Mobile-Based Safety Intervention for Women: An Empirical Study of the Kavalan SOS Application among Working Women and College Students in Tiruchirappalli District

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Abstract:
Women's safety has become a critical social concern in India due to increased mobility, workforce participation, and greater exposure to public spaces. In response, the Tamil Nadu Police launched the Kavalan SOS mobile application in June 2018 as a digital policing initiative to provide immediate emergency assistance. The app enables users to send discreet SOS alerts with real-time GPS location tracking, allowing rapid police intervention in cases of harassment, assault, stalking, kidnapping, and related threats.
This study investigates awareness, usage patterns, and perceived effectiveness of the Kavalan SOS application among working women and college students in Tiruchirappalli District. A quantitative survey design was adopted. Using purposive sampling, 200 respondents (100 working women and 100 college students) aged 18–45 years were selected. Data were collected through a structured questionnaire administered via Google Forms and analyzed using factor analysis with eigenvalue extraction and factor loading.
Six significant factors were identified using the Kaiser Criterion (Eigenvalue > 1). The most influential factor was Physical Safety and Immediate Response (6.45), followed by Geographical Location Tracking (4.12) and User-Friendly Interface (3.28). Findings indicate that although the app is perceived as beneficial, usage is lower among working women, highlighting the need for targeted awareness and training initiatives.

Keywords: Women's Safety, Kavalan SOS App, Digital Policing, Factor Analysis, Eigenvalue, Tiruchirappalli District.

INTRODUCTION

Women's safety in India remains a significant socio-legal concern, particularly in urban and semi-urban regions where women increasingly participate in higher education and employment. While greater mobility enhances empowerment, it simultaneously exposes women to risks in both public and private spaces.
According to reports published by the National Crime Records Bureau, crimes against women in Tamil Nadu showed a slight decline from 9,207 cases in 2022 to 8,943 cases in 2023. Despite this marginal improvement, serious offences such as molestation, cruelty by husbands or relatives, kidnapping and abduction, rape, and cases registered under the Protection of Children from Sexual Offences (POCSO) Act continue to pose challenges.

Technology has increasingly been positioned as a preventive and responsive tool for enhancing women's safety. In this context, the Kavalan SOS mobile application, introduced by the Tamil Nadu Police in June 2018, represents a significant digital intervention. The term "Kavalan," meaning "protector" in Tamil, reflects the state's commitment to safeguarding citizens.

The application allows users to:

- Send emergency SOS alerts
- Share real-time GPS location
- Notify selected emergency contacts
- Connect directly with police control rooms
- Activate discreet alerts during high-risk situations

Tiruchirappalli District, recognised as a prominent educational and industrial centre in Tamil Nadu, accommodates a wide network of higher educational institutions, corporate establishments, and government offices. Women constitute a substantial proportion of daily commuters. Understanding their awareness and utilization of the Kavalan app is therefore essential for assessing its effectiveness at the district level.

LITERATURE REVIEW

A sound theoretical framework provides direction for systematic investigation and identification of research gaps.

1. Women's Safety and Digital Interventions

Research indicates that mobile-based safety applications enhance emergency response time and improve psychological security among women (Sharma & Gupta, 2020). GPS-enabled systems are particularly effective in urban environments with strong police connectivity.

2. Police-Based Safety Applications

Studies show that police-developed applications tend to generate higher trust compared to privately developed safety apps due to direct integration with law enforcement (Kumar, 2019). However, awareness and training significantly influence adoption rates.

3. Global Reviews of Safety Applications

Eisenhut et al. (2020) conducted a systematic review categorizing safety apps based on functions such as SOS alerts, reporting tools, and location sharing. Similarly, Rahman et al. (2025) performed a systematic content analysis of apps aimed at preventing violence against women globally. Doria et al. (2021) emphasized themes of accessibility, security, and knowledge, while highlighting limited qualitative evidence on user experiences.

4. Indian Context

Tamilselvi et al. (2021) found that lack of awareness and technological barriers reduced the utilization of the Kavalan app despite positive perceptions. Yadav and Karna (2025) emphasized the importance of GPS tracking, audio/video recording, and emergency communication features in Indian safety apps. Bhivsan and Santosh (2025) stressed user interface simplicity and reliability in high-stress contexts.

IDENTIFIED RESEARCH GAP

Most existing studies focus either on technological features or state-level awareness. Limited research has examined district-level comparative analysis between working women and college students within the same socio-geographical context. This study addresses that gap.

OBJECTIVES OF THE STUDY

1. To examine awareness levels of the Kavalan SOS app among working women and college students.
2. To analyze usage patterns in Tiruchirappalli District.
3. To identify significant determinants influencing adoption through factor analysis.
4. To compare perceived effectiveness between working women and college students.
5. To propose policy recommendations for improved implementation.

METHODOLOGY

Research Design

The present study adopted a **quantitative descriptive survey design** to examine the level of awareness, usage patterns, and perceived effectiveness of the Kavalan SOS App among working women and college students in Tiruchirappalli District. The survey design enabled systematic collection of perception-based data from respondents and facilitated analytical interpretation for deriving evidence-based recommendations for improving digital safety interventions for women.

Sampling

Purposive sampling was employed to select a total of 200 respondents comprising 100 working women and 100 college students aged between 18 and 45 years. This non-probability sampling technique enabled focused examination of two population groups characterised by higher levels of mobility and increased exposure to public environments.

The sampling strategy helped reveal:

- Differences in digital engagement

- Variation in institutional trust
- Gaps between perceived importance and actual usage

Data Collection Tool

Data were collected through a structured questionnaire administered using Google Forms. The questionnaire was designed to gather information related to respondents' awareness, usage behaviour, and perceived effectiveness of the application.

- Physical safety
- Geographical tracking
- User-friendliness
- Awareness and training
- Institutional trust
- Psychological confidence

DATA ANALYSIS

The collected data were analysed using exploratory factor analysis. Eigenvalue extraction and factor loading techniques were applied to identify the underlying dimensions influencing respondents' perception and usage of the application. The Kaiser Criterion (Eigenvalue > 1) was used for factor retention.

Statistical Technique

Factor Analysis using:

- Eigenvalue extraction
- Factor loading matrix
- Kaiser Criterion (Eigenvalue > 1)

Extracted Factors Based on Eigenvalue Analysis (N = 200)

S. No	Factor No.	Domain / Factor Name	Eigenvalue	Percentage of Variance Explained	Interpretation
1	Factor 1	Physical Safety & Immediate Response	6.45	21.50%	Most Significant
2	Factor 2	Geographical Location Tracking	4.12	13.73%	Highly Significant
3	Factor 3	User-Friendly Interface	3.28	10.93%	Significant
4	Factor 4	Awareness & Training	2.76	9.20%	Significant
5	Factor 5	Institutional Trust	1.95	6.50%	Moderately Significant
6	Factor 6	Psychological Confidence	1.42	4.73%	Significant
7	Others	Remaining Variables (Eigenvalue < 1)	< 1	-	Not Retained

DETAILED INTERPRETATION OF FACTOR ANALYSIS AND EIGENVALUE RESULTS

Exploratory Factor Analysis (EFA) was conducted on 30 observed variables to identify the underlying dimensions influencing awareness, usage, and perceived effectiveness of the Kavalan SOS mobile application among working women and college students in Tiruchirappalli District. The Kaiser Criterion (Eigenvalue > 1) was applied to determine factor retention. Based on this threshold, six significant factors were extracted,

while components with eigenvalues below 1 were excluded from further analysis due to limited explanatory power.

1. Factor 1: Physical Safety & Immediate Response (Eigenvalue = 6.45)

This factor emerged as the most dominant dimension, explaining approximately 21.50% of the total variance. The high eigenvalue indicates that immediate safety assurance and emergency police response constitute the primary motivation for app adoption.

Variables with strong loadings included:

- Quick SOS alert activation
- Immediate police response
- Reliability of emergency assistance
- Protection from harassment and stalking
- Sense of security in public spaces

The magnitude of this eigenvalue confirms that respondents predominantly perceive the application as a direct protective mechanism during emergencies. Although both groups rated this factor highly, college students reported relatively higher operational usage than working women. This finding establishes emergency responsiveness as the core functional strength of the application.

2. Factor 2: Geographical Location Tracking (Eigenvalue = 4.12)

The second factor accounted for approximately 13.73% of the variance and represents the technological reliability of GPS-enabled tracking features.

Key contributing variables included:

- Accuracy of GPS location
- Real-time tracking functionality
- Location transmission to police control rooms
- Alerts to emergency contacts
- Travel monitoring capability

Respondents emphasized the importance of precise location tracking, especially during night travel and commuting. While college students demonstrated greater familiarity with this feature, working women expressed concerns regarding network stability and battery consumption. The substantial eigenvalue suggests that technological dependability significantly influences user trust and continued adoption.

3. Factor 3: User-Friendly Interface (Eigenvalue = 3.28)

This factor explained approximately 10.93% of the total variance and reflects usability and digital accessibility.

Variables loading on this factor included:

- Simplicity of interface design
- Ease of navigation
- Quick login and activation
- Language accessibility
- Minimal technical complexity

Ease of use was identified as critical in high-stress situations requiring rapid response. College students reported higher digital comfort levels, whereas some working women indicated the need for demonstrations and digital literacy support. The eigenvalue exceeding 1 confirms usability as a significant predictor of sustained engagement.

4. Factor 4: Awareness & Training (Eigenvalue = 2.76)

This factor contributed approximately 9.20% of the variance and highlights the role of institutional sensitization and structured awareness programs.

Associated variables included:

- Knowledge of app features
- Police awareness campaigns
- Workplace orientation programs
- College workshops
- Demonstration sessions

Findings reveal that insufficient awareness remains a major barrier, particularly among working women. College students benefitted from campus-based sensitization initiatives, whereas professionals often relied on

informal information sources. The eigenvalue indicates that structured awareness strategies can substantially improve adoption levels.

5. Factor 5: Institutional Trust (Eigenvalue = 1.95)

Accounting for approximately 6.50% of the variance, this factor relates to confidence in law enforcement and governance systems.

Variables included:

- Trust in police response time
- Confidence in data privacy protection
- Belief in government commitment
- Reliability of control room monitoring

Working women demonstrated comparatively higher institutional trust than college students. However, respondents across both groups emphasized the importance of transparency and visible success cases in strengthening confidence. Although moderately significant, institutional trust is essential for long-term sustainability of digital policing initiatives.

6. Factor 6: Psychological Confidence (Eigenvalue = 1.42)

This factor explained approximately 4.73% of the variance and represents the emotional and psychological reassurance derived from app usage.

Variables loading on this factor included:

- Feeling mentally secure
- Increased confidence during travel
- Reduced fear of harassment
- Emotional reassurance

College students reported stronger psychological empowerment associated with app installation. While working women acknowledged its value, their frequency of use was lower. Despite explaining comparatively less variance, this dimension remains crucial for preventive safety and women's empowerment.

FACTORS WITH EIGENVALUE LESS THAN 1

Variables with eigenvalues below 1 were not retained based on the Kaiser Criterion. These factors did not significantly contribute to explaining variation in usage patterns. Such variables may represent overlapping or weak dimensions.

Interpretation

The overall results of the exploratory factor analysis indicate that the adoption and utilization of the Kavalan SOS mobile application is a multidimensional phenomenon influenced by technological, institutional, cognitive, and psychological factors. The extraction of six statistically significant factors (Eigenvalue > 1) demonstrates that women's engagement with the application is not driven by a single variable but rather by an interconnected structure of perceptions and functional expectations.

The most influential determinant, **Physical Safety and Immediate Response**, explains the largest proportion of variance (21.50%). This finding confirms that the primary motivation for installing and retaining the app is the assurance of rapid emergency intervention. Women perceive the application fundamentally as a protective mechanism rather than merely a technological tool. The high eigenvalue associated with this factor suggests that the credibility of police response and the reliability of SOS activation form the core foundation of user trust. Without strong emergency responsiveness, other features may lose relevance.

The second factor, **Geographical Location Tracking**, further reinforces the importance of technological dependability. Real-time GPS accuracy and effective communication with police control rooms significantly influence user confidence. This indicates that technological precision enhances perceived safety and directly contributes to adoption behavior. However, concerns related to connectivity and battery performance reveal infrastructural limitations that may affect sustained engagement.

The third factor, **User-Friendly Interface**, highlights that usability plays a critical role in emergency contexts. In high-stress situations, simplicity and rapid accessibility become essential. The findings show that digital

comfort levels vary across groups, with college students demonstrating greater ease of operation compared to working professionals. This suggests that digital literacy moderates actual usage, even when perceived usefulness is high.

The fourth factor, **Awareness and Training**, reveals a crucial implementation gap. While respondents generally acknowledge the importance of the application, structured sensitization and training programs remain insufficient, particularly in workplace environments. This indicates that policy implementation requires stronger institutional outreach beyond technological deployment.

The fifth factor, **Institutional Trust**, underscores the sociopolitical dimension of digital policing. Confidence in police efficiency, data privacy, and governmental commitment influences long-term sustainability. Trust acts as a reinforcing mechanism that supports continued reliance on the application.

Finally, **Psychological Confidence**, though explaining a smaller proportion of variance, represents an important empowerment dimension. The sense of emotional reassurance and reduced fear contributes to preventive safety and behavioral confidence, especially among younger users.

Collectively, the cumulative variance explained by the six factors demonstrates that effective utilization of the Kavalan SOS app depends on a combination of emergency efficiency, technological reliability, usability, awareness mechanisms, institutional credibility, and psychological empowerment. The comparative findings further indicate that while college students exhibit higher engagement due to digital familiarity and campus-based awareness, working women show lower adoption despite recognizing the app's importance. This gap suggests that technological solutions must be supported by targeted awareness campaigns, digital training initiatives, and strengthened institutional communication strategies to ensure inclusive and sustained adoption.

In conclusion, the factor structure validates that women's safety applications function within a broader socio-technological ecosystem. Emergency response remains the primary driver, but sustained impact depends on trust, accessibility, and systematic awareness interventions.

KEY FINDINGS

- Physical Safety & Immediate Response is the strongest determinant of adoption.
- College students show higher awareness and usage.
- Working women perceive importance but demonstrate lower engagement.
- GPS reliability and police responsiveness influence trust.
- Psychological empowerment contributes to confidence but explains lower variance.

DISCUSSION

The findings align with global research indicating that emergency responsiveness and real-time tracking remain core drivers of safety app adoption (Rahman et al., 2025). Consistent with Doria et al. (2021), usability significantly influences engagement. Indian studies similarly highlight the importance of automatic location sharing and simplified SOS activation (Yadav & Karna, 2025). However, digital literacy gaps and workplace constraints reduce adoption among working professionals (Tamilselvi et al., 2021). Technology alone is insufficient without awareness campaigns, institutional collaboration, and infrastructure support.

RECOMMENDATIONS

- **Strengthening Awareness Initiatives**

Structured awareness campaigns should be implemented in workplaces and higher education institutions to enhance knowledge and informed utilization of the Kavalan SOS App. Institutional orientation programmes, safety workshops, and digital literacy sessions may significantly improve adoption rates, particularly among working women.

- **Enhancement of Customization Features**

The application may be further strengthened by incorporating advanced customization options, such as personalized emergency alerts, selection of trusted responders, and offline-trigger mechanisms for low-connectivity environments. These features could increase user confidence and situational adaptability.

- **Ensuring Data Privacy and Security Transparency**

Transparent data protection policies and clear communication regarding data storage, usage, and confidentiality are essential to build user trust. Periodic security audits and public disclosure of privacy safeguards may enhance institutional credibility and encourage sustained engagement.

- **Promotion of Multi-Stakeholder Collaboration**

Effective implementation requires coordinated efforts among law enforcement agencies, employers, educational institutions, and non-governmental organizations. A collaborative framework can facilitate wider dissemination, capacity building, and community-level trust in digital safety mechanisms.

- **Longitudinal Impact Assessment**

Future research should adopt longitudinal designs to evaluate behavioural outcomes, sustained usage patterns, and long-term perceptions of safety. Such assessments would provide deeper insights into the app's effectiveness beyond immediate response perceptions.

- **Adoption of Inclusive and Accessible Design**

The application should integrate inclusive design principles to accommodate diverse user groups, including rural women and persons with disabilities. Features such as multilingual interfaces, voice-enabled assistance, and simplified navigation can enhance accessibility and equitable digital inclusion.

CONCLUSION

This study examined the awareness and use of the Kavalan SOS mobile application launched by the Tamil Nadu Police among working women and college students in Tiruchirappalli District. The findings show that women mainly use the app because it provides a sense of immediate safety and quick police response during emergencies. The most important factor influencing adoption was physical safety and rapid assistance.

The study also found that features such as accurate GPS location tracking and an easy-to-use interface play an important role in encouraging women to use the app. College students showed higher awareness and usage compared to working women, mainly because they are more familiar with digital technologies and receive information through colleges. Working women, although they believe the app is useful, tend to use it less due to limited awareness programs and lack of structured training in workplaces.

Another important finding is that trust in the police system and confidence in data privacy influence long-term usage. The app also gives users a sense of psychological confidence and reassurance, which supports women's empowerment.

In conclusion, while the Kavalan SOS app is a valuable safety tool, its effectiveness depends not only on technology but also on awareness, training, trust, and proper implementation. Strengthening awareness programs and digital literacy initiatives can improve adoption among all women.

REFERENCES:

1. Crime in India. (n.d.). *Tiruchirappalli city crime statistics: Crimes against women*. https://crime-in-india.github.io/cities/Tiruchirappalli/
2. Doria, N., et al. (2021). Women's experiences of safety apps for sexualized violence: A narrative scoping review. *BMC Public Health, 21*, 2154. https://doi.org/10.1186/s12889-021-12292-5
3. Eisenhut, K., et al. (2020). Mobile applications addressing violence against women: A systematic review. *Journal of Medical Internet Research, 22*(4), e15749.
4. Government of Tamil Nadu. (2022). *Policy initiatives and policing reforms for women's safety in Tamil Nadu*. Home Department, Government of Tamil Nadu. https://www.tn.gov.in
5. Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement, 20*(1), 141–151.

6. Kumar, R. (2019). Police-led mobile safety applications and public trust. *Indian Journal of Public Administration, 65*(2), 215–230.
7. National Crime Records Bureau. (2023a). *Crime in India 2022: Statistics on crimes against women*. Ministry of Home Affairs, Government of India. https://ncrb.gov.in
8. National Crime Records Bureau. (2023b). *Crime in India 2023*. Ministry of Home Affairs, Government of India.
9. Rahman, M. H., et al. (2025). Mobile apps to prevent violence against women and girls: Systematic app research and content analysis. *JMIR Formative Research*.
10. Sankar, E., et al. (2022). Women safety app. *International Journal for Research in Applied Science & Engineering Technology, 10*(6), 345–352.
11. Sharma, P., & Gupta, S. (2020). Digital safety tools and women empowerment in India. *Journal of Gender Studies, 29*(4), 455–470.
12. Tamilselvi, D. T., et al. (2021). Sheltered in safe hands: A study on the usage and effectiveness of the Kavalan SOS app among women. *Turkish Journal of Computer and Mathematics Education, 12*(10), 2156–2164.
13. Times of India. (2020, September 17). Crimes against women and children continue unabated in Tamil Nadu. *The Times of India*. https://timesofindia.indiatimes.com
14. Times of India. (2024, September 18). Tamil Nadu sees decline in overall crimes against women, NCRB data shows mixed trends. *The Times of India*. https://timesofindia.indiatimes.com
15. Tozzo, P., et al. (2021). The usage of mobile apps to fight violence against women. *International Journal of Environmental Research and Public Health, 18*(13), 6968.
16. Verma, S., & Singh, S. (2024). Surakshit: An Android application for women safety. *Journal of Mobile Computing and Applications, 9*(2), 101–110.
17. Yadav, M., & Karna, S. (2025). An analysis of women safety apps in India. *International Journal of Indian Psychology, 13*(1), 112–124.