

Securing P2P Payments for the Vulnerable: Protecting Elderly Consumers in India

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Securing P2P Payments for the Vulnerable: Protecting Elderly Consumers in India

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Abstract

The rise of peer-to-peer (P2P) payment systems in India has revolutionized the financial transactions with unprecedented levels of convenience yet with a new level of risk that the elderly users with lacking digital literacy get exposed to. This paper looks at exploring the overlapping principles of usability, accessibility, and security in servicing this vulnerable group studying the most significant factors that affect trust, confidence, and adoption. Leveraging insights of both elderly users and fintech analysts, the study has identified the vital issues including complex authentication procedure, interface navigation difficulties, and fear of data protection. Results indicate that the perceived insecurity characteristics that are cumbersome can reduce the feeling of trust whereas a higher frequency of Independence of use is relative to the levels of adoption and recommendation. The opinion of the experts further confirms the relevance of such intuitiveness features as biometric authentication and fallback, voice assistance in native languages, and trusted contact methods. The study offers practical suggestions based on the synthesis of both user feedback and professional recommendations related to the design of age-friendly and secure P2P payment systems that are both safe and convenient for its users to encourage the improved financial inclusion of older adults in India.

1 Introduction

Over the last ten years, India has undergone an extraordinary digital transformation of its financial services sector, with peer-to-peer (P2P) payment applications like Google Pay, PhonePe and Paytm spearheading the change. By providing easy, no-contact, convenient payments, these platforms have changed how Indians perform their daily financial transactions. With government policies promoting a cashless economy and enhanced access to banking even to the rural parts of India, the use of digital payments has expanded exponentially in India, which makes the country a global leader in innovation and advancement in fintech and digital inclusion (International Banker, 2023). As much as these innovations have the positive impact all over, not every niche of the society has been able to adopt and gain the positive revenue of the revolution of digital payments. Specifically, older users experience massive challenges that limit their capability to use the P2P payment systems in a reasonable way and safely. Most of the older adults have challenges with low digital literacy, age-related cognitive functions, and poor mobility (e.g., low vision, or loss of fine motor coordination), making interfacing with multifactor authentication and other complicated application navigations more complex (Chen et al., 2025). Moreover, they have limited knowledge of the ever-changing cybersecurity threats that makes them more prone to fraud, phishing, and data breaches. This population segment, therefore, forms an important population segment of end-users that is prone to digital exclusion within the Indian fintech sector.

In usability of digital payment systems, the value of focusing on usability as well as security of services cannot be over exaggerated in relation to the elderly people. On the one hand,

strong security features, including one-time passwords (OTPs), biometrics, and transaction verification techniques are necessary to protect users against growing cyber threats. Conversely, these security measures can end up being obstacles as they can make the user experience more cumbersome, when it comes to senior people, they can be annoyed and confused by multi-step authentication (Saeed, 2024). Making these security procedures less complicated without losing the safety aspect and making the interfaces easy to use by people with limitations caused by their age will also make the aged users more confident to be able to use it more. Voice navigation, support of regional languages, big fonts, and convenient workflows can be regarded as key features of an inclusive design approach (Bugár and Somogyvári, 2025).

Although the issues and problems that elderly users may encounter are visible, there is a lack of academic studies on the problem of the overlap between security and usability in the context of the Indian socio-cultural environment characterized by a variety of cultures and socio-cultural experiences. Literature results in an existing gap where there is a need to study the relationship between the dimensions of cybersecurity (technical) and usability (general) to a specific age group but especially older adults in India. This disparity is particularly urgent with the linguistic variety, different levels of literacy, and unique cultural features that have to be reflected in the fintech solutions relating to the local cultural and contextual specifications of the country (Bugár and Somogyvári, 2025). In addition, it is important to pay attention to the needs of the older users since digital payments may become the centrepiece of financial inclusion initiatives, and the failure to do so would further increase financial inequality and social exclusion. In addition to security and usability, digital literacy is a key determinant of the experience of and outcomes that the elderly employ.

According to the existing research, elderly people with minimal digital literacy distrust digital platforms or do not always realize the risks and become the best targets of scams on the Internet and financial abuse (Chen et al., 2025). To promote safer adoption, it is crucial that digital education programs to raise awareness and confidence are supplemented with apps applications designed to support persons with various skills.

The study falls at the intersection of these issues and tries to understand the problem of data protection and usability to an elderly user of P2P payment systems in India more deeply. With such detailed research, the study hopes to present viable recommendations which can aid fintech developers, policymakers and financial institutions to develop systems that do not only keep the user data well-protected, but more so consider the needs unique to senior citizens and the populations that have no experience using digital technologies.

This study seeks to explore the following research questions:

“What strategies can strengthen data protection in peer-to-peer payment systems for elderly users with limited digital literacy, while maintaining usability?”

The specific objectives of this research include:

- Exploring the key security risks and usability challenges that older users face during the use of P2P payment apps.
- Measuring the level of trust in existing digital payment systems placed by elderly and digitally illiterate people.
- Determining crucial design factors that affect the security perception as well as ease of use of such systems.

- To offer practical recommendations that would enhance security and the availability of P2P payment systems to marginalized groups.
- Contributing to existing academic discussions on fintech inclusivity and consumer data protection within emerging markets.

The structure of this thesis is as follows: Section 2 provides a review of existing research; Section 3 details the methodology; Section 4 Tools and Technologies used, Section 5 analyses the results; and Section 5 concludes with a summary, limitations, and recommendations for future work.

2 Literature Review

As digital payments become central to financial inclusion initiatives, special consideration must be given to the requirements of elderly users. Overlooking this demographic is risking financial inequality in general and in countries such as India where the digital finance sector is quickly growing it seems unfair. Digital literacy emerges as a key determinant of seniors' experience with technology. It has been revealed that older people with basic digital literacy skills tend to distrust online systems, and they are unlikely to become aware of cyber threats, exposing them to becoming an easy victim of fraud and financial abuse. This explains why it is necessary to designing payment systems that combine security, as well as usability for the elderly, especially to the tech-unsavvy populations.

2.1 Challenges in Adopting Digital Payments for the Elderly Community

There are inherent digital literacy challenges that impede elderly users to use fintech services. Combined with aging-related cognitive and sense changes and lack of exposure to technology, inattention to complicated app environments may negatively affect seniors (Msweli and Mawela, 2020). Innovative solutions present these challenges to a greater degree because all these interfaces are designed without the consideration of elders (e.g. tiny text and cramped layouts of popular payment applications (Google Pay, Paytm, and so on) cause confusion and mistypes in seniors). On the one hand, a systematic review conducted by (Msweli and Mawela, 2020) has reaffirmed that inadequate interface accessibility (e.g. having small fonts and confusing layouts) is a deterrence to mobile banking by many elderly users in developing environments. This means that other than individual characteristics, design shortcomings is a cause of digital exclusion of the elderly.

Digital illiteracy among the seniors exposes them to security risks as well. Chen et al. (2025) note that minimal technology literacy among elderly makes them distrust online spaces and unaware of cyber-related risks, therefore, being prime targets of fraud and financial schemes. Indeed, an analysis of multiple countries revealed India to be amongst the nations that perform worst in terms of digital exclusion of elderly users (91%) (Mohan et al., 2024). These people might not be aware how to defend themselves on the internet, and poor awareness or training was associated with an increased risk of being the subject of phishing and fraud attempts (Jena, 2023; Alhafiz, Singh and Rahman, 2024). The methodologies used in these empirical studies include literature review and survey. As an example, Jena (2023) surveyed the Indian seniors after the COVID-19 period and noted that most of them were ready to experiment with digital banking, yet they were still hesitating because of the insufficient security practices knowledge, and they lacked knowledge about frauds ways.

To add to this, Alhafiz et al. (2024) performed a systematic review of fraud incidents and realized that poor digital literacy is associated with a higher susceptibility to online fraud by

elders. The results reinforce the idea that enhancing digital literacy (including through educational programs and support services) is of paramount importance: not merely to ensure that seniors can use P2P payment applications to their advantage, but also to enable or empower this cohort to identify and prevent security-related risk. In short, previous studies cite poor digital literacy as one of the major impediments to usability that simultaneously causes security risks among older adults.

Another recurring theme in literature is the trade-off between robust security measures and usability by elderly users. There must be enforced security measures, e.g. one-time password (OTP), multi-factor authentication (MFA) and biometrics verification, to secure user data. Nonetheless, these mechanisms tend to add complexity that seniors are likely to be overwhelmed by and put them off usage. The empirical study conducted by Saeed (2024) on the perception of mobile app users in Saudi Arabia has shown that several participants (including older users) considered multi-step authentication procedures frustrating since they found the procedure confusing and cumbersome. It was also observed that mere age was not noted as a predictor of the security-usability perceptions but rather, the extent of concern and confidence placed by users to this capability indicated how comfortable (or not) they felt with the security option presented to them in that setting (Saeed, 2024).

In fact, some studies observe that elderly users often have trouble in using security features which are not user-friendly or in some cases, they avoid such features. On a similar note, a study conducted by Noah et al. (2022) on user reviews of mobile payment applications found that the intricate user interfaces and the indirect security procedures of these applications made it challenging or even impossible to use in a safe manner for elderly customers since it inhibits them to follow all the essential security procedures due to frustration on the use of the mobile payment application. Such results are consistent with the general body of the literature on usable security, which stresses that security controls should be human centred otherwise users will develop ways around them or quit using the service, compromising the level of security (Cerf et al., 2023; Assal et al., 2019).

According to Das et al. (2024), the existing Multi Factor Authentication mechanisms create large cognitive burden on elderly, and in their research (on analysing privacy mechanisms of seniors), the researchers propose simplifying the protection controls within a payment application. Their study for future work would provide high data protection in limited steps, e.g. simplified verification flow, or not-repetitive-user-input contextual authentication. Similarly, there have been proposed design principles of inclusive security. Bugár and Somogyvári (2025) introduced a conceptual framework on designing ethical payment systems that recommend inclusive and accessible security that should be emphasized without violation of safety. This implies that in order not to impose protective measures as a burden on the senior, the interface must be made intuitive, i.e., by making the font larger, using language they can easily understand and enabling logins via biometrics or trusted devices saved on the phone.

Methodologically, a lot of this work is conceptual or design-forward: Bugár and Somogyvári (2025) formed their principles based on a critical evaluation of fintech design and ethics. Security measures that are too complicated could be counterproductive since elderly may either bypass or ignore the secure platforms altogether. The ability to strike that optimal balance between strengthening data protection and maintaining simplicity and clarity to the user is thus amongst primary concerns in the literature.

2.2 Trust and Risk Perception

Digital payment systems trust, and perceived risk are the key variables that determine the adoption or rejection of P2P payment apps by elderly users. Most research show that the older generation are cautious when it comes to online finance and it is their perception of the safety of a platform that determines whether uptake would succeed or not. In an Indian post-COVID situation, Jena (2023) documented that many elderly were still both mistrustful of online payment, regardless of perceiving any gain, mostly because they were afraid of the risks of security and fraud. The observation is in line with those extensions of Technology Acceptance Model (TAM) that address older users: e.g., in an extended TAM, Yang et al. (2023) included the concepts of trust and perceived risk and then justified through surveys that those have a powerful influence on elderly behavioural intentions. In their study of the elderly Chinese users, Huang et al. (2024) present solid empirical evidence of such relationship through their study of elderly Chinese users. In the study, they demonstrated the perceived trust in technology had a positive correlation with the willingness of the elderly to use mobile payments and the risk was a negative correlation, which inhibited the urge to use it. Interestingly, they also learned through their model that ease of use indirectly increases trust and usefulness hinting that when an app is easier to operate by an elderly person, he feels more confident and becomes more apt towards the usefulness of the app which stimulates the adoption switch in the end.

A key insight is that lack of trust could be related to the low levels of digital literacy and experience, which have been discussed above. On the other hand, trust can be built through positive experience and through social support. Still, Choi et al. (2024) examined panel data on South Korean consumers and discovered that older adults, who received more online access to digital engagement daily and intergenerational support (e.g. living with younger relatives), were more likely to be open to using fintech services.

Perceived risks were reduction possibilities with the discernment of these seniors when they felt like using digital media and received tech-savvy generation advice to guide their use (Choi et al., 2024). Such a finding suggests the significance of changing risk perception through using social and informational support mechanisms: an older user who is instructed on how to use an app safely or who observed successful results will have more trust towards the system. In fact, the most common recommendations are the trust-building and education. As an illustration, a systematic review conducted by Alhafiz et al. (2024) highlighted that frequent education and awareness campaigns could enhance the level of confidence in online banking among the seniors and consequently boost trust and safe adoption.

Likewise, Saeed (2024) noted that the more an app user felt aware of an app privacy and security, the more they felt positively about the app security usability, which supported the proposal that transparency and user education (through such entities as unambiguous detailing of security features, tutorials, or customer service) could be used to mitigate fear (Saeed, 2024)

2.3 Confidence, Self-Efficacy, and Usage Frequency

User confidence or digital self-efficacy in the use of technology among elderly is another topic that finds mention in the literature regularly. The prior experience with digital tools of many seniors is minimal which results in a lack of confidence in being able to use new apps without assistance. The absence of technical skills by an elderly person (proxy of low self-efficacy) is a major hindrance to the adoption of mobile banking discovered by Msweli and Mawela (2020). Practically, an older user, who is uncertain of how to navigate an app or how to solve problems within the app will tend to not use that app or use an app very minimally. Empirical research supports this, in the most recent post-COVID survey self-efficacy

(confidence levels in technology) was a strong positive predictor of Indian seniors' intention to use e-banking, but anxiety had a negative impact (Jena, 2023). That is, the seniors who believe that they could cope with the technology are more likely to use it than those who feel anxious or insecure about the technology restrict their use. Literature also talks about the impact of support networks in usage frequency: elderly people living with joint families or societies where they can obtain aid will use the apps a bit more frequently, as there are other individuals to whom they can turn in case there is an issue (Najma and Begum, 2023). On the other hand, older persons who are living independently and without a support structure may hardly or never use P2P apps. In this way, the prevalence of usage of aging users is strongly related to their trust to use the app and the design easiness of the application. It is suggested to support the training of digital skills and create more user-friendly interfaces that could lead to the frequent use of the services in this demographic.

2.4 Research Gap

Although groundbreaking studies have been conducted on the capacity of older people to adopt the digital banking and payment system in India (Najma and Begum, 2023; Jena, 2023) and other parts of the world (Huang et al., 2024; Choi et al., 2024), a lot of these studies isolate usability and security/data protection as distinct entities. The factors of behavioural adoption, possible risks perceived, and digital literacy explored in existing literature (Chen et al., 2025; Msweli and Mawela, 2020) are rather discussed as a whole without paying attention to the specifics of how the decisions about app design impact the balance between usability and data protection among elderly people who use the peer-to-peer (P2P)-based payment programmes.

There is no empirical evidence regarding the experience of the elderly integrating both the security-usability trade-off aspect in real-life P2P payment settings with both elderly survey data and expert feedback especially within the Indian UPI ecosystem. In addition, studies focusing on design (Das et al., 2024) still do not pay much attention to the combination of accessibility, trust-building, and fraud prevention within one unified framework when the target audience is the user population of old age.

The purpose of this study is to bridge this gap by evaluating the quantitative survey study of elderly users and qualitative focus on proficiency in the identification of arbitrarily related factors of usability and security, combined design solutions (biometric fallback, voice support of local languages, trusted contacts) proposing to provide elderly users of P2P payments in India with effective trust, access, and protection, which can be statistically shown to be related to each other. It also seeks to propose good strategies based on this synthesis so that it can contribute to the focus group study since it has become one of the most significant issues in the peer-to-peer payments world as regards to digital inclusion besides raising awareness on the number of scams reported annually. The research also closed the gap between theoretical research and practical application in the industry, as the provided guidelines are inspired directly by statistical data. The described integrated approach provides the replicable design which can be applied in other emergent markets that struggle with similar tasks of combining security, usability, and adoption among the elderly audience.

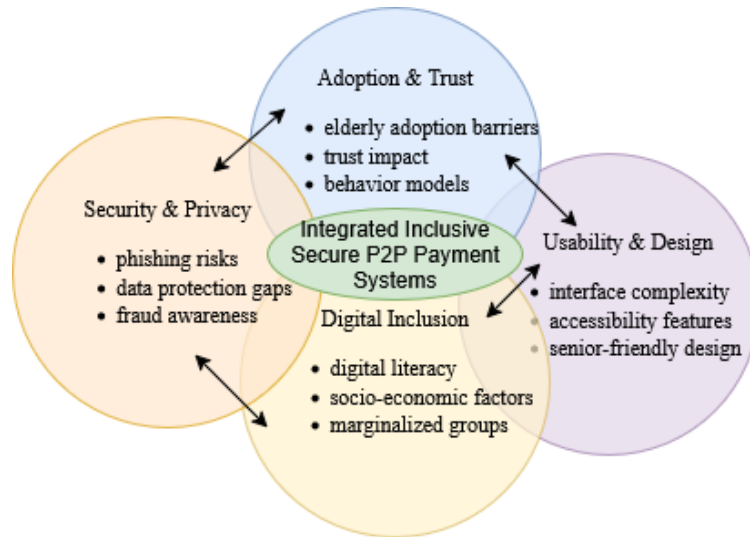


Figure 1: Intersecting Themes in Elderly FinTech Research Underpinning This Study

3 Research Methodology

This research adopted a mixed-methods approach to investigate the intersection of usability, accessibility, and security for elderly users in India’s digital P2P payment ecosystem. The methodology involved two key components, quantitative analysis of elderly user survey responses and qualitative insights from fintech professionals.

3.1 Research Design and Procedure:

To gain a holistic understanding of the problem, the study followed an exploratory design grounded in user-centred research principles. Primary data was collected through two channels: (1) an online survey administered to elderly participants (aged 60 and above), and (2) another online survey with 7 fintech professionals and user experience experts.

The survey instrument was designed to assess users’ comfort with digital payment apps, perceived risks, preferred interface features, and barriers to adoption. The questionnaire consisted of closed-ended questions using Likert scales, as well as categorical questions to gauge demographics, digital literacy, and usage patterns. It was distributed through WhatsApp groups and Facebook Elderly community groups. A total of 71 valid responses were gathered. Simultaneously, seven domain experts were consulted to review preliminary insights and assess the feasibility and relevance of proposed interface strategies. These included payment product specialists, product managers, developers working in the fintech space. The Expert survey was distributed via LinkedIn and WhatsApp.

3.2 Tools and Technologies:

Data collection was conducted using Google Forms for both the elderly user survey and the expert feedback survey, enabling efficient and accessible response gathering. Data analysis and visualization were performed in Google Colab using Python libraries such as pandas for data manipulation, matplotlib and seaborn for graphical representation, and SciPy, stats for conducting statistical tests. Pearson Chi-square tests of independence and Cramer’s V were applied to assess significant associations between categorical variables like frequency and age. For the expert feedback, Microsoft Excel was employed to identify design

recommendations and to perform triangulation matrix between the two surveys to develop a set of practical feature suggestions aimed at improving P2P payment app usability and security for elderly users.

3.3 Data Analysis Process:

Sample Size:

The survey was conducted through 71 participants who were 60+ of age with basic literacy skills. Such a sample yielded a broader basis to not only analyze usability or security difficulties but also the patterns of behavior concerning the use of the P2P payment apps by this generation. Snowball sampling was utilized to target elderly, due to lower digital literacy. Behavioral analysis methodologies in Python were used to gain a deeper insight into the interaction of elderly users with the apps and their most important patterns that affect the perception of security and usability. The Expert survey received feedback from 7 fintech professionals for insights.

Target Population:

The participants of this study include elderly users in India that have adopted peer-to-peer (P2P) payment applications. Those who participated in the survey were people aged 60 and above. The survey aimed to distribute the survey across India to receive different types of survey responses that could help analyse the survey more efficiently.

Validating the Questionnaire:

The questionnaire was formulated with the guidance of existing literature on fintech usability and security among elderly users. To maintain content validity, it was vetted by the subject-matter experts in the settings of finance and technology.

Scales and Measurements:

This study uses a five-point Likert scale in the questionnaire with responses of Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree to evaluate how users felt about the usability, trust, and security frustrations with P2P payment apps. The questionnaire was separated into categories on demographics, digital experience, interface usability, security concerns, and trust levels. There are multiple choice, short answer and Dropdown questions included as well. The questions were intended to be straight and objective to foster truthful and precise answers among the elderly.

4 Design Specification

The study has a quantitative survey-based research design with statistics as the analytical tool to study usability and security issues affecting the elderly consumers of peer-to-peer (P2P) payment apps in India. The study design is based on the consideration of the real-life user perceptions, behaviour, and challenges collection via a properly formulated questionnaire and descriptive processing of the data obtained with the help of Python-based statistical analysis. Additionally, the secondary survey conducted with 7 FinTech professionals

4.1 Survey Instrument Structure:

The survey aimed to collect detailed information on a few dimensions including demographic data, the digital experience, interface ease-of-use, frustration issues over security, and trust in P2P payment platforms. The main aspect of question layout was a five-point Likert measure that was able to measure subjective perception in a manner that was easily understood by the

older individuals. The questionnaire was then validated through expert review and pilot testing to be sure of clarity and relevance.

4.2 Data Collection and Sampling Approach:

The targeted participants were 60 years old and older who had either used or were familiar with P2P payment apps. Snowball sampling was efficient in the access to older users with different levels of digital literacy and connectivity. Data was collected electronically, and respondents with lower tech-familiarity were taken through the process as needed.

4.3 Analytical Framework:

Python was used to analyse the survey data by utilizing Pandas to manipulate the data, Seaborn and Matplotlib to visualize it, and SciPy to test it statistically. The most important parts of the analytical framework are:

- Descriptive Statistics - to summarize participant demographics and baseline responses.
- Chi-square tests of independence - to examine associations between categorical variables such as usability issues and user traits (e.g., age, digital experience).
- Cramér's V Test - to quantify the strength of statistically significant relationships when Chi Square Test shows mild significance.
- Triangulation Matrix, which was developed for the significant quantitative reports from Chi Square tests and Cramer's V with theme-based results of the fintech professional survey responses ensuring a level of cross validity and any areas of similarities and any discrepancies between what was being reported by the users of a product or service and what the industry was saying.

This design allowed identifying the key pain points and insights around usability and security experienced by elderly users and support to the approach to seeing how these aspects interact in this age group and to help articulate recommendations for app features.

5 Implementation

The implementation started by designing and conducting two primary surveys,

- Survey 1 was administered to elderly Indian people who use peer-to-peer (P2P) payment applications in India to meet the demographic needs, digital knowledge, ease of use, and incident on security.
- Survey 2 was carried out among experts in the fintech industry and included professional views on usability and safety settings more applicable to old age.

Both surveys were conducted online, and wordings were simplified to make it easy to follow in the elderly group.

After the data were gathered, the elderly user data was uploaded into Google Collab, Python to be worked on. The dataset then went through a cleaning and preprocessing consisting of deleting incomplete entries, treating of missing data, uniformising formats, and recodification of categorical variables of interest in the research queries through use of Pandas. This was followed by the generating descriptive statistics in Collab to summarise the profile of the sample and key response distributions once pre-processing had been conducted. This gave both a basic insight into the population of interest and typical trends in the usability or

security experience. The next step entailed the inferential statistical test by using Chi Square test analysis, all valid combinations of categorical variables were tested using chi-square tests of independence (via SciPy) to identify associations between usability and security outcomes with user attributes (such as age, digital literacy, frequency, ease of use). Each significant Chi-square result was used to calculate Cramer's V to measure the effect size, and the significance was interpreted by standard values (small, medium, large). Relationships that satisfied the $p < 0.05$ condition were chosen and analysed, so that both the statistical and practical importance is met. Visualisation of the results was performed in Seaborn and Matplotlib -this includes heatmaps to estimate contingency tables and bar plots of the top associations with respect to effect size. The final step was to analyse the two datas in Microsoft Excel. Thematic of responses was done manually into categories (e.g., biometric authentication, simplified layouts, scam reporting features).

The responses were analysed and as a final step triangulation matrix was developed for cross-referencing quantitative statistical results of the Survey 1 that were significant, and the qualitative expert advice of Survey 2 that had been analysed in the basis of themes.

6 Evaluation

In this section, a detailed discussion of the surveys data of elderly users who use P2P payment apps, paying particular attention to important usability and security concerns and their dependence upon user traits. This analysis critically examines the strength and meaning of such relationships, answering the main research question.

6.1 Descriptive Analysis

The sample of the survey was a group of 71 elderly individuals of a varying background, related to digital literacy and various experiences with payment apps. There was an age bias to the 60-69 age category but there were individuals above 70 years of age. The representation regarding gender was equal as both male and female points of view regarding usage and trust-related matters were presented.

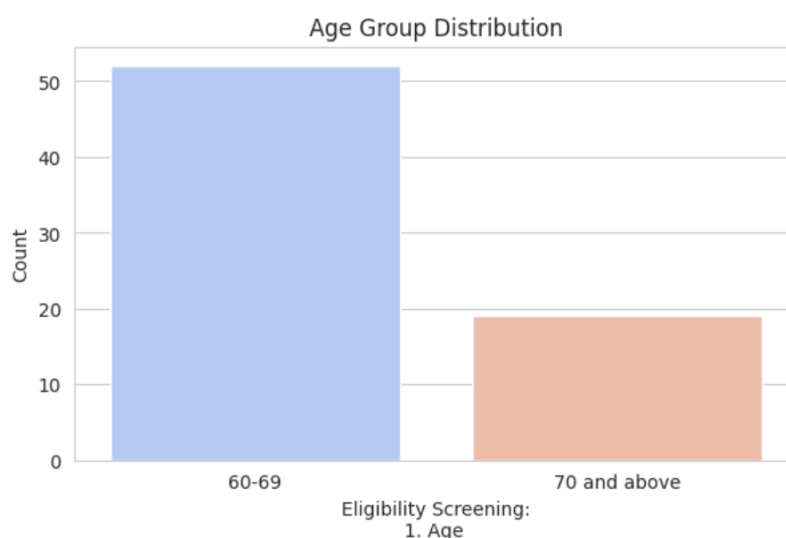


Figure 2: Eligibility Screening - Age

There was also a wide geographic spread with respondents based in different states of India and it was thus possible to capture regional differences in adoption patterns. Most of the respondents referred to at least some application of P2P payment like Google Pay, PhonePe, and Paytm. Concerning the frequency of usage, most respondents lastly used P2P payment apps at least once a week, with a significant portion doing it at daily intervals. This implies that even such segment as elderly users can be quite aware of digital payments since even age-related hurdles have to a substantial extent been overcome.

Digital literacy levels varied:

- Some respondents reported high confidence in navigating app interfaces independently.
- Others indicated that there is frequent reliance on family members for guidance.

When the participants were asked about their security experience, most of the participants had at least once come across suspicious messages or scam. All the same, there was a mixed recognition of where to complain about the scams, and many could not clearly say what to do. Concerning the recommended security features, the use of biometric-based authentication (falling back to simple PIN) was generally considered better than the password, or a complex sequence of PINs, particularly combined with the prominent visual guide and voice prompts in local languages. In general, three distinct patterns have come through the descriptive analysis:

- Adoption is not the factor of primary obstacles, as the frequency is quite high among confident users.
- Independent use is highly affected by trust and confidence.
- The design of a security feature should consider the ease-of-use and high fraud prevention to lean on elderly populations.

6.2 Pearsons Chi Square Test + Cramer's V Analysis

The three statistically significant associations that were identified in light of the Chi-square tests are the core to the comprehension of the interaction between usability and security among the elderly users of P2P payment systems. To be more exact, dissatisfaction with security measures (i.e., OTPs, PINs) was strongly interrelated with app trust ($\chi^2 = 19.44$, $p = 0.0127$, Cramer $v = 0.370$, medium effect). This implies that awkward sign in procedures have the capability of destroying the trust and hence people may not adopt and use it in the long run. The frequency of using the application was strongly correlated with confidence using the application alone ($\chi^2 = 33.68$, $p = 0.0060$, Cramer's $V = 0.344$, medium effect). It is possible to interpret this fact that an optimized level of user self-efficacy, which can be achieved by using an assistant voice, designation that resembles simpler Senior Mode interfaces, or tutorials, would mean more engagement. Also, a strong relationship was found between trust and recommending the app to one another ($\chi^2 = 24.12$, $p = 0.0022$, Cramer $V = 0.412$, moderate effect). This further supports credence of trust as not only an adoption factor but also a motivating factor of the positive word-of-mouth, which is paramount in growth of elderly user bases.

These statistical models show whether it is the security design that minimizes frustration and leads to the development of confidence and trust, it directly correlates with the usage patterns in the platform, and advocacy in relation to the platform. These findings thus confirm the position that the security features should be adaptive, and accessibility inclined without compromising the protection and also without losing accessibility, which is in tandem with

the research question, which is on the need to balance between data protection and ease of use by elderly users with little digital literacy.

Table 1: Chi-Square Test Results for P2P Payment App Usage

Variable Pair	Chi ² Statistic	df	p-value	Cramér's V	Effect Size
Trust × Recommend	24.12	8	0.0022	0.412	medium
Frustration × Trust	19.44	8	0.0127	0.370	medium
Confidence × Frequency	33.68	16	0.0060	0.344	medium
App Usage × Recommend	53.22	16	< 0.001	0.612	large
Problem Reporting × Suspicious Messages	41.27	9	< 0.001	0.440	medium
Help Needed × Security Frustration	23.70	6	0.0006	0.409	medium

6.3 Evaluation of Triangulation Matrix

The triangulation matrix of Chi-square test analysis with the insights of the expert survey data consistently identified that there were high values in a few areas of importance, especially Trust and Recommend and Problem Knowledge and Suspicious messages, where the expertise of the statistical significance and the expert survey feedback would support similar interventions. The medium-strength relationships like Security Frustration and Trust and Confidence with Frequency Match the opinions of experts; they also pointed to the lacks in the implementation and testing.

Lower effect sizes, including Device Used and Frequency and Digital Literacy and Confidence can still be considered for design factors, e.g., interface adaptations to interface size limits and low electricity programs to make them prospective. In others, e.g. Fraud Experience and Trust, the experts went beyond the quantitative scope, suggesting policy-based interventions as well as technical ones.

This integrated analysis makes the results of this research more valid as the solutions such as simplification of authentication, voice assistance, the elderly-friendly design, and proactive anti-scam-reporting features, among others, become not only statistically significant but also confirmed as promising by the industry professionals.

7 Discussion

Feature Recommendations Based on User Feedback and Expert Review:

Various popular modern P2P applications like Apple Pay and Google Pay are considered safe and well-designed; however, they are not targeted directly at older participants. The data of

the research allow backing a series of feature proposals that can fill this gap. A special user interface (like Senior Mode Interface) could be created, using fonts of larger size, high-contrast visuals, fewer distractions, and linear workflows aimed at eliminating cognitive overload. There should be simple biometric authentication procedures (addressing Frustration $\times$ Trust, $p = 0.0127$, medium effect from Chi Square test) e.g. facial recognition or touch ID instead of complicated multi-stage authentications, and the users will be prompted only once and not get confused.

For usability, having voice assistance on contextual basis which works in the regional languages could make users complete the transaction process and it could be done at critical points in the entire transaction process. A situation wherein the involvement of the so-called Trusted Contact option is available would enable the elderly users to appoint a relative or a care provider as the trusted contact who would watch over and assist, serving towards the development of confidence without compromising autonomy. There could be visual fraud warnings, or programmatically applied animations or a colour scheme, which would activate during suspicious behaviour, enhancing risk awareness. To further promote independence and learning, a periodic performance dashboard tailored for elderly users could display easy-to-understand analytics on their spending patterns, fraud attempts averted and completed tutorials. Integration with local community support networks or senior helplines could offer immediate offline backup during digital uncertainty. Also, customizable accessibility themes could cater to users with specific impairments such as tremors or partial vision loss.

A small transaction summary card containing icons and speaking of each payment made after receipt of the payment may assist the user in checking of what he/she did. Chatbot support or in-app messages should be triggered if the user seems to be indecisive or stuck and needs some way of assistance. More so, an active scam filter might scan a questionable text or URL and inform the users prior to their involvement.

Based on the responses for the survey, it was found out that there are a great number of old users lacking confidence when they use an application the first time. To cope with this one should offer a tour-like view with steps when opening the app, the first time to discover it and feel like a user, which would include a mix of voice, visuals, and interactive instructions. A lot of people were complaining about memorizing passwords so having biometric fallback and trusted contacts-based recovery options would enhance retention, and limit lockouts. In case the respondents favoured the phone support, then they should have a quick-call button that connects to the customer support directly and is located on the most noticeable places in the app.

Expert criticism also demonstrated adaptive design methods, in which the application can learn the language, grid design, and even errors, in which the user is most likely to make within the app and adapt to it. Depending on the survey themes, a contextual Do You Need Help? button may also be shown when someone is pausing or attempting to move on but failing the help without interruptions. In addition, the presence of community tutorials or peer support forums integrated into the app may help instil confidence through the exchange of experience and testimonies.

8. Conclusion and Future Work

This study has gone far in establishing the diverse issues a user coming of age encounters in using the peer-to-peer (P2P) payment systems in India. The combination of the results of quantitative surveys of older adults and the comments of the participants of the study gave

the researchers the following pain points to pay attention to excessive sequence of authentication procedures, challenges in orienting in the interface of the applications, and a certain degree of lack of trust in the system of such applications. The results demonstrate the necessity of urgent fintech creation since the age-friendly design can consider the issue of security and convenience of use in the form of biometric authentication with fallback PIN-codes, voice access in local languages, or safety promotion through trusted contact tools, which allow elderly users to make transactions on their own and without harm.

In addition, the recommendations are supported by the close connection between the occurrence of issues as reported by users and expert recommendations, which contributes to the credible and practical applicability of the offered solutions. The overlapping of the two sources of data leads to the convergence toward a redesign ethos revolving around so-called cognitive simplicity, contextual guidance and supportive user systems. Application of such interventions can considerably increase the levels of trust, confidence, and adoption rate by elderly users, thus supporting financial inclusion in a fast-digitising economy.

However, the research does have its own limitations. With the cross-sectional design used, it offers a snapshot of time and not the changing behaviour and confidence of the elderly users to repeated exposure to digital payment tools. Moreover, in the proposed solutions, neither prototype testing was conducted nor was the potential of the suggested solutions to be tested in the real world confirmed. The longitudinal research in the future may follow the trends of adoption to obtain more detailed information about the influence of long-term exposure, specific education, and changed interface designs on users. On application-related note, a pilot programme such as the creation of a “Senior Mode Interface” that liaises with elderly users would provide fintech designers with actionable responses in real-time. This may go hand in hand with adaptive security processes driven by artificial intelligence to modify the level of protection offered to individual levels without creating more cognitive stimulus.

In order that these solutions have both scale and enduring impact, it is important to have coordinated action at the level of fintech companies and the presence of policymakers and regulatory authorities, the community organisation. Alliances might facilitate the normalisation of the elderly-friendly security requirements, make them trusted and enhance the uniformity of usability principles in various platforms. Lastly, technology, on its own, simply will not do senior citizens need more- they should become more comfortable with technology through complementary digital literacy programs, focused on older generations, taught during workshops, at community centres, and on online tutorials, and that confidence and skill should help the seniors to feel empowered to operate in an increasingly cash free society. The industry can respond to this challenge in a holistic way, combining secure design, education, and trans-sectoral collaboration, thereby closing the digital divide considerably and making sure that the elderly do not fall to the wayside in the future financial ecosystem.

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