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Empowering Women Digitally: A Randomised Controlled Trial on Digital Financial Literacy and Women's Economic Empowerment in Rural Pakistan

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Abstract

This study examines the effectiveness of a digital financial literacy intervention aimed at improving financial knowledge, confidence, and behaviour among rural women in Pakistan. Using a randomized controlled trial conducted in two selected villages in the Rawalpindi district, women were assigned to receive digital financial literacy training either individually or jointly with a male household member. The intervention, delivered in person and via mobile phones, focused on core topics including budgeting, saving, and secure digital transactions. The training substantially improved women's financial knowledge, digital confidence, and self-efficacy. The intervention also increased the use of mobile wallets, greater engagement with formal savings mechanisms, and encouraged more consistent budgeting practices. When male household members participated alongside women, the intervention further enhanced women's financial autonomy and promoted more active joint decision-making over household finances. These findings demonstrate the potential of contextually grounded digital interventions to expand women's financial inclusion and highlight the value of household engagement in reinforcing women's economic agency.

Keywords: Digital Financial Literacy; Financial Inclusion; Women's Empowerment; Behavioral Interventions; Randomized Controlled Trial

JEL Classification: C93, D14, O16, J16

When women gain digital financial literacy, they don't just learn to use technology; they unlock the power to transform their lives, families, and communities.

1. Introduction

Financial inclusion is increasingly recognized as a foundational element in advancing poverty alleviation, gender equity, and sustainable economic development. Access to formal financial services enables individuals to absorb financial shocks better, invest in human capital, accumulate savings, and strengthen their economic agency (Banerjee et al., 2015; Suri & Jack, 2016; Karlan et al., 2022). Despite notable global progress in extending financial services, persistent inequalities, particularly gender-based, remain a critical challenge in the developing world. According to the *Global Findex Database* (World Bank, 2025), approximately 1.4 billion individuals worldwide are still without access to a bank account, with women representing a disproportionately large share of this financially excluded population. Notably, in low-and middle-income countries (LMICs), the gender gap in account ownership remains at six percentage points, with women systematically less likely to access banking, mobile money, or digital financial services. These gender disparities are especially pronounced in South Asia. In Pakistan, for instance, only 7% of women report owning an individual account at a formal financial institution, compared to 35% of men, a gap that reflects not only economic constraints but also entrenched social, cultural, and digital barriers (Chamboko et al., 2018). The gap is even wider among rural women due to lower literacy, restricted mobility, and sociocultural constraints. Only 14% of women in rural Pakistan report ever using a mobile money service, compared to 41% of men (GSMA & Karandaaz, 2022). According to BISP-Ehsaas surveys (Government of Pakistan, 2023), less than 10% of rural women can complete a mobile transaction without assistance. Addressing these challenges is essential for realizing the full promise of inclusive financial systems and achieving equitable development outcomes.

Digital financial literacy transforms women's empowerment in LMICs by enhancing their ability to access, understand, and effectively use financial tools and services (Field et al., 2021; Gangopadhyay, 2009). When women gain the skills to effectively engage with mobile banking, digital payments, and online savings platforms, they are better equipped to manage

household finances, invest in small businesses, and make autonomous economic decisions. This helps to enhance their confidence and decrease their dependency on informal or male-dominated networks. In many contexts, mobility and traditional banking access are limited for rural women; in these cases, digital financial literacy plays a significant role by bridging structural gaps and fostering greater inclusion (Chamboko et al., 2018). Additionally, when women are encouraged to participate fully in the digital economy, it directly and positively affects economic and social autonomy, shifting gender dynamics and nurturing equitable development outcomes (Jayachandran, 2021).

The financial exclusion of women in a developing economy originates from various socio-cultural, structural, gender, and digital barriers (Banerjee et al., 2011; Jayachandran, 2021). Particularly, gender roles and societal norms act as two substantial hurdles for women's physical mobility, restraint their financial autonomy at the household level and often keeping them tied to household responsibilities. Consequently, they are often forced to stay out of the labour force (Doepke et al., 2022). These constraints are further augmented by digital inequities, i.e., low levels of digital literacy, limited ownership of smartphones, and unaffordable data services, which restrict women's ability to engage with emerging financial technologies. As a result, despite the rapid expansion of mobile money services like JazzCash and Easypaisa, women remain markedly underrepresented among active users of digital financial platforms (GSMA & Karandaaz, 2022; State Bank of Pakistan, 2022). This exclusion is not merely symbolic; it carries tangible economic implications. Women's limited access to financial tools undermines their capacity to manage money independently, invest in microenterprises, or build financial resilience, ultimately reinforcing patterns of economic dependency on male family members for routine transactions (Anderson et al, 2021; Showkat et al, 2025).

Despite persistent barriers, the potential of digital financial services to advance women's economic empowerment is considerable in LMICs. Mobile-based financial platforms have expanded rapidly in recent years, with over 50 million mobile wallet accounts registered as of 2023 (Pakistan Telecommunication Authority, 2023). The introduction of Raast, Pakistan's instant digital payment system launched by the State Bank of Pakistan, signals a significant policy commitment to payment digitization and financial inclusion (State Bank of Pakistan, 2023). In parallel, major social protection initiatives such as the Benazir Income Support Program (BISP) and Ehsaas Kafalat have increasingly adopted digital payment mechanisms for cash transfers, offering a direct interface between women and the formal financial system (Government of Pakistan, 2023). However, these innovations risk reinforcing existing inequalities without targeted efforts to enhance women's digital literacy, strengthen their financial capabilities, and ensure access to enabling technologies. In the absence of inclusive design and targeted support, the promise of digital financial inclusion may remain elusive for the women these reforms seek to empower (Duflo, 2012; Krause et al., 2016).

The study was conducted in rural regions of Punjab province, Pakistan, targeting low-income women between the ages of 20 and 40. Participants were randomly assigned to one of three groups: a control group with no intervention; a first treatment group that received digital financial literacy training; and a second treatment group that received the same training along with joint sessions involving male household members, such as husbands, fathers, or brothers. These joint sessions were designed to challenge restrictive gender norms and foster more equitable household financial decision-making. The study's primary outcomes capture

immediate changes in women's financial capabilities and behaviours following the intervention. These included improved digital financial literacy, frequency and types of mobile wallet transactions, increased confidence in digital financial tools, and enhanced personal savings and budgeting practices. The intervention also aimed to strengthen women's financial self-efficacy by equipping them with the skills and confidence to manage their finances independently. At the same time, secondary outcomes explored broader shifts in women's economic empowerment and agency. These included habitual engagement with digital financial tools, greater autonomy in household-level financial decisions, heightened trust and awareness of security in digital transactions, and improved perceptions of financial well-being. Together, these measures offer a comprehensive view of digital financial inclusion's immediate and longer-term effects on women's economic lives.

According to the World Bank Global Findex (2025), only 7% of rural women in Pakistan have access to a formal financial account, compared to 21% of urban women and 34% of men overall. There are many reasons behind these disparities, including but not limited to deep-rooted structural constraints, i.e., gender/social norms, limited financial literacy, and physical mobility. Therefore, in our study, targeting rural women is not only an effort to tackle these persistent inequalities, but also to bring these issues at the policy front, for example, in the recent years, various national strategies and programs, including the State Bank of Pakistan's Banking on Equality framework and the updated National Financial Inclusion Strategy have advocated the women's financial inclusion as a pathway to broader economic empowerment and household resilience. The present study also generates rigorous evidence to guide gender-responsive financial policies in Pakistan and similar economies by rigorously evaluating a scalable, tech-enabled intervention in rural regions.

This study adds to the expanding body of research on financial inclusion, digital public infrastructure, and gender empowerment in LMICs. While prior work has highlighted the role of financial literacy and access to savings in enhancing household welfare, limited attention has been paid to how digital financial literacy can be tailored to the unique challenges faced by women in patriarchal and resource-constrained settings such as Pakistani society. Moreover, most financial literacy interventions emphasize content delivery over practical engagement, often failing to account for the digital access barriers, trust deficits, and behavioural frictions that hinder women's adoption of financial technologies. By integrating information provision with hands-on support and confidence-building measures, this randomized controlled trial offers robust evidence on effective strategies for converting digital access into tangible financial empowerment for women. Another distinguishing feature of this study is the inclusion of a male household member in the intervention process, which helped foster household-level support, reduce potential resistance, and enhance the overall uptake and sustainability of women's financial engagement.

Methodologically, this randomized controlled trial enables the identification of the causal effects of digital financial literacy interventions on both short-term financial behaviours and longer-term indicators of women's economic empowerment. Including two distinct treatment arms allows for a disaggregated analysis of intervention components, separating the impact of digital training and hands-on support from the added influence of involving male household members. This design facilitates an exploration of how intra-household gender dynamics may reinforce or hinder financial behaviour change. Outcome data are collected through structured surveys administered to participants at baseline and follow-up, ensuring consistency in measurement across treatment and control groups. The study also incorporates in-depth qualitative interviews to complement the quantitative analysis, capturing women's experiences

with digital financial tools. These narratives provide essential context to understand behavioural responses, perceived barriers, and the underlying mechanisms driving change.

This study addresses a critical evidence gap at the intersection of technology, gender, and economic development. Approximately 90% of women in Pakistan remain outside the formal financial system. Expanding access to and effective use of digital financial tools holds the potential for far-reaching impact for individual women, their households, and the broader economy. By rigorously evaluating a scalable, locally grounded model for building women's digital financial capabilities, this research aims to generate actionable insights for policymakers and practitioners. The findings are intended to inform the design of inclusive financial strategies and contribute to developing a more equitable and accessible financial system in Pakistan.

Overall, the present study intends to make three contributions. First, it provides new and robust causal evidence on the effectiveness of digital financial literacy interventions for women in a low-income, patriarchal setting. Second, it introduces a novel experimental design that isolates the role of male household participation in shaping women's financial outcomes. Third, it contributes to broader debates on how digital financial infrastructure can be inclusive through targeted, gender-responsive program design. These findings directly affect policymakers and development practitioners promoting equitable digital finance in South Asia and beyond.

The results show that digital financial literacy training significantly improved women's financial knowledge, digital confidence, and budgeting practices. It also increased the use of mobile wallets and formal savings platforms. Notably, when male household members were included in the training, women reported greater financial autonomy and shared decision-making within households. These effects suggest that intra-household engagement can increase the impact of financial capability programs by reducing social frictions and reinforcing support for behavioural change.

The implications of this study extend well beyond Pakistan and are directly relevant to a broader set of low-income and developing countries that face parallel challenges in promoting gender-equitable access to digital financial services. In many such settings, particularly across South Asia and Sub-Saharan Africa, women remain disproportionately excluded from formal financial systems due to similar combinations of social norms, limited digital literacy, and infrastructural deficits. By experimentally isolating the impact of targeted digital training, hands-on support, and male household engagement, this study offers a scalable and evidence-based framework for improving women's financial inclusion in constrained environments. As countries across South Asia and Sub-Saharan Africa scale up investments in digital finance, the insights from the present study can inform the design of inclusive policies that prioritise access and meaningful and sustained use of digital finance among marginalised populations, i.e., rural women.

The study is organised as follows: Section 2 presents the theoretical framework; Section three demonstrates the empirical literature on digital financial literacy. Sections four, five, six, and seven discuss the methods, empirical findings, discussions, strengths, and limitations of the study. Finally, the last two sections highlight the policy insights and future research directions.

2. Theoretical Framework

This study is grounded in three interrelated economic and behavioural theory strands to explain how digital financial literacy interventions affect women's financial behaviour and empowerment in low-resource, gender-constrained environments. These include: (1) intra-household bargaining theory and financial inclusion models, (2) behavioural economics and

financial capability frameworks, and (3) social norms theory, especially as it relates to gendered constraints. These perspectives inform the intervention's design and shape the theory of change and testable hypotheses.

Standard economic models suggest that access to financial services improves individual welfare by enabling consumption smoothing, encouraging savings and investment, and reducing vulnerability to economic shocks. Within the framework of collective household models (Chiappori, 1988; Browning & Chiappori, 1998), individual household members make decisions based on their relative bargaining power, which is partly determined by control over resources.

In contexts where women gain control of income or financial tools, there is robust evidence that household spending patterns shift toward investments in children's health and education (Duflo, 2003; Ashraf, 2009). However, merely granting access, such as to mobile money accounts, is often insufficient. In patriarchal settings like rural Pakistan, women frequently lack the necessary literacy, confidence, or autonomy to use these tools effectively. This gap between ownership and use underscores the need for capability-building interventions that address technical and social barriers.

Our intervention builds on this theoretical foundation by providing women with digital financial literacy training to enhance their understanding, skills, and confidence in using mobile-based financial services. A key proposition of our theory of change is that such training increases women's effective engagement with digital accounts and, over time, their influence over household financial decisions. As women demonstrate competence and contribute more actively to household financial management, we expect a corresponding improvement in their bargaining power and decision-making agency.

From this framework, we derive the following hypothesis:

- **H1:** Digital financial literacy training increases women's likelihood of owning and actively using digital financial accounts (e.g., JazzCash, Easypaisa, Raast).

Building on insights from behavioural economics, we recognize that informational access alone may not translate into behaviour change. Low-income individuals, particularly women in rural settings, often face cognitive and psychological frictions, such as low self-efficacy, mistrust in institutions, and inertia, that inhibit the use of even beneficial financial services (Banerjee & Mullainathan, 2010; Karlan et al., 2016). These challenges are particularly pronounced in digital contexts, where interacting with unfamiliar interfaces, security protocols, and perceived risks creates high entry barriers.

The financial capability framework (Xiao & O'Neill, 2016) suggests that effective financial engagement requires knowledge, skills, confidence, and behavioural readiness. Our approach emphasizes experiential learning, "learning by doing," to overcome cognitive frictions. Women are guided through mobile transactions, PIN creation, balance checking, and budgeting activities, reducing the mental costs of adoption and enforcing consistent, long-term engagement with digital tools.

We hypothesize that this capability-focused design improves financial behaviours beyond access:

- **H2:** Hands-on support (e.g., onboarding assistance, troubleshooting apps) leads to higher usage of digital financial services compared to information-only interventions.

- **H3:** An increase in financial literacy is associated with a higher level of self-reported financial confidence, planning behaviour, and trust in digital financial systems.

We anticipate these shifts in confidence and behaviour to generate spillover effects, including more consistent saving practices, increased frequency of digital transactions, and more proactive financial planning.

In addition to capability constraints, gendered social norms often limit women's economic agency. In patriarchal contexts, expectations about male financial dominance and female (supporting hypothesis 1) are deeply embedded, shaping who can access and use financial services (Bicchieri, 2006; Mackie et al., 2015). These norms create reputational, relational, and even physical costs for women who attempt to exercise financial autonomy, especially when it challenges household hierarchies.

To address these social frictions, our intervention includes a treatment arm that involves male household members, typically a husband, brother, or father, in the financial literacy training. The rationale is grounded in growing empirical evidence showing that joint participation in development interventions can reduce norm-based resistance and improve outcomes for women. When men and women acquire financial knowledge, mutual respect, shared goals, and more equitable decision-making may be fostered.

We hypothesize that such joint exposure facilitates norm shifts and improves the enabling environment for women's financial engagement:

- **H4:** When male household members are engaged in training, intra-household financial frictions decrease, leading to higher adoption and usage of digital financial tools by women.

Finally, we theorize that improved access, reduced behavioural frictions, and stronger intra-household cooperation will drive progress towards the broader measures of women's economic empowerment. As women begin to manage financial transactions, participate in household budgeting, and exercise greater control over income, they may experience increased agency, mobility, and decision-making authority.

- **H5:** Increased digital financial inclusion improves women's economic empowerment, including greater control over financial decisions and increased contribution to household finances.

By integrating intra-household bargaining theory, behavioural economics, and social norms frameworks, this study articulates a comprehensive causal pathway for how and why digital financial literacy interventions might shift women's financial behaviours and empowerment outcomes. Including individual and joint training arms allows us to test whether enhancing financial capability alone is sufficient or whether shifting household norms is necessary for sustained transformation. This theoretical model guides the experimental design, informs our hypotheses, and provides a foundation for interpreting causal impacts observed across treatment arms. Figure 1 sums up the theoretical framework.

3. Empirical Literature

In recent years, the intersection of financial literacy, digital technologies, and women's economic empowerment has attracted growing academic and policy attention. As availability and access to digital financial services increase globally, they offer new avenues for women, particularly in the case of developing economies. Women are able to access various essential services, for instance, access to the formal financial system, and manage resources, which in

turn enhance women's economic empowerment at the household level. However, in order to obtain the maximum benefits from these services is strongly dependent on the traditional and digital financial literacy levels. It is a well-established idea that women who do not have access to essential knowledge and skills often remain excluded from the formal economy and cannot use various digital tools and services for savings, credit and budgeting and entrepreneurship.

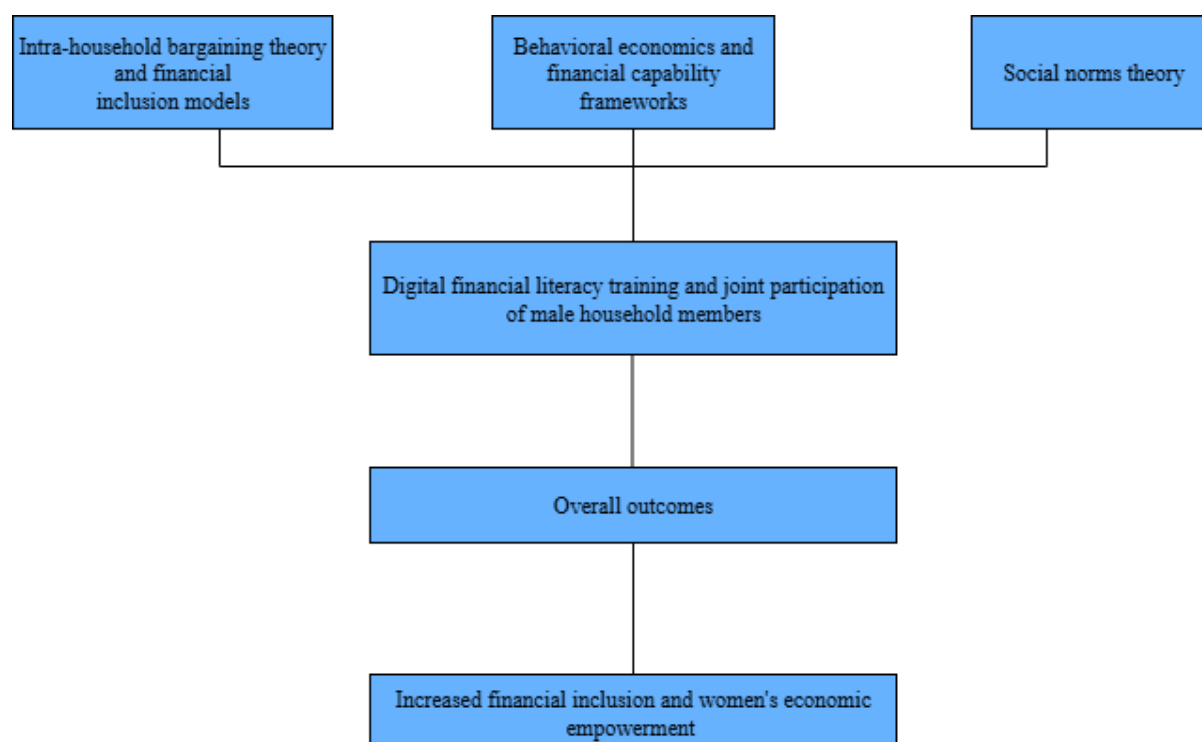


Figure 1: Theoretical Framework at a Glance

Through a randomised controlled trial, Koomson et al. (2020) have assessed the impact of digital financial training on financial inclusion in Ghana. The study concluded that female beneficiaries of financial literacy training are more likely to own a bank account and save more as compared to the control group. The study highlighted the need for initiating financial training programs at the national level to close gender gaps. On the same lines, Koomson et al. (2021) have conducted a randomised control trial in the case of the Ghanaian economy and demonstrated the interconnection between financial literacy and household consumption. The study has applied two econometrics techniques to explore further this issue, i.e., the instrumental variable approach and the difference in difference method. The study concluded that financial literacy training enhances women's economic empowerment and thus leads towards higher and smooth household consumption. The research also illustrates that specific and targeted interventions related to financial literacy empower women and bring a substantial increase in household welfare. Therefore, it is necessary to initiate gender focused programs to achieve sustainable development goals.

Meherali et al. (2021) also conducted a systematic review to examine whether digital literacy empowers adolescent girls in LMICs. Analysing evidence from multiple studies, the review finds that digital literacy improves girls' access to information, educational opportunities, and social networks, contributing to enhanced self-confidence and agency. However, the study also points out significant barriers such as gender norms, limited internet access, and digital skills gaps that constrain the full potential of digital literacy. The review underscores the need for

context-specific interventions that effectively address these challenges to empower adolescent girls through digital tools. Mabrouk et al. (2023) explored the role of digital financial inclusion on women's empowerment before and after the COVID-19 pandemic for the Indian economy. The study utilised data from the Global Financial Inclusion database for four years' time frame (2017-2021). As per the study outcomes, the women experienced more financial inclusion after the pandemic, which is directly connected with economic empowerment. Similarly, Esmailpour Moghadam and Karami (2023) also highlighted that financial inclusion through fintech is positively interconnected with women's economic empowerment for the sample of 113 economies.

Rahayu et al. (2023) demonstrated the interconnection between financial literacy and digital financial literacy and women's economic empowerment in Indonesia. The study collected data from 259 women respondents and applied structural equation modelling. According to the empirical outcomes, financial literacy and digital financial literacy are positively interconnected with women's economic empowerment in Indonesia. However, digital financial literacy has a relatively more substantial influence on women's economic empowerment. The findings of the study also demonstrated that policy practitioners must initiate various policies and programs focusing on digital financial literacy for women in developing economies. Empirical studies on women entrepreneurs further validate the empowering potential of digital financial literacy in LMICs. Hasan et al. (2023) examine the role of digital financial literacy in promoting financial inclusion among women entrepreneurs using survey data from 500 female business owners. The study assesses how digital literacy influences access to financial services such as loans, savings, and digital payments. The empirical outcomes show that higher digital financial literacy significantly improves women entrepreneurs' ability to access and effectively use formal financial products, enhancing their business growth and economic empowerment. Further, the study highlights the importance of integrating digital literacy training into financial inclusion policies to address gender gaps in entrepreneurship.

In another interesting study, Heath and Riley (2024) illustrated the benefits of greater use of digital technology for women. The study has included 750 women in an RCT conducted in Tanzania. The empirical findings suggest that access to and use of digital financial technology have significantly increased women's empowerment at the household level in Tanzania. Mishra et al. (2024) have revealed the pathways through which digital financial literacy enhances women's economic empowerment in a developing economy. Three hundred seventy-five women are included in this study. In order to explain these pathways, the study has included various variables, i.e., use and access to banking apps, gender norms and perceived behaviours. The study concluded that digital financial literacy is significantly connected with women's economic empowerment in India. Showkat et al. (2024) demonstrated that digital financial services are playing an essential role in breaking the traditional barriers to financial access. The study has used partial least squares structural equation modelling and gathered data from 429 women from North India. The study inferred that there is a favourable connotation between access and use of financial services and women's financial autonomy at the household level.

Showkat et al. (2025) described the connotation between financial literacy and women's economic empowerment. The empirical outcomes of the research demonstrated that financial literacy is one of the most pertinent factors to enhance women's empowerment. Financial literacy helped women through various channels. Women are able to make financial decisions independently and decide about savings and budgeting in an efficient manner. In addition, they

do not depend on male members of the household for financial needs. Rohatgi and Gera (2025) elaborated on the impact of digital banking services on women's economic autonomy at the household level in the case of the Indian economy. The study collected data from 750 women entrepreneurs in the urban region. To obtain the empirical estimates, the study has taken aid of advanced econometrics approaches, including structural equation modelling. The study has underscored the connotation between digital banking app use and women's economic empowerment, i.e., income control and financial decision-making autonomy, at the household level. According to the empirical findings, the use of digital banking apps is significantly and positively interconnected with women's economic empowerment. These apps give increased access to financial resources, reducing the transaction costs as well as improving women's financial independence. Therefore, the study concluded that it is a need of the hour to expand digital banking infrastructure and tailor financial production exclusively for women in developing economies.

Desai et al. (2025) assess the impact of business training on improving digital financial literacy among low-income women entrepreneurs through a field experiment in India. Using a randomised controlled trial design, the study measures changes in digital financial skills, business practices, and economic outcomes before and after the intervention. The study finds that business training significantly enhances digital financial literacy, enabling women to utilise better digital financial services for business transactions and financial management. This improvement leads to increased business performance and greater economic empowerment. The research highlights the importance of integrating digital financial literacy into entrepreneurship programs to support women's economic empowerment. Kumari et al. (2025) also explained the interplay between the gender based digital financial inclusion and women empowerment, and poverty reduction in selected Asian economies. The study has taken aid from panel data econometrics techniques and has presented the analysis for the time frame 2011 to 2023. According to the study outcomes, there is a positive and significant association between gender-based digital financial inclusion and women's economic empowerment and poverty reduction in the Asian region. Riley and Shonchoy (2025) also demonstrated that the adoption of digital technologies helps households to manage financial crises and loan payments.

While a growing body of research has established positive associations between financial literacy, digital capability, and women's economic empowerment across various low- and middle-income countries, critical evidence gaps remain. First, a large body of the existing literature in these economies relies on non-experimental designs, which constrain the ability to identify the causal impact of digital financial literacy interventions. Second, few studies disentangle the relative importance of digital skills versus intra-household dynamics, such as gender norms and resistance from male household members, in shaping women's financial behaviours and outcomes. Moreover, prior research often overlooks the nuanced barriers women face within the household, particularly in conservative settings where gender norms strongly shape decision-making power. There is limited understanding of whether involving male family members (e.g., husbands, brothers, fathers) in financial literacy efforts can reduce resistance, enhance support, and promote sustained use of digital financial services. This intersection of digital literacy, household gender dynamics, and behavioural change remains underexplored in academic and policy literature.

Therefore, this study contributes to closing these gaps by implementing a randomised controlled trial (RCT) in rural Pakistan. It rigorously evaluates the standalone impact of digital financial literacy training and the added effect of engaging male household members in joint sessions. The study provides causal insights into how digital knowledge can enhance women's financial inclusion and economic empowerment when paired with norm-sensitive delivery in low-resource settings.

4. Methods

4.1. Study Design

The study employs a randomised controlled trial (RCT) design to rigorously evaluate the impact of digital financial literacy interventions on women's financial behaviours, economic empowerment, and household welfare in Pakistan. The intervention targets 300 women (who have access to a mobile phone but have not received any formal financial literacy training) from low- and middle-income households, aged 20 to 40, residing in two villages located in Tehsil Gujar Khan, District Rawalpindi, Punjab. The sample was equally drawn from both villages. These villages were selected based on their demographic suitability (high proportion of low-income households) and low baseline levels of digital and financial service usage among women.

The randomised controlled trial includes two treatment interventions designed to address barriers to women's financial inclusion and empowerment. The first intervention (Treatment Group 1) provides participants with structured digital financial literacy training to improve their understanding of core financial concepts such as budgeting, saving, and managing digital payments. This training is complemented by hands-on support to help women open digital accounts, navigate mobile financial platforms, and conduct basic transactions, such as sending money, paying bills, and checking balances. The sessions are delivered in local languages (Pothohari and Urdu) using interactive tools and contextual examples to ensure accessibility and comprehension for low-literacy participants.

The second intervention (Treatment Group 2) builds on the same training and hands-on support. However, it introduces an additional component: joint engagement with a male household member, such as a husband, brother, or father. These joint sessions aim to address restrictive gender norms that often limit women's financial decision-making power by fostering open dialogue, encouraging shared financial responsibilities, and promoting greater acceptance of women's use of digital financial tools. Including male members is designed to reduce intra-household resistance, build social support, and enhance the sustainability of behavioural change. Both treatment groups receive follow-up assistance and reminders to reinforce training content and encourage continued use of digital financial services. A third group, the control group, does not receive any intervention during the study period but is included in a waitlist to receive the digital financial literacy training after the endline survey is completed.

Training and support sessions are delivered by trained facilitators in Pothohari and Urdu, depending on participant preference. Sessions are scheduled in consultation with participants to ensure high attendance and minimise attrition. In addition to baseline and end-line surveys, the study includes a qualitative component comprising in-depth interviews with a sub-sample of participants to capture lived experiences, perceived barriers, and pathways of change.

The intervention consists of a six-week digital financial literacy program delivered primarily through in-person group sessions, supported by SMS reminders, printed learning materials, and

optional follow-ups via WhatsApp messages, voice notes, and mobile calls. The training covers essential topics such as mobile money usage, digital wallet use, budgeting and saving practices, responsible financial decision-making, and online fraud prevention. In Treatment Group 1 (T1), women receive the training and hands-on support to open digital accounts and complete basic financial transactions. In Treatment Group 2 (T2), participants receive the same training and support as T1 and additional joint sessions involving a male household member (e.g., husband, father, or brother). These joint sessions are designed to promote shared financial decision-making and address restrictive gender norms that may limit women's autonomy in financial matters. The study uses a mixed-methods approach combining structured surveys, qualitative interviews, and, where feasible, mobile transaction data. Ethical considerations, including informed consent and data privacy protections, are strictly followed to ensure participant safety. The study is registered on the Open Science Framework. The registration includes a study protocol, RCT design, and planned analysis.

4.1.1. Recruitment

We have recruited participants from two selected villages within Tehsil Gujar Khan, District Rawalpindi, Punjab province. These villages were selected due to their combination of basic digital connectivity, high levels of financial exclusion, and the presence of underserved women who have limited access to formal financial education and services. Eligible participants are women aged 20 to 40 who reside in the selected villages, have personal access to a mobile phone, and have not previously received structured digital financial literacy training. Recruitment prioritises women from low- and middle-income households, particularly those facing financial inclusion barriers, such as limited education, restricted mobility, or no formal bank account. To ensure accessibility and cultural appropriateness, the study's purpose and procedures are explained using Pothohari and Urdu materials tailored to local literacy levels. Informed consent is obtained in writing or by audio recordings when literacy is a constraint. Small group community meetings are organised to raise awareness and build trust with potential participants. Based on predefined eligibility criteria, 300 women were recruited, with careful attention to ensuring diversity in age, marital status, education levels, and digital access.

4.2. Intervention

The intervention is a structured digital financial literacy training program to enhance women's knowledge, confidence, and behaviours related to digital financial services. It targets key capability gaps common among women from disadvantaged backgrounds from rural areas, such as limited digital familiarity, underdeveloped budgeting and saving practices, and low uptake of mobile banking tools. The curriculum has been culturally adapted for rural Pakistan. It is delivered primarily through low-tech, mobile-friendly channels to ensure accessibility and scalability across diverse literacy and digital access levels.

The six-week digital financial literacy training is delivered through short, mobile-based modules utilising WhatsApp voice notes, culturally contextual videos in Urdu and Pothohari, SMS reminders, and interactive quizzes. This multimodal approach ensures accessibility across varying literacy levels and digital capabilities. For participants with a low literacy level, in-person support sessions are held to supplement remote learning. The curriculum is structured to build both foundational knowledge and practical skills in a progressive sequence. In Week 1, participants are introduced to financial planning and budgeting basics, focusing on income tracking and expense management. Week 2 emphasises saving strategies, financial goal-setting, and the formation of consistent saving habits. In week 3, the training covers mobile

wallets and branchless banking tools to promote familiarity and adoption of digital financial platforms. Week 4 shifts focus to digital security and online fraud prevention, equipping participants with the knowledge to use financial technologies safely. Week 5 provides hands-on training in mobile transactions, including money transfers, bill payments, and saving via digital wallets. Finally, week 6 consolidates the learning by reviewing key concepts, revisiting individual financial goals, and addressing remaining knowledge gaps to encourage sustained use and retention of digital financial practices. All participants complete a comprehensive baseline survey before random assignment.

Participants assigned to treatment group 1 (T1) receive this core digital financial literacy training and hands-on support for setting up mobile wallets, practising digital transactions, and using mobile banking services effectively. Participants in treatment group 2 (T2) receive the same training and support as T1. However, they are also encouraged and required to complete selected modules jointly with a male household member, such as a husband, brother, or father. These joint sessions aim to build shared understanding, reduce intra-household resistance, and promote cooperative financial decision-making. Participants assigned to the control group (T0) do not receive any training during the intervention period. Nonetheless, they will be offered access to the full training program after endline data collection, consistent with a waitlist control design.

4.3.Outcomes Measures

This study evaluates both primary and secondary outcomes to understand the effectiveness of the digital financial literacy intervention. Outcomes are designed to reflect individual-level behaviour change and broader shifts in household-level financial dynamics, aligned with global financial capability frameworks (e.g., OECD/INFE, World Bank Findex).

4.3.1. Primary Outcomes

Primary outcomes capture direct, short-term changes in women's financial knowledge, confidence, and behaviour. These include:

Digital Financial Literacy Index: A composite score from 15–20 multiple-choice and scenario-based questions covering budgeting, saving, interest, mobile banking, and online fraud prevention. Scores range from 0 to 100, with higher scores indicating stronger financial knowledge and lower scores (below 40) suggesting financial vulnerability.

Use of Digital Financial Services: Assessed through self-reported and, where possible, verified usage of digital wallets, including frequency of transactions such as bill payments, money transfers, and mobile savings deposits.

Savings and Budgeting Practices Index: This composite score (0 to 3) captures key financial behaviours, including maintaining a budget, saving regularly, and the mode of saving—whether informal or through a formal financial institution. Higher scores indicate greater financial discipline and formal engagement.

Digital Confidence Scale: This 10-item self-efficacy scale, rated on a 5-point Likert scale (1–5), measures participants' comfort with performing digital tasks such as using apps, sending money, and identifying secure platforms. Total scores range from 10 to 50, and higher scores reflect increased digital independence.

Financial Self-Efficacy Scale: A 5-item scale evaluating self-efficacy in managing financial responsibilities, including expense tracking, future planning, and independent decision-making. Scores range from 5 to 25 and reflect internalised financial control.

4.3.2. Secondary Outcomes

Secondary outcomes examine broader effects of the intervention on women's economic agency and household-level dynamics:

Digital Financial Behaviour Index: It tracks actual usage of digital financial tools based on four key behaviours: opening a mobile wallet, making a digital payment, sending and receiving remittances, and using a budgeting app. Each action is coded (1 = yes, 0 = no), with the final score normalised to a 0–100 scale. Scores above 60 indicate sustained usage, reflecting a stable pattern of usage over time.

Intra-household Financial Autonomy: It evaluates women's decision-making power using two indicators: (1) who decides how their income is spent (coded 0 = others, 1 = joint, 2 = herself), and (2) whether they can make large purchases without permission (Yes = 1, No = 0). A total score of 0–2 reflects the degree of financial agency, whereas values close to 2 indicate greater financial autonomy.

Trust and Security in Digital Transactions: It combines a Likert-based measure of trust in mobile financial platforms (1–5 scale) with a 5-point knowledge test on online fraud prevention practices (e.g., OTP usage, phishing awareness). The composite score (0–10) reflects informed and secure digital behaviour, whereas a higher score reveals greater trust and informed and secure digital behaviour.

Perceived Financial Well-being: It captures subjective assessments of financial stress, emergency preparedness, and confidence in handling economic shocks, especially about health expenses or income interruptions. The score ranges from 1 (the lowest) to 5 (the highest level of confidence and financial well-being)

Figure 2 presents the primary and secondary outcomes of the intervention.

4.4. Data Collection and Management

Data for this study were collected in three waves: a baseline survey (pre-intervention), a short midline survey (during implementation), and an endline survey conducted approximately six months post-intervention. The baseline survey captures comprehensive information on participants' demographic characteristics, baseline financial literacy, digital access, mobile phone use, existing engagement with financial services, saving and spending behaviours, intra-household decision-making dynamics, and attitudes toward financial risk and autonomy.

The endline survey measures primary and secondary outcomes, including changes in digital financial literacy, adoption of mobile financial tools, shifts in budgeting and savings behaviours, self-reported financial confidence, and markers of women's economic empowerment and intra-household financial agency. A brief midline survey is conducted midway through the training to monitor engagement, assess implementation fidelity, and capture early behavioural changes.

All surveys are conducted in person and via WhatsApp by trained female enumerators using digital tablets equipped with secure survey software. To ensure inclusivity for women with low

literacy, surveys are administered in Urdu and Pothohari. Sensitive modules measuring financial control, household dynamics, or autonomy are administered via audio-assisted self-interviews (AASI) to minimise social desirability bias and improve response accuracy.

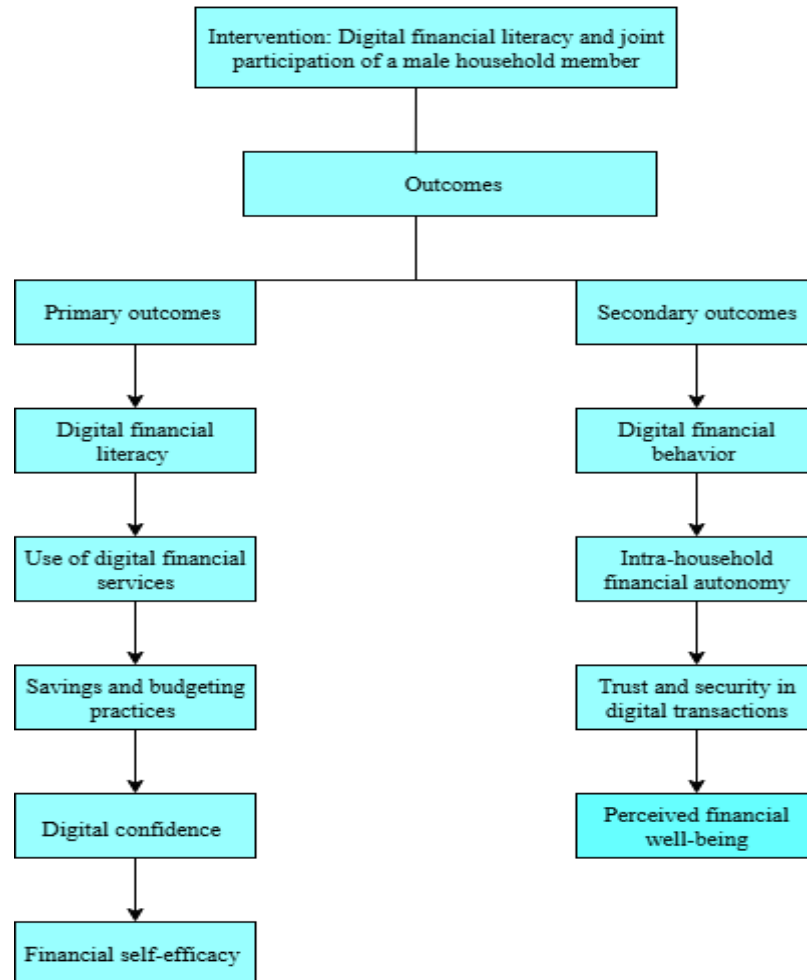


Figure 2: Primary and Secondary Outcomes

4.5. Sample Size Calculations and Statistical Analysis

This randomised controlled trial enrolled 300 women from the two villages in the district of Rawalpindi in Punjab province. Participants are randomly assigned to three groups: a Control Group (T0), Treatment Group 1 (T1, women-only digital financial literacy training), and Treatment Group 2 (T2, joint training with a male household member), with 100 participants per group. The selected sample size enhances the study's statistical power to detect more nuanced differences across treatment arms.

Sample size calculations were conducted using standard power analysis techniques, targeting a minimum detectable effect size (MDES) of 0.35 standard deviations for primary outcomes, such as digital financial literacy scores and actual use of mobile financial services. With 80% statistical power, a significance level (alpha) of 0.05, and allowing for 10–15% attrition, a total sample of 300 ensures sufficient power to detect treatment effects and conduct meaningful

subgroup analysis. These estimates are informed by effect sizes observed in previous financial literacy interventions in South Asia and account for design effects from village-level clustering.

We employ an Intention-to-Treat (ITT) estimation strategy to evaluate the causal impact of the interventions, preserving the benefits of random assignment regardless of participants' compliance with their assigned treatment. This approach estimates the average treatment effect on the full sample assigned to each group, thereby avoiding potential biases arising from selective treatment uptake. We begin by computing group-wise mean outcomes across the control group, Treatment 1, and Treatment 2. These mean differences are then used to estimate treatment effects: specifically, the difference between Treatment 1 and control, Treatment 2 and control, and the comparative effect between the two treatments ($T1-T2$). To formally test the significance of these differences and account for sampling variability, we use ordinary least squares (OLS) regression with treatment indicators included as covariates. This method is standard in randomised evaluations with continuous outcome variables and multiple treatment arms, and facilitates clear interpretation of program impacts within a policy-relevant framework.

4.6. Attrition and Retention Strategies

Minimising attrition and maintaining high follow-up rates are critical to the internal validity of the randomised controlled trials. Given the rural and low-resource setting, a comprehensive, context-sensitive strategy was implemented to promote participant engagement throughout the intervention and follow-up period. All participants received a clear orientation on the study timeline, intervention structure, and expected participation requirements at enrolment. The informed consent process emphasised the voluntary nature, confidentiality, and the potential benefits of acquiring digital financial skills. Participants were informed that the training, particularly for the control group, will be available after the study period, reinforcing community goodwill and trust.

To sustain engagement, participants in both treatment arms received weekly SMS and WhatsApp reminders and motivational messages, delivered in Urdu and Pothohari. These messages reinforced the core content of the training modules while serving as behavioural nudges to maintain momentum. Mobile-based communication minimised physical and logistical barriers, enabling women to participate without leaving their homes or disrupting domestic responsibilities. Additionally, the participants were provided with a fixed monetary compensation if they completed the whole training program and participated in all the surveys.

In-person support sessions were organised at centrally located village sites for participants with limited digital literacy or unstable connectivity. These sessions provided hands-on technical assistance, reinforced key messages, and helped reduce the risk of disengagement due to usability challenges. The study carefully monitored attrition rates across treatment and control groups. Together, these layered strategies aim to ensure high follow-up rates, reduce selection bias, and enhance the credibility of causal inference in this study. Figure 3 presents the CONSORT flow diagram outlining the details related to the participants in our RCT.

5. Descriptive Statistics

Table 1 presents baseline characteristics for the control and two treatment groups across various demographic, socioeconomic, and outcome-related variables. The analysis confirms that randomisation successfully provided statistically comparable groups prior to intervention. All p-values are derived from ANOVA F-tests, and none indicate significant differences at the 10 per cent level, underscoring baseline balance across arms.

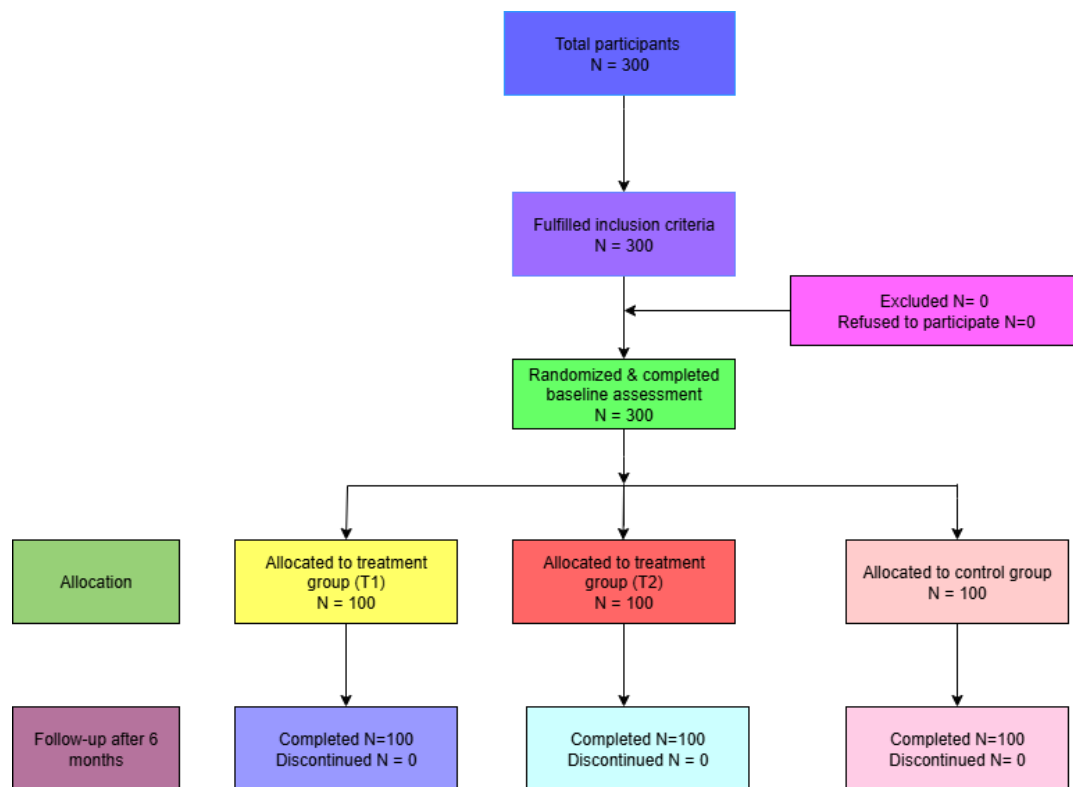


Figure 3: Flow Diagram of RCT

Participants had an average age of approximately 30 years across groups, with no notable variation ($p = 0.42$). Additionally, years of formal education also showed consistency, averaging 10 years across groups ($p = 0.51$). The proportion of married respondents was stable across arms, ranging from 72% to 75% ($p = 0.62$), and household size averaged between 6.2 and 6.4 individuals ($p = 0.46$). Average monthly household income ranged narrowly from PKR 50,000 to 51,000, with a pooled mean of PKR 51,708 ($p = 0.51$).

Baseline values of the primary outcomes similarly showed no significant differences. The digital financial literacy index (0–100 scale) ranged from 35.05 to 36.28 ($p = 0.32$), and the usage of digital financial services remained low across all groups, averaging 18.3% ($p = 0.34$). Budgeting and saving practices, measured on a 0–3 scale, and digital confidence, measured on a 10–50 scale, also remained statistically comparable across groups ($p = 0.27$ and $p = 0.26$, respectively). The financial self-efficacy scale (5–25) yielded similar average scores across arms ($p = 0.39$).

For secondary outcomes, no significant differences emerged at baseline. The digital financial behaviour index (0–100) averaged around 45 ($p = 0.37$), and intra-household financial autonomy (0–2) was uniformly low ($p = 0.41$). Measures of trust and security in digital transactions (0–10 scale) and perceived financial well-being (1–5 scale) did not significantly differ across groups ($p = 0.33$ and $p = 0.41$, respectively).

The absence of statistically significant differences in any baseline characteristics suggests that the randomisation process was effective and that any post-intervention outcome differences can be plausibly attributed to the treatment interventions rather than pre-existing group disparities.

Table 1. Descriptive statistics

Variable	Control group	Treatment 1	Treatment 2	Total sample	P values
Age (years)	30.02 (4.34)	30.09 (4.09)	30.50 (4.98)	31.06 (4.01)	0.42
Education (years)	10.01 (4.12)	10.08 (4.02)	10.07 (4.65)	10.98 (4.01)	0.51
Married	72%	73%	75%	73.09%	0.62
Household size	6.2 (1.6)	6.4 (1.8)	6.3 (1.10)	6.2 (1.76)	0.46
Average monthly household income	50,000 (8,099)	50,500 (8,358)	51,000 (8,900)	51,708 (8,500)	0.51
Primary outcomes					
Digital financial literacy index (0-100)	35.05 (3.81)	35.98 (3.11)	36.28 (4.72)	36.37 (3.10)	0.32
Use of Digital Financial Services (%)	18%	19%	17%	18.3%	0.34
Budgeting & Saving Practices (0–3)	0.58 (0.7)	0.56 (0.9)	0.57 (0.4)	0.58 (0.61)	0.27
Digital confidence scale (10-50)	15.98 (4.2)	15.61 (5.5)	15.11 (5.4)	15.21 (5.1)	0.26
Financial self-efficacy scale (5-25)	11.28 (3.7)	11.38 (4.6)	11.14 (4.1)	11.19 (4.7)	0.39
Secondary outcomes					
Digital financial behaviour index (0-100)	45.11 (2.29)	44.89 (3.22)	44.13 (4.09)	45.09 (3.52)	0.37
Intra-household financial autonomy (0-2)	0.25 (0.31)	0.26 (0.34)	0.26 (0.35)	0.25(0.32)	0.41
Trust and security in digital transactions (0-10)	3.76 (1.19)	3.14 (1.27)	3.99 (1.35)	3.01 (1.09)	0.33
Perceived Financial Well-being (1–5)	2.09(0.9)	2.21(1.01)	2.90(1.09)	2.06(1.16)	0.41
N	100	100	100	300	-

Note: Standard deviations in parentheses. P-values from ANOVA F-tests. No statistically significant differences ($p > 0.10$) across groups at baseline.

6. Empirical Results

Table 2 reports ITT estimates from post-treatment regressions assessing the interventions' impact on a range of primary and secondary outcomes. The regressions control for baseline values of each outcome and key demographic covariates, including age, education, and household income. Treatment 1 consists of digital financial literacy training for women, while Treatment 2 augments this intervention by incorporating joint participation of male household members.

6.1.Primary Outcomes

Both treatment arms significantly improved digital financial literacy relative to the control group. Treatment 1 led to an average increase of 21.1 points ($p < 0.01$) (confirming hypothesis 1). In comparison, Treatment 2 yielded an even larger effect of 26.9 points ($p < 0.01$), with the difference between the two treatments statistically significant at the 5% level (+5.8 points). Similar patterns emerge for digital confidence and financial self-efficacy (supporting hypothesis 3). Treatment 2 produced the most significant impacts, with increases of 15.0 and 7.0 points, respectively ($p < 0.01$), significantly outperforming Treatment 1 in each domain.

Budgeting and saving practices improved under both treatments (hypothesis 3 and 5). Participants in Treatment 1 reported an increase of 1.0 point ($p < 0.05$) on the 0–3 scale, while

Treatment 2 saw a larger improvement of 1.4 points ($p < 0.01$). However, the incremental difference between Treatment 2 and Treatment 1 was not statistically significant.

6.2.Secondary Outcomes

According to the empirical estimates, digital financial behaviour improved markedly across both treatment arms (hypothesis 2). Treatment 1 resulted in a 25.1-point increase ($p < 0.01$), and Treatment 2 produced a 32.9-point increase ($p < 0.01$), with a statistically significant gap of 7.8 points favouring the joint-participation approach ($p < 0.05$). Besides, gains in intra-household financial autonomy were also evident (hypothesis 4 and 5): Treatment 1 increased scores by 0.6 ($p < 0.10$) and Treatment 2 by 1.0 ($p < 0.05$), with the inter-treatment difference reaching significance at the 10% level.

Participants reported significantly higher trust and perceived security in digital transactions under both interventions (hypothesis 3). Treatment 2 again showed stronger effects (+4.2 points, $p < 0.01$) compared to Treatment 1 (+3.1 points, $p < 0.05$). Lastly, perceived financial well-being improved significantly in both groups (hypothesis 5), with a 1.81-point increase under Treatment 2 ($p < 0.01$) and a 1.12-point increase under Treatment 1 ($p < 0.05$), and the difference between the two treatments is significant at the 10% level.

Across all domains, both interventions provided substantial and statistically significant improvements over the control group, with the joint-participation treatment (Treatment 2) consistently outperforming the individual training (Treatment 1). These results underscore the added value of engaging male household members in digital financial training, particularly in settings where intra-household dynamics influence women's financial decision-making and access to technology.

Table 2. ITT Estimates – Impact of Digital Financial Literacy Intervention

Outcome variable	Control mean	Treatment 1 mean	Treatment 2 mean	T1 – control	T2 – control	T2 – T1	N
Primary outcomes							
Digital financial literacy index (0-100)	45.2	66.3	72.1	+21.1***	+26.9***	+5.8**	300
Digital confidence scale (10-50)	21.8	31.4	36.8	+9.6**	+15.0***	+5.4**	300
Financial self-efficacy scale (5-25)	14.3	18.7	21.3	+4.4**	+7.0***	+2.6*	300
Budgeting and Saving Practices (0–3)	0.9	1.9	2.3	+1.0**	+1.4***	+0.4	300
Secondary outcomes							
Digital financial behaviour index (0-100)	33.0	58.1	65.9	+25.1***	+32.9***	+7.8**	300
Intra-household financial autonomy (0-2)	1.2	1.8	2.2	+0.6*	+1.0**	+0.4*	300
Trust and security in digital transactions (0-10)	3.7	6.8	7.9	+3.1**	+4.2***	+1.1*	300
Perceived Financial Well-Being (1–5)	2.09	3.21	3.90	+1.12**	+1.81***	+0.69*	300

Note: Values represent ITT estimates from post-treatment regressions controlling for baseline value of the outcome and demographic covariates (age, education, household income). Treatment 1: Digital financial literacy training. Treatment 2: Digital training plus joint participation of male household members. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

6.3. Empirical Discussion

We have presented the empirical results of the RCT in Table 2. Overall, digital financial literacy training has enhanced women's economic empowerment in the context of a developing economy. The results also demonstrate that both interventions, i.e., digital financial literacy training and joint participation of women and male household members, significantly improved the major indicators of financial capability, confidence, and behaviour. However, we have observed that treatment 2 has outperformed treatment 1. This highlights that intrahousehold dynamics play an important role in improving digital financial inclusion outcomes.

As mentioned previously, both treatment arms have increased digital financial literacy significantly; nonetheless, T2 has demonstrated better outcomes. The existing literature supports the empirical findings that digital financial literacy closes the knowledge gaps among marginalised populations. The joint impacts of male members' participation also reveal the significance of household dynamics in traditional societies, where most of the time, male members control technology access at the household level, especially in rural areas (Field et al., 2016; Lubis, 2020). Furthermore, engaging males helps to overcome various gender barriers, for instance, women are more likely to use digital devices; besides, they face fewer restrictions and greater uptake and digital knowledge retention. Our results also reveal that both interventions help women to improve confidence and financial self-efficacy, particularly in T2. The empirical outcomes illustrate the significance of psychological factors in adopting digital financial technologies. Various theories in behavioural economics demonstrate that even if barriers to access are removed, low confidence acts as a hindrance for women to adopt advanced technology (Banerjee et al., 2015; Mishra et al., 2024). On the same lines, joint sessions serve as social enforcement, affirming women's participation and self-belief in the financial decision-making process (Carpena et al., 2019; Karlan et al., 2016; Showkat et al., 2025).

The observed improvements in budgeting and saving behaviours are consistent with previous studies, indicating that financial literacy programs, particularly those including behavioural components, can influence short-run financial practices (Grohmann et al., 2018). However, the lack of a statistically significant difference between Treatments 1 and 2 on this outcome suggests that household dynamics play a less critical role in these specific domains once basic skills are acquired. The most significant treatment effects are observed on the digital financial behaviour index, where Treatment 2 yields a 32.9-point gain, significantly higher than Treatment 1. This result aligns with findings from Jack et al. (2021), who show that household-level support can significantly enhance the usage of digital financial tools. In our context, male co-participation has helped to validate digital behaviour changes in conservative household environments, making financial behaviours more sustainable.

The empirical results presented in Table 2 demonstrate that treatment 2 has a significant and stronger impact on women's intra-household financial autonomy. It is also reflected in the existing literature on household bargaining that involving a male member helps to shift norms. Thus, engaging both spouses in the digital financial literacy training brings desired results and fosters more and better intra-household dynamics (Ashraf, 2009; Schaner, 2017). It also reduces any asymmetry in information and enhances joint decision-making. Moreover, both interventions have helped women to develop confidence and build trust; however, treatment 2 is far more effective as compared to treatment 1.

The existing literature demonstrates that perceived risk and mistrust are the two most pertinent barriers to adopting digital finance, especially for women (Barboni et al., 2018). Therefore, the joint participation of a male member of the household reduces the fear of digital fraud or surveillance. This is particularly relevant in those settings where women face various social risks to use mobile phones or banking apps (CGAP, 2019). Our results underscore that a significant increase in financial well-being, especially when engaging a male member of the household (treatment 2), indicates subjective benefits beyond behaviour change. The prior literature also reveals that interventions which aim at financial capability reduce financial stress and improve mental well-being. Additionally, improvements in subjective well-being may also show an improved level of intra-household communication and decreased conflict, an avenue ripe for further exploration (Haushofer & Shapiro, 2016; Hassan et al., 2021; Rahayu et al., 2023).

To sum up, the consistently higher performance of Treatment 2 supports a growing body of evidence that financial inclusion interventions are more effective when designed to accommodate social and household dynamics (Jayachandran, 2021). Programs that overlook these dynamics may fail to generate transformative outcomes, particularly in patriarchal societies. Future interventions should therefore consider joint modules or family-based designs to reinforce behavioural change and enhance impact.

7. Strengths and Limitations of the Study

This study offers several important contributions to the literature on digital financial inclusion and intra-household dynamics in the context of a developing economy. Firstly, a core strength lies in the experimental design: using a randomised controlled trial enhances internal validity and supports credible causal inference regarding the effects of digital financial literacy interventions. The study has employed a multi-arm design, one with individual female training and a second joint participation with a male household member. Therefore, the present research has a far-reaching impact than a simple comparison. The study offers convincing experimental evidence on the importance of household-level involvement, a significant factor which has strong theoretical underpinning but is most of the time overlooked in the empirical designs (Jayachandran, 2021; Ashraf, 2009).

Secondly, the study uses a wide range of outcome measures, including knowledge, behavioural practices, psychological mediators (such as self-efficacy and confidence), and subjective well-being. This multifaceted paradigm offers a more comprehensive understanding of how interventions affect behaviour and perception and is consistent with novel perspectives on financial literacy (Carpena et al., 2019). Additionally, measures of trust and intra-household autonomy are methodological advances in evaluating the interplay between gendered decision-making authority and digital literacy.

Thirdly, the present RCT is conducted in the context of a developing economy where women have to experience various gender and social norms. The results of the study are applicable in case of similar low- and middle-income economies with the same social norms and gender barriers; thus, it increases the external validity of the study. Additionally, in T2, we have engaged a male member of the household (husband, brother, or father); this notion is somewhat ignored in the prior literature on financial inclusion. Thus, the present research offers profound insights into culturally sensitive and scalable strategies at the household level to enhance women's financial autonomy.

Despite these strengths, several limitations merit critical attention. First, while the short-run impacts are encouraging, the study does not capture long-term behavioural persistence, such as changes in savings accumulation, credit use, or labour market participation. Without follow-up data, it remains unclear whether the observed gains in financial capability translate into sustained financial resilience or mobility (Karlan et al., 2016; Grohmann et al., 2018).

Second, the reliance on self-reported outcome measures, particularly for digital behaviour, autonomy, and well-being, introduces the risk of social desirability bias, especially in a context where participation in an externally sponsored training may induce overreporting of "positive" behaviours. While efforts were made to ensure privacy and neutral administration, future work could strengthen measurement validity by incorporating administrative or device-level usage data (Jack et al., 2021).

Third, although the study explores intra-household dynamics, it does not include direct measures of male attitudes, norms, or behavioural change, which limits the ability to isolate the precise channels through which male co-participation exerts its effects. The design implicitly assumes that joint participation improves female outcomes through norm-shifting or information sharing, but these mechanisms remain empirically underexplored in the current setup (Field et al., 2021).

8. Conclusion and Policy Implications

The RCT provides a compelling narrative on the effectiveness of digital financial literacy interventions in improving women's financial knowledge, confidence, autonomy, and behaviour. The results demonstrate that even a relatively low-cost, in-person and mobile-delivered training can yield substantial gains in digital financial capability among rural women. Particularly, including male household members in the intervention significantly strengthens these effects across nearly all dimensions, including financial behaviour, trust in digital transactions, and perceived well-being. These findings demonstrate the significance of formulating gender specific financial inclusion programs and initiatives at the national level that account for intra-household dynamics and prevailing sociocultural norms.

Based on the empirical outcomes, we propose three policy implications. First, standalone digital literacy programs targeted at women can be highly effective, especially when women have limited access to formal training platforms. Leveraging mobile technology to deliver content asynchronously can reduce logistical barriers and increase scalability across rural and underserved regions. Second, integrating male household members into financial education programs should be considered a critical design feature in traditional societies. Joint participation facilitates behavioural change by fostering shared understanding and reducing resistance within households, and increases the likelihood of sustained usage of digital financial tools. It is plausible that development programs should move beyond individual-based models and adopt a more holistic, household-level approach when operating in environments with strong gendered power dynamics.

Third, policy efforts to expand digital financial inclusion should prioritise behavioural enablers, including trust, confidence, and perceived security, alongside infrastructure and access. Therefore, the regulatory bodies and financial service providers in developing economies should complement digital onboarding strategies with public awareness campaigns and user-centric training that demystifies technology, especially for first-time and low-literacy users (women).

The broader relevance of these findings extends well beyond Pakistan. In many low- and middle-income countries, gender disparities in financial inclusion are reinforced by social norms, limited digital access, and lack of financial confidence. Interventions that combine technological solutions with behavioural insights and social context, particularly those that strategically involve household decision-makers, are more likely to succeed. As governments and development actors seek to promote inclusive growth through digital finance, embedding gender-equity considerations and intra-household engagement into program design will be essential for achieving meaningful and lasting impact.

9. Future Research Directions

The study provides several avenues for future research to deepen understanding and inform more effective policy design on the interconnection between digital financial literacy and women's empowerment.

First, assessing the long-term sustainability of behavioural and psychological changes induced by digital financial training is interesting. Follow-up studies that track participants over extended periods are needed to evaluate whether improvements in financial literacy, confidence, and intra-household autonomy translate into permanent changes in savings behaviour, credit use, entrepreneurial activity, or labour market outcomes. Understanding the persistence of treatment effects is essential for assessing cost-effectiveness and guiding resource allocation. Second, future studies should investigate how male household engagement enhances outcomes. The present study shows that joint participation has a more substantial impact, but does not directly measure shifts in male attitudes, intra-household communication, or bargaining power. Mixed-method or multi-arm designs with modules explicitly focused on male behaviour, norms, and power-sharing could offer sharper insights and explain the channels by which and why joint interventions work.

Third, future studies should prioritise heterogeneity analysis to identify subgroups that benefit most from specific intervention features. Understanding how treatment effects vary by age, education level, baseline digital usage, or household structure can support better targeting and tailoring of programs. This is particularly relevant for resource-constrained governments aiming to maximise returns on intervention spending. Fourth, cross-country replication in diverse institutional and cultural contexts is essential to assess the generalizability of findings. While this study is situated in Pakistan, similar gendered constraints to financial inclusion exist across South Asia, Sub-Saharan Africa, and parts of Latin America. Comparative trials that test the same intervention across countries or regions help disentangle context-specific from universal mechanisms and provide more robust policy guidance.

Declarations

Acknowledgement

I am truly grateful to the exceptional women economists at RCTXIMPACT, whose expertise in conducting randomised controlled trials across diverse contexts shaped this study from design to completion.

Ethics Approval and Consent to Participate

The Research Ethics Committee, RCTXIMPACT, Islamabad, Pakistan, approved the present research. All participants provided informed consent before participating in the research, and the researcher ensured compliance with the ethical guidelines outlined in the Declaration of Helsinki.

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