria using informal financial services between 2018 and 2020. Different demographic groups exhibit varying financial preferences and behaviors; for instance, younger women tend to be more credit-savvy, while older women need more trust-building efforts with financial institutions. They often benefit from face-to-face interactions and services embedded in existing social networks. Financial exclusion, as noted by Athari (2022), threatens political stability and development. Alhassan et al. (2021) found substantial evidence that political instability hinders financial development, with a positive correlation between political unrest and lower financial inclusion rates.

It is essential to distinguish between financial inclusion and access to finance, as a lack of usage does not necessarily imply a lack of access. Financial exclusion can be either voluntary or involuntary. Some individuals opt out of using formal financial institutions for reasons such as religious beliefs (Ezzahid & Elouaourti, 2021), while others are involuntarily excluded due to being perceived as high-risk clients, low incomes, discrimination (based on gender or race), or insufficient information. In some cases, physical distance to service points or unsuitable product features further exacerbate exclusion.

Additional barriers include high costs (Rahman, 2021), an unfavorable policy environment, inappropriate products, documentation requirements, the absence of financial institutions in rural areas, or a lack of collateral (World Bank, 2014). Distinguishing between voluntary and involuntary financial exclusion is crucial for developing effective policies. Those most affected by financial exclusion include the poor, rural residents, unemployed individuals, women, and those discriminated against based on race, ethnicity, disability status, or gender. Policies aimed at promoting financial inclusion also play a pivotal role in addressing social exclusion within society.

2.3. The Fourth Industrial Revolution

Over the span of the last 250 years, the first three Industrial Revolutions have brought about profound changes in the way value is created, significantly shaping the global landscape (Li, 2020). Between 1870 and 1930, a new wave of interconnected technologies emerged, complementing the advancements of the first Industrial Revolution. Innovations such as telecommunications, household appliances, and electrification played a pivotal role in transforming society. The second and third Industrial Revolutions further shaped the global economy by introducing technological developments that altered how societies and economies were structured. Digital data storage, processing, and transmission have transformed nearly every industry, significantly changing both personal and professional lives. These three industrial revolutions created new opportunities and led to enormous modifications in various sectors.

Today, the advent of the Fourth Industrial Revolution (4IR) has had a profound effect on our daily lives, representing a substantial shift in both human and technological progress. Africa's economic and social landscape has also evolved as a result of 4IR (N'dungu & Siegne, 2020). As Schwab (2016) notes, technology has become intricately woven into everyday existence, influencing how we live, work, and communicate. The World Economic Forum (2018) posits that 4IR presents an opportunity to construct a human-centered, inclusive society. Innovative advancements in areas such as artificial intelligence, automation, nanotechnology, the Internet of Things (IoT), 3D printing, and genetic modification have all been enabled by 4IR. Moreover, 4IR has become a tool for accelerating the achievement of sustainable development goals. The transformative power of blockchain, the internet, and AI technologies has reshaped numerous organizations, nations, sectors, and communities, and these changes are rapidly expanding across various areas, becoming widespread at an accelerated pace.

Despite the vast potential of 4IR, scholars have identified several challenges. The introduction of advanced technologies, particularly automation, has raised concerns about potential job losses (Schulze, 2019). While the 21st century seeks to explore sustainability, automation has displaced human labor in several industries. To meet the demands of a technology-driven world, many sectors are encouraging their workforce to enhance their technological skills and undergo training. One of the major challenges is the shortage of qualified IT professionals needed to facilitate digital financial inclusion.

Sterling (2019) highlights the technological inequality in society, affecting both developing and underdeveloped countries, where millions of people lack access to technical systems. For impoverished and marginalized groups, daily survival needs take priority over the benefits of 4IR, raising concerns about global digital finance and technological inclusiveness, particularly in Africa. Moreover, automation poses threats to individual livelihoods (Schwab, 2016; Kabir, 2021; Ramaphosa, 2020). Ensuring digital equality across individuals, regardless of gender, is critical. Governments should prioritize gender equity, as statistics reveal that women's internet accessibility is 12% lower than men's in developed nations, and in poorer countries, the gender gap in internet access reaches 32.9% (Kabir, 2021). This significant disparity in digital inclusion limits women's access to digital financial services.

2.4. Stylized Facts on Women's Empowerment

The global discourse on achieving the Sustainable Development Goals (SDGs) emphasizes women's empowerment and well-being as fundamental to their lives (Laszlo, 2020). Development programs aimed at women in the Global South have increasingly focused on enhancing their economic empowerment. The goal of women's economic empowerment (WEE) is to address gender disparities, particularly in developing nations. However, ongoing debates question the effectiveness of WEE policies and programs in achieving meaningful empowerment (Awan & Awan, 2023; Tetteh et al., 2024).

Women's empowerment is a multifaceted and broad concept that involves various aspects of life. It implies the need for empowerment across all spheres simultaneously (Chutia, 2022). Women's subordination in patriarchal systems, along with the lack of recognition for their contributions, forms the basis for discussions on empowerment. It is essential to acknowledge the significant role that women play in overall development and to facilitate their meaningful participation in the development process. Empowerment is closely linked to the goals of equality, social justice, and freedom (Shah et al., 2023). At its core, empowerment involves gaining power—broadly understood as providing individuals, groups, or communities the ability to make decisions, participate in processes, access resources, and exercise their freedom of choice in areas where they have traditionally been deprived.

Women's empowerment can be analyzed through six common dimensions: economic, social, political, physical, legal, and psychological. These dimensions are based on women's sense of self-worth, their freedom to make choices, their access to opportunities and resources, their right to control their own lives (both inside and outside the home), and their capacity to shape social change, contributing to a more equitable social and economic order on both national and international scales. Women's empowerment emphasizes their ability to effect change for personal and collective growth, particularly within the household (Banerjee et al., 2020).

In Nigeria, despite recent progress in women's empowerment, the 2019 Nigerian Demographic and Health Survey (NDHS) reported disparities in employment between married men and women. While 74% of married women aged 15-49 were employed in the 12 months preceding the survey, 99% of married men were employed. Additionally, 15% of employed women were not compensated for their work. Rural women primarily engage in caregiving for children, the elderly, and sick family members, as well as household chores and informal employment. The NDHS (2018) also found that married women's participation in the labor force varies by age, with older women more likely to be employed, while no such variation was observed among married men.

There are also earnings disparities between genders, with women earning less than their husbands in most cases, and only 5% of women earning more than their spouses. Regarding perceptions of domestic violence, while progress has been made, women were more likely to justify a husband beating his wife compared to men. Furthermore, the NDHS (2018) reported that men were three times more likely than women to own a house, with 37% of men owning homes compared to just 11% of women. Established evidence shows that women's economic empowerment has a strongly positive impact on family well-being (Annan et al., 2021; Soharwardi & Ahmad, 2020). Empowered women are more likely to attend antenatal care, provide food, and help ensure child survival, all while reducing gender inequalities in household resource allocation (Gammage et al., 2020).

This study builds on the existing literature, focusing on context-specific decision-making models for women in rural Nigeria. It emphasizes the large number of women living in rural areas and explores how promoting decision-making through financial inclusion variables can enhance empowerment.

2.5. Theoretical literature

Empowering women involves facilitating change. This study examines the concept of change, focusing on how interventions can drive progress and advancement within a specific group. In this context, financial inclusion plays a crucial role in helping women achieve economic empowerment in at least two ways.

First, women who participate in the financial system are more likely to save, invest in productive ventures, and increase their private spending. Second, having access to formal financial services enables women to manage their finances more effectively and make informed decisions about household expenditures. Financial inclusion is expected to lead to significant changes in women's decision-making, particularly regarding health and household spending.

Although empowerment indicators cannot provide an exact measure of changes in women's decision-making abilities, they can highlight the direction and significance of the change. Moreover, providing women with access to credit and creating opportunities for financial engagement expands their range of alternatives, increases their awareness of their financial independence, and enhances their bargaining power.

3. Research Method

3.1. Materials and Method

This study utilizes nationally representative datasets from the Nigerian Demographic and Health Survey (NDHS). The National Population Commission administers the NDHS 2018, which provides data on household health and demographic variables. Relevant to this study are responses from the NGKR7BFL.DTA recode file, which covers mothers with children aged 0 to 60 months. This dataset offers responses from 33,924 observations across all six geopolitical regions of Nigeria from women within reproductive ages (15-49 years).

3.2. Description of Variables

Women's empowerment encompasses multiple dimensions, as it involves various aspects of women's lives and activities (Malhotra, Schuler & Boender, 2002; Soharwardi & Ahmad, 2020). Many micro-analyses have relied on Demographic and Health Surveys (DHS) datasets to explore women's lives (e.g., Soharwardi & Ahmad, 2020; Amir-ud-Din, Naz & Ali, 2023). This study focuses on women's participation in decision-making regarding their own earnings and healthcare, based on the DHS survey-derived Women's Empowerment Index. The choice to use the children recode file is grounded in the need for mothers with children aged 0-60 months to provide for their children and access healthcare.

We classified the dependent variable as women's participation in decision-making, based on responses to the following questions:

(i) WEE Index 1 (V739): "Who usually decides how to spend respondent's earnings?" (ii) WEE Index 2 (V743a): "Who usually decides on respondent's healthcare?"

Responses to the question about who decides how to spend the respondent's earnings were categorized as follows: only the respondent, the respondent and her husband/partner, the respondent and other household members, only the husband/partner, or someone else. For this paper, we coded the first two responses as 1 (empowered) and the other responses as 0 (not empowered) to generate a binary dependent variable suitable for logistic regression analysis.

Measurement of Financial Inclusion: Our key explanatory variable is financial inclusion, which has been characterized in the literature by elements such as the use of mobile money and ownership of accounts at financial institutions (Demirgüç-Kunt et al., 2020). These elements are indicators of social performance, financial security, and autonomy.

This study follows existing literature, using questions V169b and V170 from the DHS recode file, which capture "use of a mobile telephone for financial transactions" and "ownership of an account in a bank or other financial institution." Responses are coded as 1 for "Yes" and 0 for "No." The financial dimension of empowerment is reflected in account ownership and the use of mobile phones for financial transactions, as these promote access to healthcare and household welfare.

Other control variables include individual characteristics that may influence decision-making and the use of digital systems, such as educational attainment (education enhances engagement with financial inclusion), labor participation (which strengthens empowerment), household headship (a determinant of decision-making power), and place of residence (urban/rural).

3.3. Method of Analysis

This study aims to test whether financial inclusion enhances Nigerian women's empowerment in decision-making on their own earnings and healthcare. We use the following model specification:

$$WEE_i = \beta FI_i + \emptyset \gamma_i + \varepsilon_t$$

Where:

- Where, WEE_i represents the empowerment measure for the ithi^{th}ith woman,
- FI_i is an indicator of financial inclusion,
- βFI_i is the vector of control variables, and
- ε_t are represents normally distributed error terms.

To estimate this regression model, we rely on a logistic regression estimation technique, with the dependent variable being women's empowerment (binary: 1 if the respondent makes decisions on how to spend her earnings, 0 otherwise). The key financial inclusion variables are "ownership of an account in a bank or other financial institution" (1 if Yes, 0 otherwise) and "use of a mobile phone for financial transactions" (1 if Yes, 0 otherwise).

The logistic model is expressed as:

where: $logit\ (P) = \log\left\{\frac{p(y=1)}{1-(p=1)}\right\} = B_0 + B_1 x_{i1} + B_1 x_{i2} + B_p x_{in}$

For i =1…n

Which is expressed in odd ratio as: $\frac{exp(\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots.\beta_n X_n)}{1+exp(\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots.\beta_n X_n)}$

This model allows us to estimate the likelihood of women's empowerment as a function of financial inclusion and other control variables.

4. Results and Discussion of Findings

4.1. Descriptive Statistics

The descriptive analysis in Table 1 presents the characteristics of the 33,924 respondents within childbearing ages 15-49. Approximately 50.6% of women reported having empowerment related to decision-making on spending their own earnings, while 37.4% indicated decision-making power over their healthcare. Only 9.93% of women were found to use mobile phones for financial transactions, and 15.78% had account ownership in a bank or financial institution. This highlights that financial inclusion has not reached a significant proportion of women in Nigeria. According to a report from FINDEX 2018, only 27.3% of Nigerian women own bank accounts, which is lower than the 36.9% average for sub-Saharan Africa, indicating that Nigeria has one of the world's largest unbanked populations.

Regarding the respondents' level of education, 45% had no formal education, 15% had primary education, 31% had secondary education, and only 7.7% attained higher education degrees. This suggests that a majority of the respondents are less educated and likely excluded from the formal sector, which typically requires monthly earnings and bank account ownership. In terms of household headship, less than 10% of respondent households were headed by women, indicating that headship may influence decision-making in Nigerian households. Additionally, 67% of the women were currently working, with 65% residing in rural areas.

Table 1: Descriptive Statistics for 33924 Respondents

Group	Variables	Total	(%)
	Decision on respondent earnings (Respondent + husband)	17171	50.60
WEE index 1	Others	16753	49.40
WEE index 2	Decision on respondent health care(Respondent+ husband)	12694	37.42
	Others	21230	52.58
FII(1)	Use of mobile telephone for Financial transaction	3367	9.93
	Not using mobile telephone for Financial transaction	13099	38.61
	No response	17458	51.46
FII(2)	Has an account in a bank/financial institution	5355	15.79
	not having account in a bank/financial institution	28569	84.21
Place	Urban	11699	34.49
	Rural	22225	65.51
Education	No education	15391	45.36
	Primary	5274	15.54
	Secondary	10623	31.31
	Higher	2636	7.77
Headship	Men headed houses	30734	90.59
	Women headed houses	3190	9.41
Labour	Respondent working	22837	67.32
participation	Respondent not working	11087	32.68

Author's compilation from IPUMS-NDHS 2018 datasets

The logistic regression results for the two models are presented in Table 2. All statistical tests confirm the relevance and quality of the regressions. The Chi2 tests are significant at the 1% level, and the pseudo-R^2 of McFadden and log pseudo-likelihood are also statistically satisfactory. The use of mobile phones for financial transactions was found to have a significant association with decision-making on both earnings and healthcare, with odds ratios of 1.36 and 1.25, respectively. This indicates that the odds of making decisions on one's earnings and healthcare are 36% and 25% higher for women who use mobile phones for financial transactions compared to those who do not. Additionally, those with accounts in a bank or financial institution have odds 42% and 32% higher, respectively. This finding supports earlier studies such as Egami and Matsumoto (2020), Mpofu (2022), and Arshad (2023), which assert that financial inclusion can promote financial independence and strengthen women's economic empowerment, particularly in healthcare-related decisions.

The study also reveals that mobile phones for financial transactions help women make independent decisions regarding sending money, bill payments, and purchasing airtime for fast communication and networking. Educational attainment exhibits a significant relationship with decision-making: women with no education, primary education, or secondary education demonstrate lower odds of decision-making than those with higher education levels. The likelihood of decision-making on healthcare is 26% lower for women with no education and 21% lower for those with primary education, compared to women with higher education. Similarly, women with no or lower levels of education exhibit a 77% lower likelihood of making decisions regarding their own healthcare spending. This result highlights that educational attainment is crucial for women's empowerment and decision-making, enabling them to make informed choices about their lives, health, and well-being. These findings corroborate those of Engida (2021), Ali Alhazmi (2023), and Kirkwood et al. (2024).

Women who head their households exhibited lower odds of decision-making on their own earnings, potentially reflecting the influence of family ties on women's livelihoods. However, women with jobs were found to have approximately 36 times higher odds of making decisions about their own earnings alongside their husbands, compared to women without jobs. This confirms the role of women's labor participation in economic empowerment and decision-making within households, as evidenced by research from Tagat (2020) and Gupta and Roy (2023). Education continues to be a key policy tool in promoting women's empowerment. Regarding the association between place of residence and decision-making on healthcare, the odds of decision-making are 26% higher for women living in urban areas compared to those in rural areas. This suggests that urbanization, along with the social and environmental context of a residence, has implications for women's decision-making.

Table 2: The Effect of Financial Inclusion on Women's Empowerment

	Model 1: WEE index 1			Model 2: WEE index 2		
	Odds Ratio	**std.Err.**	**P>|t|**	**Odds Ratio**	**std.Err.**	**P>|t|**
Use mobile phone for financial transaction	1.36	0.09	0.000	1.25	0.069	0.005
Having account at a financial institution	1.42	0.08	0.000	1.32	0.063	0.000
No education	0.74	0.05	0.000	0.23	0.013	0.000
Primary	0.79	0.05	0.002	0.54	0.033	0.000
Secondary	0.739	0.049	0.000	0.77	0.041	0.000
Higher	1.000	(omitted)		1.000	(omitted)	
Women-headed house	0.47	0.021	0.000	0.77	0.031	0.000
Respondent working currently/employed	30.71	1.21	0.000	3.10	0.090	0.000
Urban	-	-	-	1.26	0.034	0.000
Rural	-	-	-	1.00	(omitted)	
_cons	0.105	0.007	0.000	0.50	0.030	0.000
LR chi2(7)		14294.38		LR chi2(8)	6023.99	
Prob > chi2		0.000		Prob > chi2	0.000	
Log likelihood		-16363.1		Log likelihood	-19414.8	
Pseudo R2		0.304		Pseudo R2	0.134	

Author's result computation

The goodness-of-fit test, estimated using the Hosmer-Lemeshow test for the two models, as reported in Table 3, confirms the stability of the models. The Hosmer-Lemeshow test is a tool used to check whether the expected events in a logistic regression model reflect the observed events in the data. The null hypothesis states that the observed and expected proportions are the same. Since the Chi^2 probability values are greater than 0.05, the models demonstrate a good fit, and the variables are suitable for determining the association between the dependent and independent variables.

Table 3: Goodness of Fit Test (Hosmer-Lemeshow goodness-of-fit test (gof)

Variable:	model 1 (WEE index)	Model 2(WEE index)
No of observations	33922	33922
No of groups	7	9
Hosmer–Lemeshow chi2(5)	9.89	Hosmer-Lemeshow chi2(7) = 7.11
prob>chi2	0.0785	0.41

Author's result computation

4.2. Discussion of Findings

The study's use of datasets from the Nigeria Demographic Survey aligns with the growing body of research exploring the effects of financial inclusion on women's empowerment globally. According to the Global Findex study (2022), women in Nigeria exhibit lower levels of financial inclusion and empowerment, which is consistent with findings from other developing nations like Ghana, Tanzania, and Togo.

The adoption of smartphones has enhanced digital payments and created avenues for the dissemination of information, which correlates positively with financial inclusion. It has been demonstrated that mobile phone usage increases women's earning potential by providing greater access to opportunities and information. This result has also been observed in studies conducted in other African nations, such as Kudama et al. (2021), Ngoa and Song (2021), and Susan and Natu (2023). Additionally, this study found that mobile phones, through text messaging, mobile apps, and other types of exchanges, can improve overall health awareness and knowledge. This finding supports previous research by Egami and Matsumoto (2020), Mpofu (2022), and Arshad (2023), which identified that financial inclusion helps women become financially independent, enabling them to seek healthcare and strengthen their economic empowerment.

Owning a financial account, especially one with a financial institution or mobile banking, enhances women's financial stability and improves their health by providing access to funds for business growth and increasing income, both of which improve living conditions in households. It also offers a safe and convenient method of transferring and storing money. Women's participation in the workforce is also crucial for enhancing autonomy and decision-making within households, as this study demonstrates. This finding is supported by research from Tagat (2020), Gupta, and Roy (2023), which highlight the significant impact of women's labor engagement on financial independence and decision-making within households.

Overall, financial inclusion—especially through the use of digital systems—promotes women's autonomy and has a positive impact on their well-being and income in Nigeria. The use of commercial bank-led mobile money apps such as First Bank Mobile, UBA Mobile, and Zenith Bank Mobile, as well as fintech mobile money apps like Paga, Interswitch, Quickteller, Opay, Moniepoint, and Kuda, are examples of the digital tools facilitating this inclusion. However, significant challenges remain in embracing and advancing digital financial inclusion in Nigeria and other developing nations. These challenges include cultural practices that limit women's financial independence, traditional gender roles, and a lack of access to financial institutions and agents.

5. Conclusion and Policy Implications

This study examined the impact of financial inclusion on women's empowerment across households, focusing on how bank account ownership and mobile money usage influence women's decision-making concerning their earnings and healthcare. The findings revealed that expanding platforms for women's inclusion in financial activities and increasing their ability to operate financial accounts and use mobile phones for financial transactions significantly strengthens their decision-making power. Promoting financial inclusion for women remains a critical challenge in African nations, in line with international conventions and declarations advocating for equal rights for women and condemning policies that hinder social cohesion.

Digital financial inclusion has emerged as a catalyst for women's economic empowerment and serves as a strategic tool to propel the achievement of the 2030 Sustainable Development Goals, particularly SDG 5: Gender Equality. This transformative approach fosters the expansion of both financial and non-financial institutions. The introduction of mobile money is a notable example, significantly improving women's access to financial services. Mobile money accounts provide privacy and instill confidence in managing income, fostering a culture of saving among women. Complementary initiatives, such as the introduction of ATMs and online services, have further promoted women's effective engagement in digital financial inclusion.

This paper calls for government consideration of diverse strategies to strengthen and empower women, particularly by facilitating payments for healthcare through digital financial systems, ensuring adequate and easy access to healthcare services. Enhanced regulatory frameworks for mobile money operations and the expansion of agent banking networks across communities, particularly in rural areas, are also necessary. The use of mobile phones for mobile payments has gained global acceptance, and there is a pressing need to ensure that rural women benefit from this digitalization.

The paper emphasizes the importance of digital equality across genders. Governments should prioritize gender equity, as the significant gap in women's digital inclusion affects their access to digital financial services and limits their empowerment in household decision-making. Public awareness campaigns through mass media should also be conducted to promote financial inclusion and women's empowerment.

6. Limitations and Further Research

This study's primary limitation lies in its focus on a single-nation context. The research acknowledges that other contextual factors may contribute to endogeneity among the variables. Future research should consider a multi-country strategy to enhance the universality of the results. Expanding the scope would allow for the inclusion of additional contextual factors, which could help address the multidimensional influences of community and personal determinants on women's willingness to adopt financial inclusion practices.

Acknowledgement statement: The paper benefited from the insights provided by the African Scholars Mentorship Network (ASMN) hosted by DePECOS Institutions and Development Research Centre (DIaDeRC), Nigeria. We extend our appreciation to the anonymous reviewers for their valuable comments.

Conflicts of interest: The authors declare that there is no conflict of interest in relation to this paper, as well as the published research results, including the financial aspects of conducting the research, obtaining and using its results, as well as any non-financial personal relationships.

Author contribution statements: KFA and OKA conceptualised the study. KFA conducted the analysis of DHS and the extraction of NDHS data. The background was done by OKA with inputs from JIA and COI. JIA and COI conducted the scoping review of the literature. KFA and OKA collated the work and prepared the first draft.

Funding: This research did not receive any grant from any funding agency in the public, commercial, or non-profit sections. This research was a self-funded project.

Data availability statement: The datasets analysed are available at the Nigerian Demographic Health Survey domain (https://dhsprogram.com) and is made available to the public upon request.

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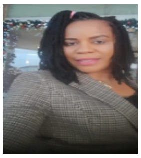
About the Author (s)

AKEJU Kemi Funlayo is a Lecturer of Development Economics. Her works focus on issues of African development policies and programs in the areas of poverty, child and maternal health, fertility, financial inclusion, inequality, social protection, gender issues, climate change, and socio-economic dimensions of economic shocks. She has proven experience in developing micro and macroeconomic models to inform policies to aid strategic plans for advocacy and solution-based research on SDG goals and targets. Dr. Akeju has written and presented papers at both local and international conferences. Her ongoing research includes project works on digital financial inclusion, financial resilience, social protection, women's empowerment, and household well-being. She has also published many research outputs in reputable indexed journals. She has mastery of both quantitative and qualitative methodologies in the social sciences research.

Dr Oluwayemisi Kadijat Adeleke holds a PhD in Economics from the University of Benin, Nigeria through a fully sponsored PhD scholarship from the African Economic Research Consortium (AERC) and her PhD program was a collaborative effort between the University of Ibadan and the University of Benin Nigeria. Also, she has been an Associate Member of the Association of Chartered Certified Accountants (ACCA) since 2010. She obtained a Bachelor of

Science in Economics (B.Sc. Economics) from Covenant University, Ota, Ogun State in July 2006. After the mandatory National Youth Service Corps, she proceeded to obtain a Master of Science in Economics in 2010; and PhD in Economics in 2019 at the Department of Economics, University of Benin, Edo State, Nigeria. Currently, she is a Lecturer in the Department of Economics, at Redeemer's University, Nigeria, where she teaches both undergraduate and postgraduate students. Her area of specialization is in the fields of Macroeconomics, Development Economics, Environmental Economics and Financial Economics. She also acts as a reviewer for several reputable journal outlets. Also, she is a member of the Nigerian Economic Society (NES) and has a goal to continue writing and producing high-quality research and publishing the findings in top journals with the ultimate goal of advancing knowledge in the field of Economics.

Judith Ifunanya Ani, PhD is a postdoctoral fellow at Walter Sisulu University, South Africa. She also dedicates her time to Causes and community services in the Academia including leading Partnerships at DePECOS Institutions and Development Research Centre, Ota, Nigeria. With a research interest in health, gerontology, gender, migration, food security and climate change, she has received awards for her impactful research, contributing to several funded projects.



Chisaa Onyekachi Igbolekwu holds a Doctorate in Sociology from the University of Ibadan Nigeria. She is currently the Technical Manager at Direct Consulting and Logistics (DCL), a public health development company and Nigeria implementing partner for the International Vaccine Access Centre (IVAC), Johns Hopkins University Blomberg University USA. Dr Chisaa Onyekachi Igbolekwu is interested in public health, gender issues, women's health, fertility, adolescent wellbeing, Vaccine/Immunization, development issues and crime. She has published several articles on these issues in national and international Journals.