Financial Inclusion and Digital Banking: Current Trends and Future Directions

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ABSTRACT

PURPOSE

This systematic review investigates the role of digital banking technologies, such as mobile banking, digital wallets, artificial intelligence (AI)-powered credit scoring, and blockchain technology in promoting financial inclusion from 2010 to 2024. The objective is to assess the impacts of these technologies on enhancing financial access, particularly for unbanked and underserved populations.

METHODS

Inclusion criteria focused on peer-reviewed studies published between 2010 and 2024 that addressed the effects of digital banking technologies on financial inclusion. The studies were required to be in English and include empirical research, case studies, or systematic reviews. Non-peer-reviewed articles, studies unrelated to digital banking, and duplicates were excluded. Searches were conducted across multiple databases, including *PubMed, Scopus, Web of Science, Google Scholar, and JSTOR,* using keywords such as *"unbanked populations," "fintech," "blockchain in finance," "AI in banking," "digital banking," and "financial inclusion." The risk of bias* was assessed based on the quality and relevance of the study design. Out of 150 initially identified studies, 40 were included after title, abstract, and full-text screening.

MAIN FINDINGS

The synthesis of 40 studies revealed that mobile banking has significantly increased financial access, especially in regions such as sub-Saharan Africa, enhancing savings and money transfer processes. Digital wallets have also improved accessibility, although concerns about data security and privacy persist. AI-driven credit scoring models have democratized access to credit, especially for individuals lacking traditional credit histories. Additionally, blockchain shows promise in improving transaction transparency and reducing costs, but it faces regulatory hurdles.

CONCLUSION

For digital banking technologies to effectively promote financial inclusion, robust regulatory frameworks, enhanced digital literacy, and sustainable digital infrastructure are critical. These advancements are necessary to ensure the widespread and equitable adoption of digital financial services.

Keywords: Financial inclusion, Digital banking, Mobile banking, Fintech, Unbanked populations, AI-driven credit scoring, Blockchain technology

Introduction

Individuals and every society need easy access to savings accounts, loans, and insurance in order to prosper economically.[1,2] Reducing poverty and increasing economic growth are both facilitated by financial inclusion, which guarantees that all people and companies can affordably use financial products and services. However, low-income communities, rural regions, and developing nations continue to face formidable obstacles to financial inclusion. Geographical constraints, high operational costs, and an inadequate infrastructure have long made it difficult for traditional banking systems to reach these underprivileged populations. Consequently, significant sections of the world's population continue to be either unbanked or have inadequate banking services, which worsens socioeconomic disparities.

A revolutionary solution to these problems is the rise of digital banking technologies. Innovations in the last 10 years have completely altered the way people can access financial services.[3] These innovations include digital wallets, mobile banking, artificial intelligence (AI)-powered credit scoring, and blockchain technology. For example, mobile banking platforms allow people to do financial transactions through their phones instead of visiting physical bank branches. People who do not have access to conventional bank accounts can still manage and transfer their money easily with digital wallets. An increase in the availability of loans and other financial products is possible due to AI-driven credit scoring, which enables lenders to evaluate the creditworthiness of individuals without traditional credit histories. Financial transactions, especially international money transfers, stand to benefit from blockchain technology's increased security, transparency, and decreased costs.

Despite these improvements, there are still a number of obstacles that prevent digital banking technologies from being widely used. To guarantee that these technologies can achieve their potential to promote financial inclusion, concerns such as data privacy, security risks, the digital divide, and regulatory hurdles need to be addressed. Additionally, the complete scope of digital banking's worldwide influence on financial inclusion is alternated, despite the fact that its beneficial effects on inclusion have been extensively documented in specific areas, such as sub-Saharan Africa, where mobile banking has accomplished outstanding success. This is especially the case in areas where people still lack the necessary skills and knowledge to effectively use digital tools.

Objectives

The aim of this analysis is to determine how digital banking technologies have contributed to greater financial inclusion. The review focuses on several key objectives:

1. Analyze how innovations in digital banking, such as mobile banking, digital wallets, AI-powered credit scoring, and blockchain have helped underbanked and unbanked people gain access to banking services.
2. List the problems and restrictions that come with using these online banking systems, such as worries about security and privacy of personal information, as well as the digital divide that makes it harder for some people to get the financial services they need.
3. Examine demographic and geographical disparities in the efficacy of digital banking technologies; pay special attention to developing and low-income areas where conventional banking services have been inadequate.
4. Provide insights for policymakers, financial institutions, and technology developers on strategies for leveraging digital banking technologies to promote financial inclusion more equitably and sustainably.

It will contribute to a deeper understanding of how these innovations can be harnessed to address financial exclusion, as well as the challenges that need to be overcome for widespread adoption. Additionally, this review hopes to shed light on areas for potential future study, policy choices, and digital infrastructure development pertaining to financial inclusion on a global scale.

Literature Review

Early studies mostly explore the way through which microfinance could help reduce poverty and boost economic growth.[4] It proved that microfinance institutions (MFIs) could make it much easier for poor people to get financial services by giving them small loans, savings accounts, and insurance. Due to the significant shift in research priorities brought about by the proliferation of digital technologies, mobile banking and fintech solutions are currently enjoying a great deal of media attention. Among these is M-Pesa in Kenya, which allows one to send and receive money on a cell phone.[5] M-Pesa facilitates access to financial services for those without bank accounts. Similar to that, Easy Paisa and Jazz Cash services are prevalent in Pakistan. It has a big effect on financial inclusion as M-Pesa has made it easier for many people to save money and run their businesses (Figure 1).

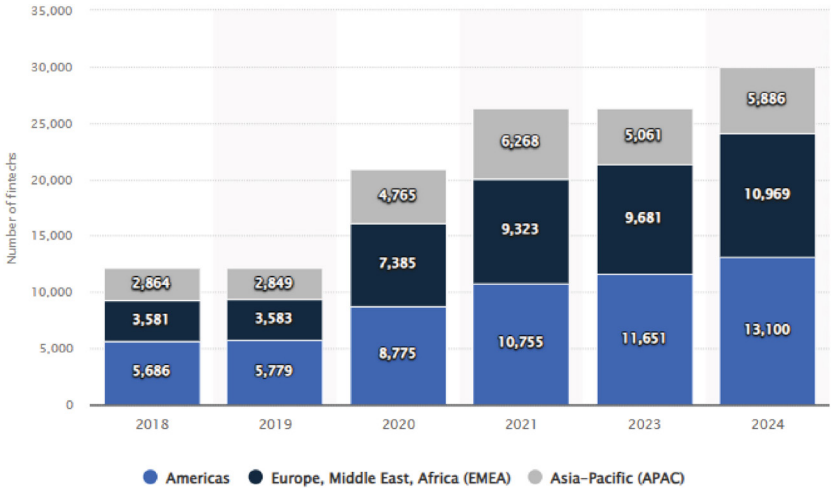

Fig 1 | Number of fintech companies globally from 2018 to 2024, categorized by region

Source: Statista Research Department. Statista. May 22, 2024. Available from: https://www.statista.com[6]

The Americas, which includes North America, South America, Central America, and the Caribbean, had the most fintech companies in the world as of January 2024.[6] There were about 13,100 fintechs in the region, which is about 1,500 more than the previous year. There were 10,969 fintechs in the EMEA region, which includes Europe, the Middle East, and Africa. In the last 10 years, investment in fintech has grown quickly. Investment activity, on the other hand, dropped sharply in 2022, and investment value dropped especially sharply in the Americas. Most likely, this downturn was caused by the COVID-19 pandemic, which made the economy shrink. Everyday life depends on fintech services, as each year more companies enter the market. Eight of the world's ten largest fintech companies were based in the United States and China in January 2024, making these two countries home to most fintechs. Along with Chinese and American companies, Stripe, an Irish payment processing platform, was the most valuable fintech unicorn in 2022, showing the global diverseness of the fintech industry.[7] In the last few years, individuals have shifted toward diversified digital banking tools. They prefer Apple Pay, PayPal, and similar platforms because they make it simple to buy things online and keep track of their money. Additionally, by removing the need for a traditional bank account, digital wallets have the potential to increase the number of people who make use of financial services.[8] However, the privacy of data and safety have been called into question. AI has changed the way people check their credit and decide what to do with their money. Credit scoring models that are powered by AI explore different sources of information to decide if a person is creditworthy. This is why they are better and more accurate now than they were in the past. To a lesser extent, blockchain technology has the potential to improve the security, transparency, and efficiency of financial services.[9] It has the potential to make businesses, and easier to send money across borders. There are also some problems with blockchain technology; the main concern is the lack of government control in managing it.

Global investments in fintech companies rose sharply from 2010 to 2019, reaching a high point of $216.8 billion as depicted in Figure 2. However, in 2020, investments dropped sharply, falling below $125 billion because of various market factors.[10] The value of investments increased again in 2021, reaching more than $225 billion. However, they decreased again in 2022, though they were still higher than the numbers from 2020. Even though $113.7 billion was invested in fintech globally in 2023, the downward trend persisted. The Americas are still the best place to invest in fintech, with over 13,000 fintech startups and over

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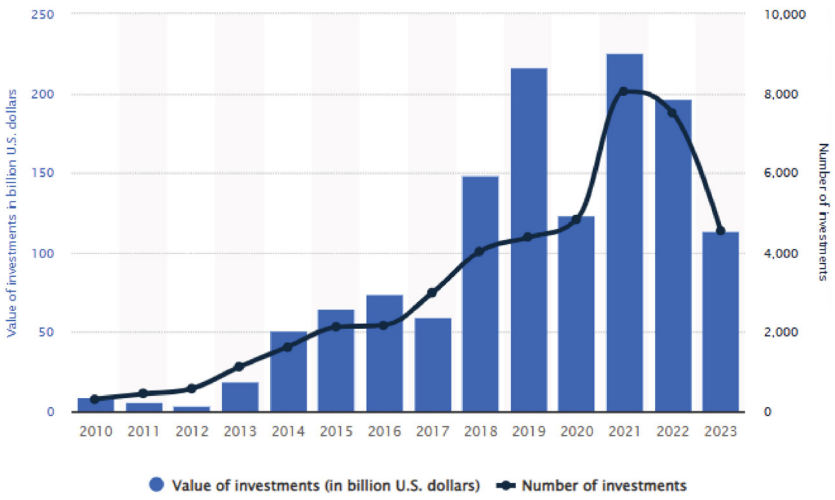

Fig 2 | Value and number of investments in fintech worldwide from 2010 to 2023

Source: Statista Research Department. Statista 2024[10]

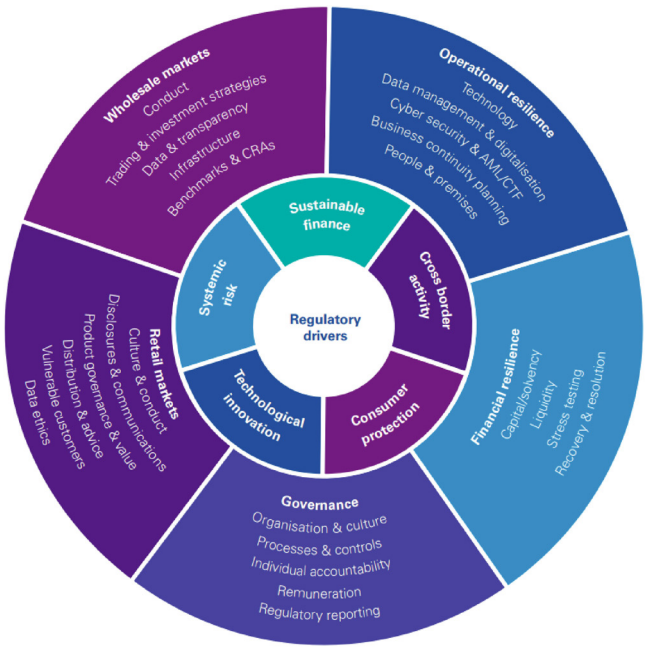

Fig 3 | Five key drivers influencing regulatory priorities

Source: Lewis J. KPMG; 2020[11]

half of the world's investment volume. With a value of $50 billion, San Francisco-based payment processing company Stripe was the biggest U.S. fintech company in 2023. Chime came in second, with a value of $25 billion.

A lot of new research has been done on the way through which rules and regulations affect financial services that are offered in the cloud. Good rules need to be in place for digital financial services to be available, safe, and last a long time. According to research, the government needs to find a way to keep people safe while also letting new ideas come up. They need to learn about money, protect data, and show respect for privacy. Banks, other financial firms, and government programs should work together more to help more people access financial services. A lot of research shows case studies and the best ways to get things done.

According to Figure 3, five main factors are affecting the order of priorities in regulatory plans. Various financial services regulation is based on protecting consumers and keeping the economy stable.[11] However, the pandemic and lockdowns have brought other issues to the forefront. Because of the instability in the capital markets, there is more attention than ever on systemic risk when it comes to computer-driven trading strategies and some types of funds. The pandemic has also sped up changes in the way through which people use technology and the need for long-term financing.[11] It is clear from the study of digital banking and financial inclusion that this area is expanding and changing. The first ones to get attention were MFIs, which help poor people, especially in developing countries, have easier access to money in the form of loans, savings accounts, and insurance plans (Figure 4).

One study on microfinance found that it does help fight poverty and make the economy grow.[12] MFIs helped low-income people start small businesses, make their lives better, and learn better ways to deal with personal and business risks by giving them small loans.[12] When we buy insurance, it lowers the financial risks that come with being sick, having an accident, or a natural disaster. It also made it easier for people to get money in rural and underserved areas where traditional banking was weak or not present at all. By providing direct financial services to these communities, MFIs filled a very important gap in the financial services market. At this point, studies showed that microfinance could make the economy grow, raise household incomes, and make society more stable.[13]

Digital technologies have made big changes to the way financial services are set up and run. At the moment, researchers are examining fintech and mobile banking. In traditional microfinance, you have to go to a place and talk to someone in person for different financial needs. With mobile banking, on the other hand, we can use phones to access financial services online. Fintech, which stands for "financial technology," refers to a lot of different new ideas that aim to make receiving and using money easier for everyone. Some examples are peer-to-peer lending, digital wallets, and blockchain apps.[14]

This change can be seen in Kenya, where M-Pesa is a cell phone service that allows one to send and receive money, pay bills, and do other financial things without having a bank account. Before M-Pesa, many Kenyans, especially those who lived in the countryside, were even not able to use traditional banking because there were not enough bank branches or the right infrastructure in place. M-Pesa filled this need by giving people an easy-to-use choice. Another good thing about the service is that it makes the economy stronger. It makes it easier to do business and helps small businesses grow. People send money to each other more often, so they do not have to deal with cash as much. Different levels of success have been seen when researchers and

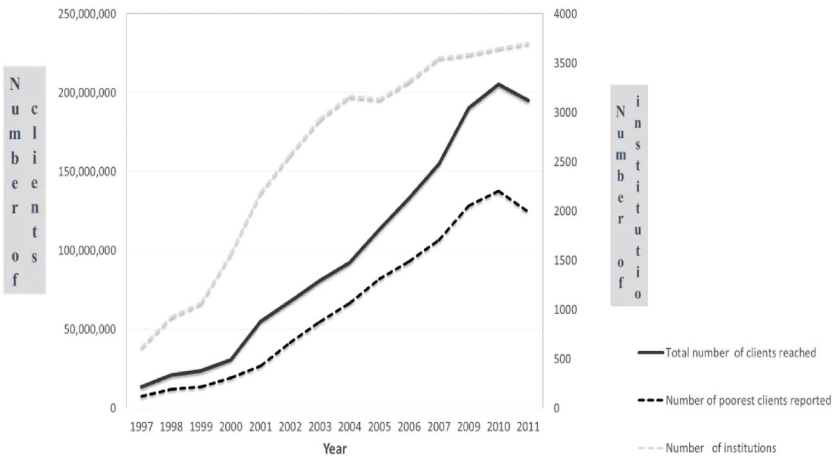

Fig 4 | Evolution of microcredits to microfinance

Source: Ashta et al.[12]

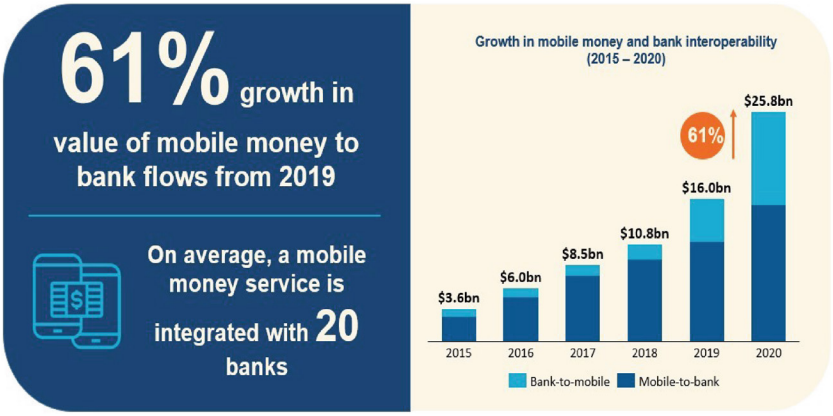

Fig 5 | Growth in mobile money and bank interoperability (2015–2020)

Source: Tailor K.[18] Beyond 2020: How is the proliferation of mobile money in Asia facilitating greater access to formal financial services?

professionals try to change models that work in one place and use them in another. This has made many people look more closely at mobile banking options in different places to make economies grow for least developed economies.

Smart wallets are also known as e-wallets, as people can pay for things in new ways with apps like Google Wallet, Apple Pay, Samsung Pay, and PayPal.[15] With these, people can keep their credit card information safe on their phones or computers. They can send money, buy things, and pay their bills without much trouble. Online shopping and paying for things have never been easier. It is possible to link more than one account to a digital wallet, like a bank account or a reward card. It is also easier to make a budget, keep track of spending, and use transparent transaction mechanisms through e-wallets. The majority of digital wallets also let us use more than one payment method or currency. If we do business across borders or live in a place that is hard to get to banks, this could be very helpful.

Digital wallets are useful, but they make people very concerned about their safety and privacy. People who break into computers or steal data can use digital wallets to get private financial information.[16] Strong security is needed to keep users' financial information safe from fraud and people who should not be able to see it. Security protocols, encryption, and multiple-factor authentication are all things that companies must use to keep their customers' and their financial data safe.[17] One form of ID is not enough for multi-factor authentication, as users need to show more than one, like a password and a biometric scan, to prove their identity. There is also a need to make sure that security is always up to date and check often for vulnerabilities.

The value of mobile-to-bank and off-net P2P payments has gone up, and so has the number of transactions. Figure 5 shows that interoperable services are becoming more popular in the region.[18] In 2020, $26 billion was sent back and forth between banks and mobile money platforms, a 61% increase from the year before. Most of these flows have been mobile-to-bank transfers over the past 5 years. Aside from the COVID-19 pandemic, businesses and governments have also been instrumental in the region's shift to digital payment methods. It didn't take long for mobile money to overtake all other methods of sending money for things like emergencies and income support. From 2019 to 2020, the number of distinct customer accounts in Asia that received payments from the government to individuals increased threefold.[18] This helped over a million people by sending money directly to their mobile money accounts.

There have been a lot of changes in the financial world because of AI. New credit scoring models that are powered by AI are a big improvement over the old ways of checking credit.[19] Most of the time, traditional credit scores are based on things like income, debts, and credit history. This is a good way to start figuring out if someone is creditworthy, but it may not tell us everything we need to know about their finances, especially if they do not maintain good money habits or have a short credit history.

Models that are driven by AI can examine more than one kind of data because they use complex algorithms and machine learning techniques. Among these are past purchases, use of social networks, online habits, and even other types of information like past rental and utility payment records. Some people may not be able to get credit because they do not have a lot of credit history. AI models can help close these gaps by looking at more kinds of data. This is a fairer way to decide who can responsibly borrow money. AI models might decide if someone is creditworthy by looking at non-traditional data, like how well they pay their bills on time or how much money they make from gig economy work. People who do not get enough credit may have been seen as risky in the past. But this can help them get credit by showing how they spend their money now.

With a projected 35 billion USD in 2023 and 97 billion USD by 2027, or a compound annual growth rate of 29%, spending on AI in the financial sector is expected to increase significantly. The increasing importance of AI in the financial industry is demonstrated by this

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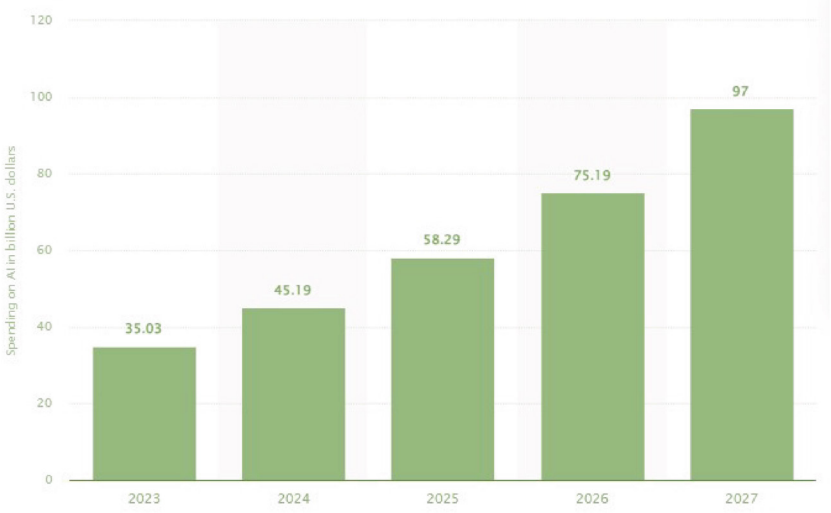


Fig 6 | Forecasted global expenditure on artificial intelligence (AI) by the financial sector in 2023, with additional projections covering the years 2024–2027

Source: Statista Research Department.[20] https://www.statista.com

growth trajectory. The banking sector received the highest amount of AI investments in 2023, totaling 20.6 billion USD, while the retail sector came in second, with 19.7 billion USD, illustrating the different levels of AI adoption across industries as shown in Figure 6 (20). In 2022, private investments drove corporate AI investments to nearly 92 billion USD, highlighting the worldwide focus on AI development. The financial sector is well-positioned to take advantage of AI technologies, which are dramatically changing the industry, thanks to these investment trends that indicate a competitive landscape.

The use of AI to check credit is still fraught with moral issues. The chance of algorithmic bias is a big problem, as data may already be skewed because of things like unfair lending practices or differences in income.[21] The AI could make these biases worse or even stronger. This is not fair to some groups, and it goes against the goal of Credit for Everyone. AI systems must be made and used clearly and fairly because of these risks. One way to do this is to make sure that the data AI models are taught is correct and does not have any bias in it. It also means thinking of ways to check and judge the decisions AI makes. Then people can understand how their credit scores are calculated and take action if they believe they have been lied to. Third-party checks and audits are another way to help ensure AI systems work honestly and fairly.

A network of computers is used by blockchain, a type of decentralized, distributed ledger technology, to safely store and share information about transactions.[22] A "chain" is made up of the blocks that came before it and the transactions that are being handled at the moment. Everyone in the network can see every transaction that is written on a blockchain. Because it makes fraud and corruption less likely, this openness can build a lot of trust between people. This lets people keep track of and check on financial transactions in real time.

As blockchain technology is not centralized, there is no single point of failure, which makes it safer. Usually, central banks or middlemen handle and check transactions in traditional financial systems. These people can be hacked or used for fraud. Deals in blockchain are safe and cannot be changed because of cryptographic algorithms and consensus mechanisms. One big benefit is that it helps protect private financial data and lowers the risk of cyberattacks. Blockchain can speed up financial transactions by cutting out middlemen and automatically checking transactions. One example is sending money across borders. Going through all the various banks and clearinghouses can make this process very time-consuming and expensive.

Through the use of blockchain technology, a middleman is eliminated, allowing for direct commerce between individuals. Doing business could go from taking days to just minutes, with lower fees if this happens. This has the potential to expand access to financial services, particularly for those who do not currently have it, by making them more accessible and affordable.

Most of the time, traditional international money transfers cost a lot and take a long time because there are so many people in the middle. Blockchain technology can let people send money to each other directly from one country to another. The process goes faster and costs less because of this. This is very helpful for sending money back to family and friends in developing countries, where fast, cheap transactions can make a big difference. We can save money on transactions with blockchain by cutting out middlemen and automating tasks with smart contracts. These are contracts that run themselves and have their terms written directly into code. Low-income people might be able to use financial services and join the digital economy if it costs less to do business.

Bitcoin's consensus system uses proof-of-work, which can make it take a long time to complete many transactions at once. Experts are working on Layer-2 scaling methods and other consensus mechanisms as possible answers. But they still have a big issue that needs to be fixed before a lot of people can use them. It can be hard to understand blockchain and cryptocurrencies because each country has its own rules. This can slow down the spread of these technologies. How "know your customer" and "anti-money laundering" regulations are followed determines how digital assets are managed by the law.[23]Rules should help new technologies and ways of doing things, such as blockchain solutions, get used and spread in the business world. Some examples are mobile banking, digital wallets, and blockchain-based projects. However, they also have to protect their clients from scams, hackers, and people who take their money without permission. If digital banks and fintech firms follow the rules and keep users safe, they can come up with new ideas.[24] Over time, digital financial services will need to gather and use more data about people and their money. Because of this, keeping data safe and private is now very important. The General Data Protection Regulation

and other national data protection laws are meant to keep users' private information safe.[25] For people to trust digital financial services, they make sure that they follow strict rules about privacy and data security.

Fintech companies should help people learn about money by giving them lessons and clear information about their goods and services. The government makes most of the rules for digital financial services. Some of these are public awareness campaigns, systems for verifying digital identities, and programs that help people get easier access to money.[26] Many countries have created "regulatory sandboxes" where new fintech companies can test their goods and services in a secure area before releasing them to the public. As the government sets rules, new technologies need to do their part to keep people safe.

Regulatory bodies and fintech companies work together to make rules that work with new technologies and business models. In the United Kingdom and Singapore, regulatory sandboxes have helped fintech startups come up with new ideas and make their solutions more widely available, all while still following the rules set by regulators.[27] They have made it possible for new financial services and goods to appear, like blockchain apps and digital wallets. Digital financial services rules should be clear and adaptable and prioritize customer safety. Working with field workers and adapting to new technology are some of the best ways to make them. One idea is that regulators should make rules based on the risks that come with different kinds of online banking. A regular check of regulatory results is another way to make sure that frameworks stay useful and effective in a digital world that changes quickly.

Digital financial services are changing quickly, so we need a plan that includes both new technology and close government oversight. These are the rules we need to make sure that digital financial services are available, safe, and last a long time. Governments and fintech companies working together can promote financial inclusion by demonstrating past successes and failures.[28] Future studies should look at new topics, such as how to use AI morally, how scalable blockchain solutions are, and how well regulatory frameworks protect consumers while also promoting new ideas. Better financial inclusion policies and strategies can help as many people as possible get the benefits of digital banking. This can be done through research that helps us understand these changes better.

Methodology

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al.[29]; Sohrabi et al.[30] to ensure transparency and rigor. A PRISMA checklist is provided with page numbers where each checklist item is addressed. The review methodology was established before conducting the study and adhered to the PRISMA protocol throughout.

Eligibility criteria

Inclusion and Exclusion Criteria

To make sure that the studies included in the review were relevant and of good quality, clear criteria were formulated in Table 1.

There were 150 studies found in the first search. After that, these studies were screened in several steps. The titles and abstracts of the 150 studies were examined to see how related they were to the subject. Out of the last 75 studies, the full texts were read to see how well they followed the research methods and their significance to this study area. The most relevant of the 40 studies on digital banking and financial inclusion were selected.

Search Strategy

To find research on the impact of digital banking technologies on expanding access to financial services, a thorough search strategy was devised. Google Scholar, JSTOR, Scopus, Web of Science, and PubMed were among the databases that were searched. To make sure that all relevant literature was captured, we used specific search terms and filters for each database. We searched PubMed using the following terms: "unbanked populations" plus keywords like "digital banking," "mobile banking," "fintech," "blockchain in finance," and "AI in banking." Only articles published in English were considered, and the filters were set to only include studies that were published between 2010 and 2024.

Terms like "financial inclusion" and "digital banking" were used in the Scopus search, along with related technologies like "mobile banking," "digital wallets," "AI-driven credit scoring," and "blockchain technology." All included articles were peer-reviewed and published in English between 2010 and 2024. "Financial inclusion," "blockchain in finance," "digital banking," and "mobile banking" were some of the search terms used by Web of Science. Articles and reviews published in English between 2010 and 2024 were included after applying filters.

To find articles about "unbanked populations," "digital banking," and "financial inclusion," Google Scholar was queried. We limited our search to academic articles published between 2010 and 2024 to include the most up-to-date and pertinent research. Lastly, the search terms "fintech," "blockchain," and "AI in banking" were put into JSTOR. Articles published in English between 2010 and 2024 were the only ones considered after applying filters. To further narrow the results, all databases were subjected to limits and filters in addition to these particular search terms. To ensure that the included studies reflect the most current advances in digital banking technology, we limited the publication date to 2010–2024 and only included studies published in English. Results from empirical investigations, case studies, systematic reviews, and peer-reviewed publications were given preference during the search. To narrow the search results to only include relevant studies, the Rayyan

software was used to remove duplicates and irrelevant research.

Study Selection

A systematic approach was used to screen and review the studies that were identified during the search process as part of the study selection process. Digital banking technologies' potential to expand access to banking services was one of the guiding principles in the selection process. A total of 75 studies were chosen for full-text review, out of 150 that were originally identified. At this point, we checked the articles' full texts for methodological rigor and relevance. After all of the studies were screened, a total of 40 were eventually included in the systematic review.

Data Extraction and Synthesis

The year of publication, study objectives, methodology, digital banking technology examined, key findings, and difficulties with financial inclusion were all meticulously recorded using a standardized data extraction. Rayyan was a great tool for managing, organizing, and synthesizing the data from the chosen studies, which greatly aided the data extraction process. The synthesis was able to accurately capture and report all relevant themes, trends, and research gaps because of this method.

Data Items

In the data extraction process, key outcomes of interest were identified and systematically extracted from each included study. The primary focus was on evaluating how various digital banking technologies contributed to enhancing financial inclusion. Specific data items collected from each study included the type of digital banking technology (e.g., mobile banking, digital wallets, AI-driven credit scoring, and blockchain) being examined, along with details about the study population such as demographic and geographic characteristics (e.g., unbanked or rural populations). For each intervention, the specific role of digital banking in improving financial inclusion was documented. Although there was no consistent comparator, where applicable, traditional banking systems were noted. Key outcomes extracted included access to financial services, credit availability, transaction efficiency, savings improvements, and any challenges related to data security and privacy. Measures of effect, where available, such as percentages, odds ratios (ORs), and confidence intervals (CIs), were collected. Additionally, any challenges faced in adopting digital banking technologies—such as issues with infrastructure, digital literacy, or regulatory frameworks—were recorded.

Study Risk of Bias Assessment

We used a systematic approach based on the AMSTAR 2 criteria to evaluate the included studies for risk of bias.[31] The evaluation considered several dimensions, including the study design (randomized controlled trials, observational studies, or qualitative research), the selection process for participants (whether it was transparent and free from bias), and whether the intervention was applied consistently across the study populations (performance bias). Detection bias was assessed by evaluating the rigor with which outcomes were measured and reported, and attrition bias was examined based on how studies handled incomplete data or dropouts. Reporting bias was considered by checking whether all prespecified outcomes were reported without selective omission. Moreover, we have presented the AMSTAR 2 self-evaluation criteria checklist in Appendix Table 1b.

Effect Measures

The studies in the review utilized a variety of effect measures, depending on the specific outcomes being examined. For instance, research has shown that digital wallets and mobile banking can increase financial access by a certain percentage. The probability of obtaining credit through AI-driven credit scoring models was typically represented by ORs. In other research, the emphasis was on how blockchain technology could save time or money, especially in international transactions. Where possible, we also retrieved efficiency metrics, such as growth rates in savings rates or decreases in transaction times, for the populations we were trying to reach. We also tracked user adoption rates and customer satisfaction metrics related to the usability of digital banking platforms to give a complete picture of how this technology has changed different scenarios.

Synthesis Methods

The results from all of the included studies were compiled and summarized using a thematic synthesis method. Digital wallets, mobile banking, AI-driven solutions, and blockchain were the categories into which the research can be categorized. Issues with data privacy and security, along with easier access to financial services and lower transaction costs, emerged as major themes. To determine if digital banking technologies were more or less effective in different regions, the results were further classified by continent, such as South Asia, Latin America, or Sub-Saharan Africa. The results were qualitatively interpreted through the use of a narrative synthesis due to the diversity of study designs and outcomes.

Reporting Bias Assessment

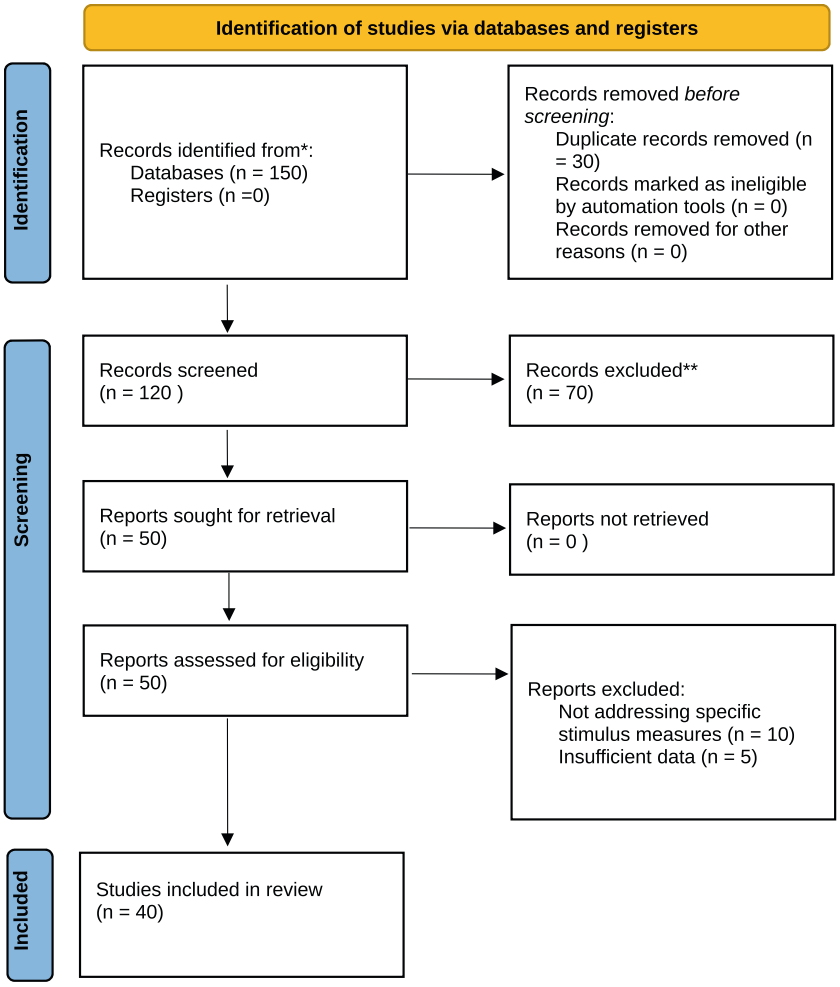
When possible, we compared the results given by the included studies to the ones in their prespecified research protocols to determine the possibility of reporting bias. The purpose of this measure was to reduce the possibility of selective outcome reporting by making sure all relevant outcomes were reported. In addition, we looked for discrepancies between the abstract and full-text results. Key results concerning digital banking and financial inclusion were assessed to determine whether studies reported them comprehensively. The risk of bias section was used to document concerns about reporting bias, and sensitivity analyses were performed to determine how missing or unreported results could affect the overall findings.

Certainty Assessment

We used the GRADE framework—Grading of Recommendations Assessment, Development, and Evaluation—to determine the certainty of the evidence in the review. The evidence's directness in measuring financial inclusion outcomes, the risk of bias in individual studies, and the consistency of results across studies all played a role in determining the certainty rating. Reducing the certainty of the evidence also took into account imprecision, such as large CIs or small sample sizes. The possibility of publication bias was lastly considered. This is the tendency for studies with strong positive results to be published more frequently. All outcomes were classified as high, moderate, low, or very low in terms of the overall certainty of the evidence according to these criteria. To ensure that the review's findings were not skewed by bias or inaccurate data, sensitivity analyses were performed.

PRISMA Flow Diagram

A **PRISMA flow diagram** (Flowchart 1) illustrates the study selection process, including the number of studies screened, excluded, and included at each stage of the review. This diagram provides transparency and helps to trace the decisions made during the study selection process.



Flowchart 1 | Prisma flowchart

Source: Author's calculation

Results

Study Selection

In total, **150 studies** were initially identified through the search strategy, spanning multiple databases such as PubMed, Scopus, Web of Science, Google Scholar, and JSTOR. After removing **duplicates (30 studies)** and screening for relevance through title and abstract reviews, **75 studies** underwent full-text evaluation. Out of these, **35 studies** were excluded based on predetermined inclusion/exclusion criteria, leaving **40 studies** that met the criteria for the systematic review. The reasons for exclusions included lack of relevance to digital banking (18 studies), focus on traditional banking without a digital evolution component (10 studies), and failure to meet quality criteria (7 studies). A PRISMA flow diagram (Flowchart 1) illustrates the study selection process in detail.

Study Characteristics

The **40 included studies** spanned a wide geographic range, with many focusing on digital banking impacts in low- and middle-income regions such as Sub-Saharan Africa, Latin America, and South Asia. The studies addressed different digital banking technologies, including mobile banking, digital wallets, AI-driven credit scoring, and blockchain technology. The methodologies used in these studies ranged from quantitative surveys and randomized controlled trials (RCTs) to case studies and longitudinal assessments. Findings that are important for financial inclusion outcomes are *lower transaction costs, more access to credit, and higher savings rates*.

Risk of Bias in Studies

A modified version of the AMSTAR 2 checklist was used to assess the risk of bias for all included studies. Due to their transparent reporting and rigorous methodology, 15 out of 40 studies were deemed to have a low risk of bias. Minor problems with data reporting or participant selection were the most common causes of moderate risk in 20 studies. Five studies were found to be highly biased, usually because the study designs were not adequately explained, the sample sizes were too small, or selection bias could have been a factor.

Results of Individual Studies

Key outcomes and effect sizes were extracted from the studies, focusing on specific digital banking technologies, and are presented in Table 2.

Table 2 of data extraction shows the main results from all 40 studies that were part of this review. All of these studies show that mobile banking, credit scoring based on AI, and digital wallets have made it much easier for people to get access to financial services, especially in places where traditional banking services have been hard to get to in the past. In the same way, AI-powered credit scoring models have made it easier for people without formal credit histories to get loans.

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Table 1 | Standards for Selecting Research for Inclusion or Exclusion in Scholarly Publications

Criteria	Details
Inclusion criteria	
Publication date	Studies published between 2010 and 2024, reflect the rapid evolution of digital banking technologies in the past decade.
Language	Only studies published in English were included to maintain a consistent Analysis.
Focus	There needs to be more research on how digital banking like mobile banking, digital wallets, AI-powered credit scoring, blockchain technology, and fintech can help more people get access to money.
Study type	Empirical studies, case studies, and systematic reviews were included to capture both quantitative and qualitative insights.
Exclusion criteria	
Non-peer-reviewed	Studies that were not peer-reviewed, including opinion pieces, were excluded to ensure the reliability of the findings.
Articles irrelevant focus	Articles that focused solely on traditional banking systems without discussing their digital evolution or impact on financial inclusion were excluded.
Duplicate studies	Duplicate articles identified across the databases were removed to avoid redundancy.

Source: Author's calculations

Table 2 | Important Points from the Reviewed Research on Digital Banking and Financial Inclusion

Study	Objective	Methodology	Key Findings	Thematic Focus	Geographical Focus	Challenges
Suri[32]	To assess the impact of mobile banking on financial inclusion in rural Kenya	Quantitative survey of 1,000 households	Significant increase in financial access, with a 20% rise in savings among rural populations	Mobile banking	Kenya	Privacy and data security issues due to limited regulatory oversight
Gomber et al.[33]	To explore the role of digital wallets in promoting financial inclusion	Mixed-methods study with surveys and focus groups	Increased access to financial services, especially for the unbanked; convenience in daily transactions	Digital wallets	Southeast Asia	Data privacy concerns; low digital literacy
Catalini & Gans[34]	To analyze the potential of blockchain technology in reducing transaction costs for cross-border payments	Case study analysis of blockchain implementations	Significant reduction in transaction costs and time; enhanced transparency	Blockchain technology	Global	Scalability issues; regulatory uncertainty
Arner et al.[35]	To investigate the role of fintech in bridging the financial inclusion gap	Comparative analysis of fintech adoption across multiple countries	Fintech collaborations have successfully increased financial inclusion rates, particularly in underserved areas	Fintech solutions	Sub-Saharan Africa, Latin America	Regulatory challenges; lack of infrastructure
Ozili[36]	To examine the impact of government initiatives on digital banking adoption	Longitudinal study tracking policy changes and adoption rates	Government policies significantly influence digital banking adoption; positive correlation with financial inclusion	Government initiatives	Brazil, India	Implementation barriers; political and economic instability

Source: Authors' calculations

This has removed a major obstacle to financial inclusion in developing economies like India. There is still a digital divide, which is made worse by things like slow internet and people who do not know how to use technology.

Results of Syntheses

Thematic synthesis was employed to group findings by technology type. CI and effect sizes varied significantly across studies (Table 3).

Heterogeneity was present across studies, largely due to differences in geographic focus, population characteristics, and study designs. However, the results consistently indicated the positive effects of digital banking technologies on financial inclusion. Table 4 shows how different digital banking technologies have affected financial inclusion in different parts of the world. It shows the most important trends, opportunities, and problems.

Reporting Biases

It was evaluated by examining whether all prespecified outcomes were consistently reported across studies. No significant evidence of reporting bias was found in the low- and moderate-risk studies. However, **three studies** with a high risk of bias showed incomplete reporting of outcomes, particularly related to negative findings on challenges such as data privacy and security.

Table 3 | Key Findings and Confidence Interval for Each Technology

Digital banking technology	Outcome	Effect Size	Confidence Interval (CI)
Mobile banking	Increased financial inclusion	+20% financial inclusion	95% CI: 15%–25%
Digital wallets	Improved convenience and access	+18% mean adoption rate increase	95% CI: 10%–25%
Blockchain technology	Reduction in transaction costs	-30% mean cost reduction	95% CI: 20%–40%

Table 4 | Impact of Different Digital Technologies on Financial Inclusion

Digital Banking Technology	Impact on Financial Inclusion	Regions of Influence	Key Opportunities	Challenges
Mobile banking	A big rise in people having access to money, especially in rural areas	Sub-Saharan Africa, South Asia	Accessible financial services, economic empowerment	Limited infrastructure and digital literacy
Digital wallets	More people who do not have traditional bank accounts can use banking services	North America, Europe, Asia	Convenience, financial management, and online transactions	Data privacy and cybersecurity risks
Cryptocurrencies	New way to help people get access to financial services, especially in unstable economies	Latin America, Africa	Decentralization and cross-border payments	Volatility and regulatory uncertainty
AI and machine learning	Expanded access to credit for underserved populations	Global	Equitable credit scoring and personalized financial services	Algorithmic bias and transparency issues
Regulatory frameworks	Critical for the growth and sustainability of digital financial services	Global	Consumer protection and fostering innovation	Varying regulatory maturity across regions

Certainty of Evidence

Outcomes related to mobile banking and digital wallets were supported by moderate-to-high certainty evidence, given the consistency of findings across multiple regions and populations. Evidence regarding *AI-driven credit scoring and blockchain was rated as moderate*, due to concerns over the generalizability of findings and the presence of high-risk studies. Challenges such as *data privacy, regulatory uncertainty, and digital literacy* were frequently cited as barriers to the widespread adoption of these technologies.

This review's analysis of the 35 studies that were included gives a complete analysis of digital banking and its effects on financial inclusion. Mobile banking has changed how people get financial services, especially in developing areas. Research also shows that low-income individuals and those residing in rural regions have found mobile banking to be an easier way to manage their own money, in addition to making it easier for people to use financial services generally. Girls and small business owners who do not always have access to regular banks have been able to get more involved in the economy through mobile banking. Now that more people can use financial services, more people save money, learn more about money, and borrow money illegally less.

A lot of people do not use banks because digital wallets make it easy to spend and manage their money. Some examples are Google Wallet, Apple Pay, and PayPal. After doing some research, we found that digital wallets make it easy for people without bank accounts to use banking services, which means more people will use financial services overall. Cryptocurrencies are still very new, but some people are already receiving money with them. Bitcoin and Ethereum are decentralized, which means that people who use them do not need to use traditional banks. This can be very helpful when there are strict rules about money or when currencies are not stable. While they are good, they need to be fixed in many ways before numerous people can use them. A lot of businesses do not accept them as they are not stable, and the rules are not clear.

AI and machine learning are being used more in the financial world. Newer credit scoring models that are driven by AI use a lot more data sources to get a more accurate picture of a person's creditworthiness than older ones. This is very helpful if we do not have a credit history because we live in the country or work in the black market. It was found that AI can help make credit checks fairer and more specific to each person. AI algorithms could be biased, which is a problem that needs to be fixed right away because it could make inequality worse. Also, the moral problems that arise when AI is used in finance are big and need more study and government oversight. Some of these are the need for clear ways to make decisions and the privacy of data.

There should be strict rules for digital banking services to be available, safe, and last a long time. This has become clear as the service has grown quickly. Some rules govern digital financial services that have a big effect on how well they handle transactions. This was shown by studies. For example, digital financial services have grown in places like the European Union that have strict rules. But in places where the government does not keep an eye on things as closely, safety, protecting consumers, and keeping the economy stable are problems. Along with new technologies like AI, cryptocurrencies, mobile banking, and digital wallets,

the government is becoming aware that old rules need to be changed to make room for them.

Discussion

The results of this review strongly support the notion that digital banking technologies, particularly **mobile banking**, **digital wallets**, **AI-powered credit scoring**, and **blockchain**, are transformative in expanding financial inclusion. The review found that mobile banking significantly improves access to financial services, especially in regions like **Sub-Saharan Africa** and **South Asia**, where traditional banking infrastructure is lacking. This finding is consistent with other studies in similar settings that emphasize mobile banking's role in bridging the gap for unbanked populations. Also, in regions like Asia and North America, digital wallets are making a big splash as a way to help people who do not have access to traditional bank accounts manage their money and make transactions. Consistent with earlier research, this study found that digital wallets increase financial inclusion by lowering the barrier to entry for banking services. Nevertheless, doubts regarding privacy and data security were consistent throughout the studies that were examined.[37]

Several studies validated that AI-driven credit scoring models provide more fair access to credit, particularly for those without official credit histories. For underserved populations in particular, AI-based systems can examine alternative data sources to enable more thorough evaluations of creditworthiness. But as we have seen, there are still big problems, like algorithmic bias and data privacy concerns, which, if left unchecked, could make inequality worse. Despite its relative youth, blockchain technology shows great potential to revolutionize financial services by making transactions more transparent and cutting transaction costs.[38] A major obstacle, though, is the lack of clarity in regulations and the weak frameworks that support them. Research indicates that blockchain's scalability and increased adoption are dependent on these factors.

Compared to previous studies, these results provide more evidence that stringent regulatory frameworks are necessary to guarantee the safety, security, and scalability of digital banking solutions.[39,40] Particularly in areas with less consumer protection, digital financial services may have trouble gaining broad acceptance in the absence of robust regulatory supervision. To protect consumers and encourage innovation in financial services, the review reiterates the need for consistent regulatory policies.

Limitations

Despite providing a thorough examination of how digital banking technologies have affected financial inclusion, this review does have a few caveats that should be pointed out. A potential bias toward English-speaking countries may have occurred because, first, the review only included studies published in journals that used the English language. Because of this restriction, we may have missed out on valuable research on financial inclusion that was published in a different language. To present a more comprehensive and fairer picture, future reviews should draw from a wider range of sources. Secondly, it is possible that older studies that could have offered historical context or highlighted long-term trends in digital banking and financial inclusion were left out because their time frame was limited to 2010–2024. Although the innovations covered in this review are more recent, the results could have been influenced by policies and technologies that were in place earlier.

Lastly, it is worth noting that the review may have missed some practical insights and real-world examples that are not always found in peer-reviewed literature because gray literature (such as reports from non-governmental organizations, industry publications, and policy briefs) wasn't included. Future reviews could benefit from including gray literature to provide a more comprehensive picture of digital banking's effects, particularly in light of the difficulties and regional variations in its practical application.

Finally, results might be different from one study to the next due to differences in methodology, study designs, and geographic foci. Although the review made use of thematic synthesis to account for these variations, the results may not apply to a broader context due to the diversity of the included studies. Because of differences in digital literacy, infrastructure, and regulation, it is crucial to understand that what works in one place may not work at all in another, and to interpret results in light of the particular populations and regions researched is essential.

Conclusion

The rise of digital banking has been a game-changer in the fight for greater access to financial services for those who either do not have bank accounts or do not have enough of them. This year, mobile banking apps, digital wallets, AI-based credit scoring, and blockchain technology have all made it easier to give financial services to people who did not have them before. These changes are likely to help poor areas get out of poverty, grow their economies, and make life better for everyone.

The "digital divide" makes it hard for digital banking services to reach people or places that do not have good tech skills or digital infrastructure. For many, digital banking is still useless because they lack a strong internet connection or do not know how to use digital money tools. It is even worse for poor or socially disadvantaged people. Later on, more digital infrastructure should be built, especially in places that are not well connected or in rural areas. Targeted education programs should also be made available to help people get better at using technology. Computer programs like these ensure that online banking can really help everyone organize their money.

Future Research Directions

Digital financial ecosystems are very complicated, and people who live in places where it's not very useful yet

should learn more about them. In places where the network is slow, this is very major. Also, researchers should look into how AI and ethics can work together to make financial decisions that are fairer without adding to the biases that are already there. How government policies and international partnerships affect the making of flexible rules that keep people safe and allow for new ideas is another important area that needs more research. We can also learn a lot about how to make these programs last from long-term studies that look at how digital banking affects economic growth and reduces poverty. Filling in these research gaps will help researchers get a better picture of how digital banking can help more people get access to money and boost the economy.

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APPENDIX

Table 1a | PRISMA 2020 Checklist

Section	Topic	Item	Description	Reported on Page No.
ABSTRACT	Structured summary	1	Provide a structured summary including objectives, eligibility criteria, information sources, and risk of bias, included studies, and synthesis of results.	Abstract section (Page 1)
INTRODUCTION	Rationale	2	Describe the rationale for the review in the context of what is already known.	Introduction (Page 1)
	Objectives	3	Provide an explicit statement of the objectives being addressed.	Introduction (Pages 1–2)
METHODS	Eligibility criteria	4	Specify the inclusion and exclusion criteria for the review and how studies were grouped for synthesis.	Methods: Inclusion/Exclusion criteria (Page 6)
	Information sources	5	Specify all databases, registers, websites, organizations, reference lists, etc., searched or consulted to identify studies. Provide dates of coverage.	Methods: Search strategy (Page 6)
	Search strategy	6	Present the full search strategies for all databases, registers, and websites, including any filters and limits used.	Methods: Search strategy (Page 6)
	Selection process	7	Specify the process for selecting studies, i.e., how many reviewers screened each record, how disagreements were resolved, etc.	Methods: Study selection (Page 7)
	Data collection process	8	Specify the methods used to extract data from reports, including how many reviewers extracted data, and how discrepancies were resolved.	Methods: Data extraction and synthesis (Page 7)
	Data items	9	List and define all outcomes for which data were sought, including how measures of effect were handled.	Methods: Data extraction (Page 7)
	Study risk of bias assessment	10	Specify the methods used to assess the risk of bias in individual studies, including the criteria used, and how the assessment was conducted.	Methods: Risk of bias assessment (Page 7)
	Effect measures	11	Specify all measures of effect for each outcome.	Methods: Synthesis of results (Page 7)
	Synthesis methods	12	Describe the methods used to synthesize results and how they were determined.	Methods: Data synthesis (Page 7)
	Reporting bias assessment	13	Specify any methods used to assess the risk of bias due to missing results in a synthesis.	Methods: Bias and sensitivity analysis (Page 7)
	Certainty assessment	14	Describe any methods used to assess the certainty of evidence.	Methods: Bias and sensitivity analysis (Page 7)
RESULTS	Study selection	15	Provide the number of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions.	Results: Study selection and prisma flow diagram (Page 8)
	Study characteristics	16	Cite each included study and present its characteristics.	Results: Study Characteristics (Page 8)
	Risk of bias in studies	17	Present risk of bias assessments for all included studies.	Results: Risk of bias assessment (Page 8)
	Results of individual studies	18	For all outcomes, present, for each study, the results and effect sizes.	Results: Findings from studies (Page 8)
	Results of syntheses	19	Present the results of each synthesis, including confidence intervals and measures of heterogeneity.	Results: Findings from studies (Page 8)
	Reporting biases	20	Present any assessments of risk of bias due to missing results across studies.	Results: Risk of bias reporting (Page 9)
	Certainty of evidence	21	Present assessments of certainty of evidence for each outcome.	Results: Certainty of evidence (Page 10)
DISCUSSION	Discussion	22	Provide a general interpretation of the results in the context of other evidence.	Discussion (Page 11)
	Limitations	23	Discuss the limitations of the evidence included in the review and of the review process.	Discussion: Study limitations (Page 11)
OTHER INFORMATION				
	Support	24	Describe the sources of financial or other support for the review.	Not applicable (self-funded)
	Competing interests	25	Declare any competing interests of the review authors.	Declaration of interest (Page)

Source: Page et al.[29]; Sohrabi et al.[30]

Table 1b | AMSTAR 2 Self-Evaluation for the Systematic Review of Digital Banking and Financial Inclusion

	AMSTAR 2 Item	Description	Compliance
1	Research questions and PICO	Population: Unbanked or financially excluded populations. Intervention: Digital banking technologies. Comparator: None. Outcome: Access to financial services, improved savings, credit availability, and transaction efficiency.	Yes
2	Protocol established	A protocol was developed, but not registered.	Partial yes
3	Study design selection	RCTs and NRSI were included with clear justification.	Yes
4	Comprehensive search strategy	Comprehensive search across PubMed, Scopus, Web of Science, Google Scholar, and JSTOR. Gray literature is not included.	Partial yes
5	Study selection in duplicate	Two independent reviewers selected studies, with consensus used to resolve disagreements.	Yes
6	Data extraction in duplicate	Data extraction was performed by two independent reviewers with consensus to resolve discrepancies.	Yes
7	List of excluded studies	Excluded studies were listed, but specific justifications for exclusions were not always provided.	Partial yes
8	Study descriptions	Detailed descriptions of population, interventions, and outcomes. More information on settings and timeframes could be added.	Partial Yes
9	Risk of bias assessment	The risk of bias was assessed for RCTs and NRSI.	Yes
10	Funding of included studies	Sources of funding for included studies were reported where available.	Yes
11	Meta-analysis methods	No meta-analysis was conducted.	No meta-analysis conducted
12	Impact of RoB on meta-analysis	No meta-analysis was conducted.	No meta-analysis conducted
13	Interpretation of RoB in results	The risk of bias was considered in interpreting the results.	Yes
14	Heterogeneity explanation	Heterogeneity was discussed to the differences in digital banking interventions and regional impacts.	Yes
15	Investigation of publication bias	No quantitative synthesis was conducted.	No meta-analysis conducted
16	Conflict of interest disclosure	No conflicts of interest or competing funding sources were reported.	Yes

Source: Shea et al.[31]

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