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Impact of Security Threats on E-commerce Businesses Operated by Women Entrepreneurs: A Comparative Study in Delhi and Faridabad Districts

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Abstract

This study investigates the cybersecurity challenges faced by women entrepreneurs operating e-commerce businesses in two distinct urban centers of North India—Delhi and Faridabad. As digital platforms increasingly become vital tools for economic empowerment, women-led ventures remain disproportionately vulnerable to cyber threats due to limited access to technical knowledge, institutional support, and affordable cybersecurity infrastructure. Utilizing a quantitative, questionnaire-based research design, this study surveyed 300 women entrepreneurs (150 from each city) to examine the prevalence of cybersecurity threats, the effectiveness of institutional support mechanisms such as District Industries Centres (DIC), and the barriers to implementing digital safeguards. Descriptive and inferential statistical analyses, including Chi-square tests, revealed that while awareness of cybersecurity issues is relatively high (over 70%), actual threat exposure—including phishing, malware, and account breaches—is widespread, affecting 66% of respondents. Moreover, institutional schemes like DIC are underutilized due to low awareness and administrative complexity. Key implementation barriers included high costs (36%), time/resource constraints (31%), and technical skill gaps (15.3%). Significant regional differences were observed, affirming the role of urban infrastructure and institutional accessibility in shaping cybersecurity resilience. The study concludes that while digital platforms offer transformative potential for women entrepreneurs, this potential remains undermined by cybersecurity vulnerabilities. It calls for targeted, gender-sensitive interventions including financial subsidies, expert-led capacity-building programs, and streamlined institutional outreach to support safe and inclusive participation in India's growing digital economy.

Introduction

In the age of digital transformation, e-commerce has emerged as a powerful tool of economic empowerment for women entrepreneurs in India, offering flexibility, autonomy, and access to wider markets. However, this progress is increasingly undercut by growing cybersecurity threats—such as phishing, data breaches, account takeovers, and malware—that disproportionately affect women-led businesses. These challenges are further compounded by low levels of technical literacy, limited awareness of threat mitigation strategies, and inadequate access to institutional support systems. This study offers a comparative analysis of 300 women entrepreneurs in Delhi and Faridabad, two urban centers representing different stages of digital and infrastructural development. While Delhi benefits from relatively mature digital infrastructure and support mechanisms, Faridabad presents a digitally transitional landscape with persistent gaps in policy implementation and institutional accessibility. The research investigates the types and severity of cybersecurity threats encountered, assesses the awareness and utilization of support schemes like those offered by District Industries Centres (DIC), and identifies barriers—such as cost, time constraints, and lack of expertise—that hinder the adoption of protective measures. Using a structured questionnaire and supported by statistical tools like Chi-square tests, the study validates four hypotheses concerning operational impact, regional variation, resource constraints, and reputational damage. The findings underscore the need for gender-sensitive, region-specific cybersecurity interventions and policy reforms that promote digital safety, institutional trust, and sustainable e-commerce participation. This research contributes to the limited but growing literature on women's digital vulnerability in India and aligns with national and global agendas such as the Digital India initiative and UN Sustainable Development Goals (SDG 5 and SDG 8).

Review of Literature

In the evolving landscape of digital entrepreneurship, the intersection of gender, technology, and security has emerged as a critical research domain. With the rapid proliferation of e-commerce in India, women entrepreneurs have increasingly leveraged digital platforms to transcend conventional socio-economic constraints. However, this digital empowerment is accompanied by escalating exposure to cyber threats. As highlighted by Chakraborty et al. (2022), in a study published in the *Information Resources Management Journal*, the design, security, and user experience of e-commerce platforms significantly influence customer trust and loyalty. Inadequate website security increases susceptibility to phishing, malware, and financial fraud, especially among small-scale entrepreneurs with limited technological resources. The role of trust and institutional transparency in cybersecurity is further emphasized in a Scopus-indexed study by Oliveira et al. (2017), which highlights how organizational trust frameworks and compliance with data protection regulations influence adoption of cybersecurity best practices among SMEs. This insight aligns with findings from Madnani (2024), who evaluated the reliability of AI systems in managing sensitive data, emphasizing that user confidence hinges on data protection, transparency, and accountability—elements frequently underdeveloped in small enterprises. Moreover, Kaur (2021), in her Routledge-edited volume on women's entrepreneurship in India, illustrates the transformative impact of digital tools in promoting gender-inclusive business environments. Complementing this, a study by Dwivedi et al. (2021), published in *Government Information Quarterly*, establishes that female-led enterprises often lag behind in cybersecurity preparedness due to socio-cultural constraints, insufficient policy access, and lower digital literacy, especially in semi-urban and tier-2 cities. Regional disparities further complicate the digital inclusion of women entrepreneurs. Arora (2021) observes that while Delhi exhibits high digital maturity with advanced IT infrastructure, regions like Faridabad, though rapidly industrializing, still grapple with inconsistent connectivity and lower digital literacy rates. Bishnoi and Mittal (2017) similarly noted that consumer trust and security concerns vary by region, indicating that entrepreneurs in transitional urban markets face greater reputational risks. The institutional dimension has been addressed by Rasheed et al. (2011), whose CRISP working paper examined ICT-based empowerment models for women. Their research underscores the importance of sustained capacity-building, embedded institutional support, and localized digital training—elements crucial for cybersecurity adoption in women-led ventures. In alignment, Alshamrani et al. (2020), writing in *Computers & Security* (Elsevier), emphasize that small businesses are highly vulnerable to cyberattacks unless systematically supported by structured cybersecurity governance and risk-assessment mechanisms. Furthermore, a comparative analysis by Shin and Kang (2020) in *Telecommunications Policy* finds that gender-sensitive cybersecurity policies, when combined with business mentoring and financial support, significantly increase the resilience of women-owned digital enterprises in emerging economies. This underscores the importance of integrating consumer trust-building and institutional safeguards into cybersecurity frameworks.

Taken together, the literature converges on the understanding that while e-commerce presents transformative opportunities for women entrepreneurs, it also introduces complex challenges—particularly in terms of digital security, institutional support, and regional disparities in digital readiness. There remains a pressing need for primary, data-driven research that examines the real-world cybersecurity practices, awareness levels, and institutional engagement of women-led businesses across distinct urban contexts such as Delhi and Faridabad.

Research methodology

Research Design

This research is designed as a quantitative, questionnaire-based empirical study with a descriptive-comparative orientation, aimed at systematically assessing the cybersecurity challenges, awareness levels, institutional support mechanisms, and business impacts experienced by women entrepreneurs engaged in e-commerce in Delhi and Faridabad. A structured questionnaire served as the central tool for primary data collection.

Population and Sampling Framework

The population for this study comprised women entrepreneurs actively operating e-commerce businesses in the urban regions of Delhi and Faridabad. Given the comparative nature of the research, a stratified random sampling technique was employed to ensure equal representation from both regions and across diverse business models (product-based, service-based, and hybrid). A total of 300 valid responses were obtained—150 from each location—providing a regionally balanced and statistically sound basis for comparative analysis. Sampling frames were established using business listings, women entrepreneur networks, and digital business registries.

Questionnaire Design and Data Collection

Primary data were collected through a structured, pre-tested questionnaire, which was meticulously designed to capture both factual and perceptual insights from women entrepreneurs across multiple dimensions relevant to cybersecurity. The questionnaire covered key thematic areas including demographic characteristics (such as age group, business type, and location), awareness and understanding of cybersecurity threats, direct experience with specific cyber incidents (e.g., phishing, data breaches, identity theft, malware, hacking), and the extent of familiarity with institutional support mechanisms, particularly those offered by the District Industries Centres (DIC). Additionally, it explored perceived business impact resulting from such threats, challenges encountered in implementing cybersecurity safeguards, and the participants' expectations from government or institutional support. The questionnaire was composed of close-ended, multiple-choice, and matrix-type items to facilitate standardized responses and ensure compatibility with statistical analysis. It was disseminated via both digital platforms and printed copies to maximize outreach. A pilot test involving 20 participants was conducted to assess reliability and clarity, following which minor refinements were incorporated to enhance content validity.

Data Analysis Techniques

The collected data were systematically coded and analyzed using IBM SPSS Statistics (Version 26) to derive statistically significant insights from the questionnaire responses. The analytical process involved two levels: descriptive and inferential analysis. Descriptive statistics were applied to summarize demographic profiles and general trends using frequencies, percentages, and cross-tabulations. These offered an overview of age distribution, business type, cybersecurity awareness levels, and perceived threat experiences. For inferential analysis, Chi-square tests of independence were conducted to examine the relationships between categorical variables—such as location and threat awareness, experience of specific cybersecurity incidents, and access to institutional support like DIC schemes. In addition, Likelihood Ratio statistics were used to support the robustness of the Chi-square results, especially in cases with small expected frequencies. Furthermore, Cramér's V was employed to determine the strength of association between variables. All statistical inferences were drawn using a standard significance level of $p < 0.05$, ensuring the reliability of observed patterns across the sample.

Ethical Considerations

This research was conducted in full compliance with established ethical guidelines to ensure the integrity, transparency, and voluntariness of participation. All respondents were thoroughly informed about the objectives, scope, and academic nature of the study prior to data collection. Explicit consent was obtained through a formal consent statement embedded within the questionnaire. Participants were assured that their involvement was entirely voluntary and that they could withdraw at any stage without any consequence. The study maintained strict confidentiality of all data collected—no personally identifiable information was requested or recorded. Responses were anonymized during analysis to preserve the privacy and dignity of each respondent. Additionally, the study refrained from offering any financial incentives or coercive persuasion to encourage participation. The entire research process was designed to adhere to ethical protocols laid down by the institutional review board, particularly with respect to human subject research. Due diligence was observed in ensuring that the questionnaire did not include any content that could cause psychological discomfort or social risk to the participants. The findings derived from this research are presented objectively, and no data manipulation or fabrication was undertaken at any stage.

Scope and Limitation:

This study focuses exclusively on urban women entrepreneurs engaged in e-commerce in Delhi and Faridabad, providing a localized view of cybersecurity awareness, threat experiences, and institutional support. Rural or non-digital businesses are outside the scope of this research. Given the reliance on self-reported questionnaire data, limitations include potential biases such as recall inaccuracies and socially desirable responses. The cross-sectional nature of the study also restricts causal inferences. Nonetheless, the research contributes valuable empirical insights with relevance for gender-responsive policy design and institutional strengthening in India's digital economy.

Data Analysis and Interpretation

Demographic Profile of Respondents:

This table presents the age-wise distribution of the 300 women entrepreneurs who participated in the study, with equal representation from Delhi and Faridabad (150 each). Respondents below 25 years formed the largest group (29%), followed by those aged 46–55 (28%), 26–35 (22%), and 36–45 (17.7%). The smallest proportion (3.3%) was from the 56 and above category. This distribution reflects a diverse mix of generational perspectives in the digital business environment.

Table 1: Age-wise Distribution of Respondents

Age Group	Frequency	Percent	Valid Percent	Cumulative Percent
26–35	66	22.0%	22.0%	22.0%
36–45	53	17.7%	17.7%	39.7%
46–55	84	28.0%	28.0%	67.7%
56 and above	10	3.3%	3.3%	71.0%
Below 25	87	29.0%	29.0%	100.0%
Total	**300**	**100%**	**100%**	**100%**

Table 1 represents the distribution of respondents across different age groups, highlighting generational diversity among the sample of 300 women e-commerce entrepreneurs from Delhi and Faridabad. This age-based segmentation helps contextualize patterns in cybersecurity awareness, experience, and response behaviors. Respondents below 25 years formed the largest group (29%), followed by those aged 46–55 (28%), 26–35 (22%), and 36–45 (17.7%). The smallest proportion (3.3%) was from the 56 and above category. This distribution reflects a diverse mix of generational perspectives in the digital business environment.

Next here Figure 1 visually presents the age-wise segmentation of 300 women entrepreneurs engaged in e-commerce activities across Delhi and Faridabad. This graphical representation complements Table 1 and offers an intuitive overview of the generational spread of participants, which is an essential demographic factor influencing technological awareness, adoption patterns, and security preparedness.

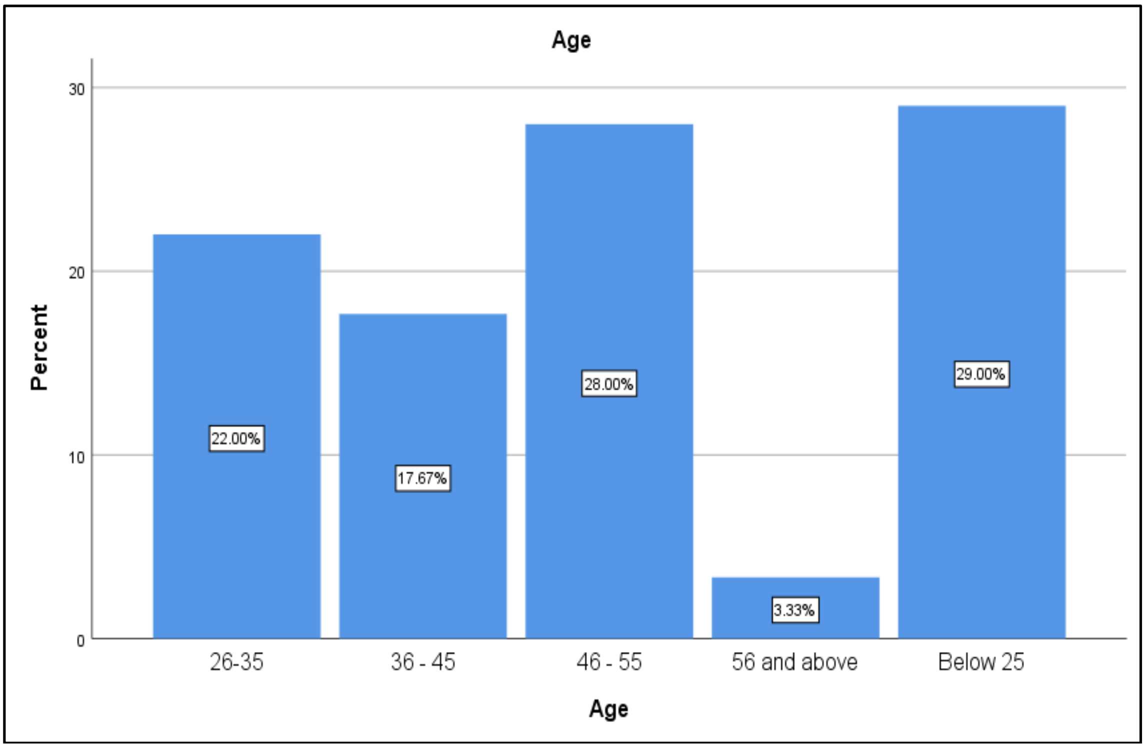

Figure 1: Age-wise Distribution of Respondents

As depicted in the bar chart, respondents under the age of 25 constitute the largest group, representing 29% of the total sample. The second-largest age cohort falls in the 46–55 bracket at 28%, followed by 22% in the 26–35 range, and 17.7% in the 36–45 group. The smallest segment—3.3%—comprises entrepreneurs aged 56 and above. The chart reveals that the majority of digital women entrepreneurs are either young (below 25) or mid-career (46–55), suggesting a dual leadership dynamic between digital-native entrepreneurs and experienced businesswomen adapting to e-commerce environments.

Location-wise Distribution of Respondents

Table 2 shows the location-wise distribution of respondents, confirming an equal representation from both Delhi and Faridabad. This geographic balance was intentionally maintained to ensure a fair and regionally comparative analysis of cybersecurity awareness and experiences among urban women entrepreneurs.

Table 2: Geographic Distribution of Respondents by Location

Location	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Delhi	**150**	**50.0%**	**50.0%**	**50.0%**
Faridabad	**150**	**50.0%**	**50.0%**	**100.0%**
Total	**300**	**100%**	**100%**	**100%**

The table reflects a 50–50 split between the two districts, allowing the research to examine cybersecurity patterns within two distinct but economically significant urban environments. This distribution strengthens the comparative integrity of the study and enhances the validity of regional inference.

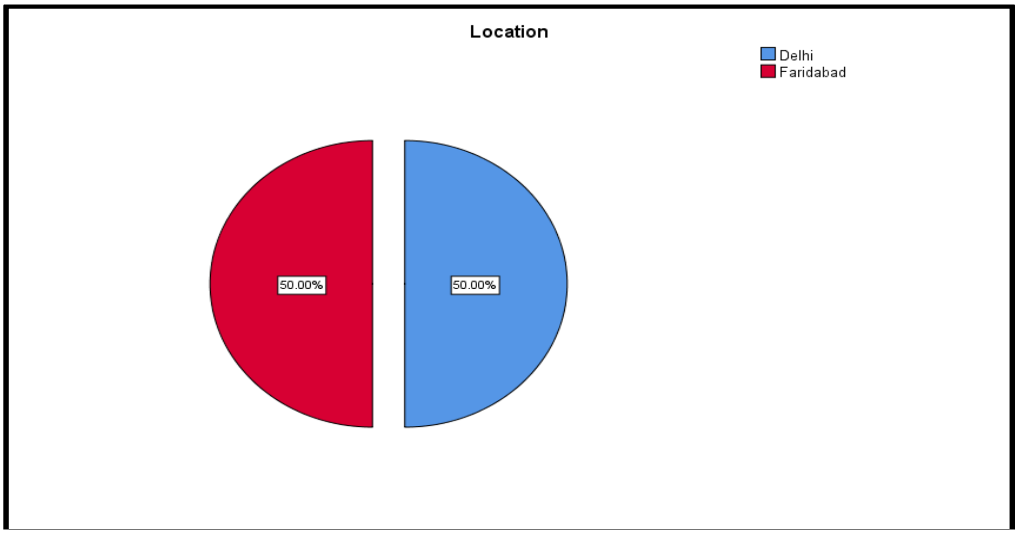

Figure 2: Pie Chart Showing Location-wise Distribution of Respondents

Figure 2 visually presents the location-wise distribution of the 300 respondents through a pie chart. As clearly illustrated, the sample was equally divided between Delhi (50%) and Faridabad (50%). This perfect parity in regional representation was a deliberate design choice to enable balanced comparative analysis across geographic contexts. The chart highlights the methodological rigor applied to ensure fairness in assessing cybersecurity awareness, threats, and institutional accessibility between the two urban zones.

Type of E-commerce Business

In Table 3 presents the distribution of women e-commerce entrepreneurs by the nature of their businesses. The data indicate that the majority (44%) operate service-based ventures, such as consulting, wellness, or beauty services. A substantial portion (30.3%) manage mixed models offering both products and services, while 25.7% are engaged in product-centric businesses like fashion or home décor.

Table 3: Distribution of Respondents by Type of E-commerce Business

Type of E-commerce Business	Frequency	Percent	Valid Percent	Cumulative Percent
Mixed (Both Products & Services)	91	30.3%	30.3%	30.3%
Product-Based (e.g., Fashion, Home Décor)	77	25.7%	25.7%	56.0%
Service-Based (e.g., Consulting, Beauty Services)	132	44.0%	44.0%	100.0%
Total	300	100%	100%	100%

This distribution underscores the strong participation of women in service-oriented sectors, likely due to lower capital requirements, ease of online delivery, and greater alignment with home-based entrepreneurship. The presence of mixed models also indicates a trend toward diversified online offerings to enhance business sustainability. Same Figure 3 illustrates the distribution of e-commerce business models operated by women entrepreneurs who participated in the study. The visual representation provides insight into the dominant business orientations—service, product, or mixed—and sets the foundation for analyzing their relationship with cybersecurity preparedness and digital operational behavior.

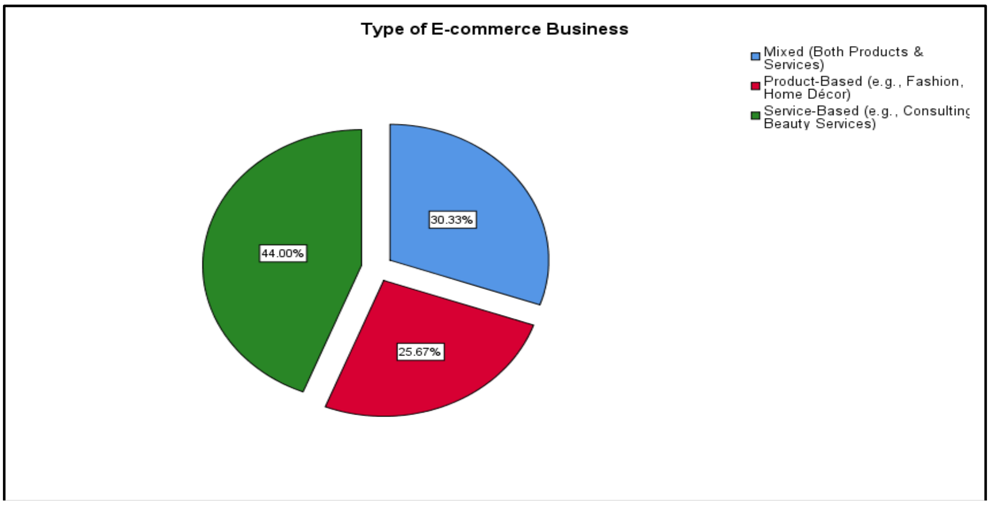

Figure 3: Bar Graph Showing Distribution of Respondents by Type of E-commerce Business

The bar graph indicates that service-based ventures account for the largest portion of the sample, comprising 44% of respondents. These businesses typically include consultancy, wellness, education, and beauty services—sectors that are often easier to digitize and manage remotely. Mixed businesses, which combine both product and service offerings, make up 30.3%, suggesting a trend toward diversification and flexible market strategies. Product-based businesses, including segments like fashion, home décor, and handicrafts, account for 25.7%. This distribution reflects the broader entrepreneurial trend among women to pursue digitally manageable, scalable, and customer-centric ventures.

Here, Table 6 presents a comparative age-wise analysis of women entrepreneurs in Delhi and Faridabad engaged in e-commerce. Understanding the demographic composition of respondents helps assess generational trends in digital entrepreneurship, especially how age may influence cybersecurity awareness, digital adaptability, and institutional engagement.

Table 4: Comparative Age-wise Distribution of Respondents by Location

Location			Frequency	Percent	Valid Percent	Cumulative Percent
Delhi	**Valid**	**26-35**	**31**	**20.7**	**20.7**	**20.7**
		36 - 45	**22**	**14.7**	**14.7**	**35.3**
		46 - 55	**42**	**28.0**	**28.0**	**63.3**
		56 and above	**10**	**6.7**	**6.7**	**70.0**
		Below 25	**45**	**30.0**	**30.0**	**100.0**
		Total	**150**	**100.0**	**100.0**	
Faridabad	**Valid**	**26-35**	**35**	**23.3**	**23.3**	**23.3**
		36 - 45	**31**	**20.7**	**20.7**	**44.0**
		46 - 55	**42**	**28.0**	**28.0**	**72.0**
		Below 25	**42**	**28.0**	**28.0**	**100.0**
		Total	**150**	**100.0**	**100.0**	

In Delhi, the largest age group of entrepreneurs falls under "Below 25" (30%), followed by those aged 46–55 (28%), and 26–35 (20.7%). A notable share (6.7%) of respondents were aged 56 and above, indicating slightly broader age representation in the capital. In Faridabad, the age spread is similar but with no representation in the 56+ category. The largest segment was tied between "Below 25" (28%) and "46–55" (28%), followed closely by 26–35 (23.3%) and 36–45 (20.7%). These results suggest that while younger entrepreneurs (below 35) form a significant portion of the digital business landscape in both cities, Delhi shows more diversity at the upper age levels. This generational distribution can influence risk perception, tech fluency, and the nature of cybersecurity preparedness across regions.

Next in Table 5 displays the classification of e-commerce business models operated by women entrepreneurs across two regions: Delhi and Faridabad. It enables comparative insight into the types of ventures—mixed, product-based, or service-based—preferred in each urban setting.

Table 5: Comparative Distribution of E-commerce Business Types by Location

Location			Frequency	Percent	Valid Percent	Cumulative Percent
Delhi	**Valid**	**Mixed (Both Products & Services)**	**42**	**28.0**	**28.0**	**28.0**
		Product-Based (e.g., Fashion, Home Décor)	**39**	**26.0**	**26.0**	**54.0**
		Service-Based (e.g., Consulting, Beauty Services)	**69**	**46.0**	**46.0**	**100.0**
		Total	**150**	**100.0**	**100.0**	
Faridabad	**Valid**	**Mixed (Both Products & Services)**	**49**	**32.7**	**32.7**	**32.7**
		Product-Based (e.g., Fashion, Home Décor)	**38**	**25.3**	**25.3**	**58.0**
		Service-Based (e.g., Consulting, Beauty Services)	**63**	**42.0**	**42.0**	**100.0**
		Total	**150**	**100.0**	**100.0**	

In Delhi, service-based businesses dominate (46%), followed by mixed businesses (28%) and product-based models (26%). Similarly, Faridabad shows a strong leaning toward service-based businesses (42%), but with a slightly higher share of mixed enterprises (32.7%). Product-based ventures are nearly equal in both cities (Delhi: 26%, Faridabad: 25.3%). The consistency in service-led models reflects a preference for low-capital, flexible enterprises, while the rise of mixed businesses, especially in Faridabad, suggests a growing trend toward diversification in urban e-commerce.

Awareness and Experience of Cybersecurity Threats

Among the 300 respondents, a large majority (70.3%) reported awareness of common cybersecurity threats. Crosstab analysis revealed that **Delhi respondents showed slightly higher awareness (70.7%)** than those from Faridabad (69.3%).

When asked about direct experience with threats:

- **Phishing, malware/ransomware, and hacking/account takeover** were the most reported.
- **Chi-square analysis** demonstrated statistically significant differences in the type and frequency of threats experienced in both cities (Delhi: χ^2 = 28.294, p = .000; Faridabad: χ^2 = 26.743, p = .000), indicating strong regional variation in exposure patterns.

The next Table 6 explores the relationship between cybersecurity awareness and the actual experience of various cyber threats among women entrepreneurs in Delhi and Faridabad. The threats considered include phishing, malware/ransomware, identity theft, account takeover, and data breaches. The table helps determine whether awareness levels correspond to a reduction in threat exposure or differ significantly by region.

Table 6: Association Between Cybersecurity Awareness and Experienced Threats by Location

Count								
			Which of the following cybersecurity threats have you experienced in your e-commerce business?					
Location			**Data Breaches**	**Hacking / Account Takeover**	**Identity Theft**	**Malware / Ransomware**	**Phishing**	**Total**
Delhi	**Are you aware of the common**	**No**	**5**	**24**	**0**	**15**	**0**	**44**

	cybersecurity threats faced by e-commerce businesses?	**Yes**	**23**	**22**	**21**	**27**	**13**	**106**
	Total		**28**	**46**	**21**	**42**	**13**	**150**
Faridabad	**Are you aware of the common cybersecurity threats faced by e-commerce businesses?**	**No**	**6**	**22**	**0**	**17**	**0**	**45**
		Yes	**29**	**19**	**18**	**29**	**10**	**105**
	Total		**35**	**41**	**18**	**46**	**10**	**150**

In both Delhi and Faridabad, respondents who reported being unaware of cybersecurity threats still experienced significant incidents—most notably, 24 cases of hacking/account takeover in Delhi and 22 in Faridabad, along with a considerable number of malware/ransomware cases. This indicates that lack of awareness does not insulate entrepreneurs from threat exposure. Among those who were aware, high threat reports were still observed. For instance, in Delhi, 27 malware/ransomware, 23 data breach, and 21 identity theft cases were reported by aware participants. Faridabad showed similar patterns, with 29 malware/ransomware, 29 data breach, and 18 identity theft cases among the aware group. These findings suggest that awareness alone may not be sufficient to prevent cyber threats, especially if technical knowledge and prevention strategies are lacking. The high frequency of attacks among both aware and unaware groups calls for deeper institutional support and practical cybersecurity training tailored to women-led e-commerce businesses.

Table 7 presents the results of Chi-square statistical tests conducted to examine whether there is a significant association between women entrepreneurs' cybersecurity awareness and their actual experiences of cyber threats. The analysis is performed separately for Delhi and Faridabad, using Pearson's Chi-square and Likelihood Ratio methods on 150 valid cases from each region.

Table 7: Chi-Square Test Results for Association Between Cybersecurity Awareness and Threat Experience by Location

Chi-Square Tests

Location		**Value**	**df**	**Asymptotic Significance (2-sided)**
Delhi	**Pearson Chi-Square**	**28.294[a]**	**4**	**.000**
	Likelihood Ratio	**36.826**	**4**	**.000**
	N of Valid Cases	**150**		
Faridabad	**Pearson Chi-Square**	**26.743[b]**	**4**	**.000**
	Likelihood Ratio	**33.968**	**4**	**.000**
	N of Valid Cases	**150**		

a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 3.81.
b. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 3.00.

The results for both locations indicate highly significant associations. In Delhi, the Pearson Chi-square value is 28.294 with a p-value of .000, and the Likelihood Ratio is 36.826—also significant at the 0.01 level. Similarly, Faridabad's Pearson Chi-square is 26.743, and its Likelihood Ratio is 33.968, both with p-values of .000. These results confirm that there is a statistically significant relationship between being aware of cybersecurity threats and experiencing them. However, the significance in both locations does not necessarily imply that awareness prevents threat exposure; rather, it may reflect that more aware respondents are better able to identify and report such threats. The note on expected cell counts ("10% of cells had expected counts < 5") is within acceptable limits, suggesting the results are robust and reliable. These findings validate the hypothesis that cybersecurity awareness levels are significantly associated with threat experience patterns, and they reinforce the need for not only awareness but also practical training and institutional intervention.

DIC Support and Institutional Awareness

Awareness of **District Industries Centre (DIC) cybersecurity schemes** was moderate, with only 49.3% of respondents reporting familiarity. In Delhi, 58.7% of respondents were aware of DIC schemes, while in Faridabad it was 61.3%.

However, actual **benefit derived from DIC support** was limited:

- Only 52 (17.3%) respondents reported receiving some form of DIC assistance.
- **Chi-square tests** again confirmed statistically significant differences in awareness and utilization between the two regions (Delhi: χ^2 = 11.070, p = .004; Faridabad: χ^2 = 8.441, p = .015).

Here Table 8 presents the relationship between awareness of District Industries Centre (DIC) cybersecurity schemes and the extent to which women entrepreneurs in Delhi and Faridabad have actually benefited from them. The table provides a cross-tabulated view to evaluate how institutional outreach and awareness levels translate into tangible support outcomes across both regions.

Table 8: Cross-tabulation of DIC Awareness and Reported Benefits from Cybersecurity Support Schemes by Location

Location			Have you benefited from any DIC support programs specifically aimed at cybersecurity?			Total
			No	Not Sure	Yes	
Delhi	Are you aware of the support schemes offered by the District Industries Centre (DIC) for cybersecurity?	No	16	15	31	62
		Yes	37	30	21	88
	Total		53	45	52	150
Faridabad	Are you aware of the support schemes offered by the District Industries Centre (DIC) for cybersecurity?	No	17	11	30	58
		Yes	38	28	26	92
	Total		55	39	56	150

In Delhi, of the 150 respondents, 88 (58.7%) reported being aware of DIC support schemes. However, only 21 of them (14%) stated they had actually benefited from these programs, while 37 respondents (24.7%) who were aware of the schemes reported no benefit. An additional 30 were unsure whether they had benefited. A similar pattern is observed in Faridabad, where 92 respondents (61.3%) were aware of DIC schemes. Among them, only 26 (17.3%) reported tangible benefits. A large proportion—38 aware but not benefited, and 28 unsure—indicates limited conversion of awareness into actual institutional support. These findings point to a significant gap between policy awareness and effective access or utility. Many respondents either do not experience the intended outcomes or remain uncertain about their eligibility or receipt of services. This suggests a need for improved implementation, better communication, and more targeted capacity-building within DIC programs to make cybersecurity resources more actionable and accessible to women-led e-commerce enterprises.

This Table 9 presents the results of Chi-square statistical tests used to assess the association between women entrepreneurs' awareness of District Industries Centre (DIC) cybersecurity schemes and their reported benefit from such programs. The analysis is conducted separately for Delhi and Faridabad using Pearson's Chi-square and Likelihood Ratio methods on 150 valid responses from each region.

Table 9: Chi-Square Test Results for Association Between DIC Awareness and Cybersecurity Support Benefit by Location

Location		Value	df	Asymptotic Significance (2-sided)
Delhi	Pearson Chi-Square	11.070[a]	2	.004

	Likelihood Ratio	**11.056**	**2**	**.004**
	N of Valid Cases	**150**		
Faridabad	**Pearson Chi-Square**	**8.441^b**	**2**	**.015**
	Likelihood Ratio	**8.402**	**2**	**.015**
	N of Valid Cases	**150**		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.60.
b. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.08.

In Delhi, the Pearson Chi-square value is 11.070 with 2 degrees of freedom and a p-value of .004, indicating a statistically significant association between DIC awareness and perceived benefit. Similarly, in Faridabad, the Pearson Chi-square is 8.441 with a p-value of .015, also statistically significant. These results suggest that respondents who are aware of DIC cybersecurity schemes are more likely to have benefited from them. However, the fact that many aware respondents still report no benefit or are unsure (as seen in Table 9) underscores that awareness alone does not ensure impact. There appears to be a conversion gap between policy knowledge and actual access to institutional support, potentially due to administrative hurdles, lack of guidance, or ambiguity in eligibility and process. Both p-values being below 0.05 affirm the significance of the association and support the notion that increasing awareness could potentially enhance scheme utilization—but only if coupled with effective outreach and simplified benefit mechanisms.

Perceived Impact of Cybersecurity Threats

Respondents were asked to rate the impact of cyber threats on their business operations:

- 15.7% reported **high impact**, 33.7% reported **moderate impact**, and 37.3% reported **low impact**.
- Notably, a small percentage (13.3%) reported **no impact**, often aligning with those unaware of existing threats.

Chi-square analysis confirmed that perceived impact differed significantly across regions:

- Delhi: $\chi^2 = 20.063$, p = .000
- Faridabad: $\chi^2 = 47.599$, p = .000

These results affirm **Hypotheses H1 and H4**, indicating that cybersecurity threats have significant operational and reputational consequences.

Here, Table 10 presents a comparative overview of the additional support requested by women e-commerce entrepreneurs from the District Industries Centre (DIC) to enhance their cybersecurity preparedness. The responses are categorized by type of support desired—such as affordable cybersecurity tools, expert consultation, financial assistance, and regular training—and are further segmented by awareness of DIC schemes in both Delhi and Faridabad.

Table 10: Preferred Forms of Additional Support from DIC to Improve Cybersecurity Resilience by Location

			What additional support would you like from DIC to enhance your cybersecurity resilience?				
Location			**Access to affordable cybersecurity tools**	**Consultation with cybersecurity experts**	**Financial support for implementing security measures**	**Regular workshops and training programs on cybersecurity**	**Total**
Delhi	**Are you aware of the support schemes offered by the District Industries Centre**	**No**	**10**	**26**	**11**	**15**	**62**
		Yes	**22**	**26**	**19**	**21**	**88**

	(DIC) for cybersecurity?						
	Total		**32**	**52**	**30**	**36**	**150**
Faridabad	**Are you aware of the support schemes offered by the District Industries Centre (DIC) for cybersecurity?**	**No**	**13**	**22**	**9**	**14**	**58**
		Yes	**23**	**29**	**20**	**20**	**92**
	Total		**36**	**51**	**29**	**34**	**150**

Across both locations, the most commonly requested support was consultation with cybersecurity experts (Delhi: 52 responses; Faridabad: 51), followed by regular workshops and training programs (Delhi: 36; Faridabad: 34). This indicates a clear demand for practical, skill-building engagements to enhance digital resilience. Interestingly, awareness of DIC schemes played a role in shaping preferences. In Delhi, 22 aware respondents requested affordable tools and 19 requested financial support, compared to lower numbers from the unaware group (10 and 11, respectively). A similar pattern was noted in Faridabad, where 23 aware respondents sought affordable tools, and 20 requested financial support—both higher than those unaware. These findings suggest that greater institutional awareness not only increases expectations but also encourages proactive engagement. The strong interest in consultation and training—regardless of awareness level—underscores the need for DICs to move beyond policy declarations and offer regular, accessible, and region-specific capacity-building initiatives.

Here, Table 11 provides the statistical results of Chi-square tests conducted to evaluate whether women's awareness of DIC cybersecurity schemes is significantly associated with their preferences for specific types of additional institutional support. The data is analyzed separately for Delhi and Faridabad.

Table 11: Chi-Square Test Results for Association Between DIC Awareness and Preferred Cybersecurity Support by Location

Location		**Value**	**df**	**Asymptotic Significance (2-sided)**
Delhi	**Pearson Chi-Square**	**3.224**[a]	**3**	**.358**
	Likelihood Ratio	**3.246**	**3**	**.355**
	N of Valid Cases	**150**		
Faridabad	**Pearson Chi-Square**	**1.332**[b]	**3**	**.722**
	Likelihood Ratio	**1.348**	**3**	**.718**
	N of Valid Cases	**150**		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.40.

b. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.21.

For Delhi, the Pearson Chi-square value is 3.224 with 3 degrees of freedom and a p-value of 0.358. Similarly, the Likelihood Ratio is 3.246 with the same significance level. For Faridabad, the Pearson Chi-square is 1.332 and the p-value is 0.722, with the Likelihood Ratio producing almost identical results (1.348; p = 0.718). In both cases, the p-values are well above the 0.05 threshold, indicating that there is no statistically significant relationship between DIC awareness and the type of support respondents prefer. This suggests that regardless of whether women entrepreneurs are aware of DIC's existing cybersecurity schemes, their expectations and support preferences remain broadly consistent. The demand for tools, training, consultations, and financial support is widespread and not influenced by prior exposure to DIC initiatives. This finding points to the universal nature of support needs and highlights the importance of inclusive outreach strategies that cater equally to both aware and unaware beneficiaries.

Challenges in Implementing Cybersecurity Measures

The top challenges cited were:

- High cost of cybersecurity tools (36%)
- Lack of time/resources (31%)
- Lack of expertise (15.3%)
- Perception that cybersecurity is not a priority (17.7%)

These responses suggest the presence of systemic constraints, particularly financial and knowledge-related barriers. While awareness exists, implementation remains a challenge—highlighting a gap between knowledge and action.

Here Table 12 examines the perceived impact of cybersecurity threats on the business continuity and growth of women-led e-commerce ventures in Delhi and Faridabad. The data is categorized by whether respondents had experienced any actual negative impacts (such as data loss or reputational damage).

Table 13: Impact of Cybersecurity Threats on Operational Resilience by Location

Location			How would you rate the overall impact of cybersecurity threats on the operational resilience and growth of your e-commerce business?				Total
			High impact	Low impact	Moderate impact	No impact	
Delhi	Have you experienced any negative impact on your business due to cybersecurity threats (e.g., loss of customer data, revenue loss, reputation damage)?	No	0	16	15	0	31
		Yes	19	43	27	30	119
	Total		19	59	42	30	150
Faridabad	Have you experienced any negative impact on your business due to cybersecurity threats (e.g., loss of customer data, revenue loss, reputation damage)?	No	0	30	41	0	71
		Yes	28	23	18	10	79
	Total		28	53	59	10	150

In Delhi, 119 respondents who had experienced negative impacts rated the consequences as **high (19)**, **moderate (27)**, **low (43)**, or **no impact (30).** Interestingly, even among those who hadn't experienced direct attacks (31 respondents), several still reported **moderate or low impact**, possibly due to indirect exposure or perception of risk. In Faridabad, the 79 respondents who experienced threats reported **high (28)**, **moderate (18)**, **low (23)**, or **no impact (10).** Among the 71 who did not report any negative experience, surprisingly many still perceived **moderate (41)** or **low (30)** levels of impact. These findings suggest a **significant psychological or operational perception of threat**, even in the absence of direct experience, highlighting the **diffuse nature of digital insecurity**.

Table 13 presents the Chi-square test results for the association between perceived business impact and actual experience of cyber threats.

Table 13: Chi-Square Test Results – Impact of Cybersecurity Threats and Experience

Location		**Value**	**df**	**Asymptotic Significance (2-sided)**
Delhi	**Pearson Chi-Square**	**20.063**[a]	**3**	**.000**
	Likelihood Ratio	**29.141**	**3**	**.000**
	N of Valid Cases	**150**		
Faridabad	**Pearson Chi-Square**	**47.599**[b]	**3**	**.000**
	Likelihood Ratio	**62.388**	**3**	**.000**
	N of Valid Cases	**150**		

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 3.93.
b. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.73.

In both cities, the results are **highly statistically significant**:

- **Delhi**: χ^2 = 20.063, df = 3, p = .000
- **Faridabad**: χ^2 = 47.599, df = 3, p = .000

These values strongly support the hypothesis that **those who have experienced threats also perceive a higher operational impact**, affirming the real-world consequences of digital insecurity. The likelihood ratio tests corroborate the Pearson Chi-square values, and minimal expected count warnings indicate reliable distribution.

4.5 Challenges in Implementing Cybersecurity Measures

Table 14 presents the key barriers reported by women entrepreneurs while attempting to implement cybersecurity safeguards, segmented by city and prior experience of threat impact. In Delhi, high cost (40), lack of time/resources (36), and insufficient expertise (23) were the most cited issues among those who had experienced cyberattacks. Even among those without such experiences, 12 reported time constraints and 10 cited cost issues.In Faridabad, similar patterns were observed. Among the 79 who experienced attacks, high cost (34), time/resource constraints (22), and perception of no threat (16) were significant. Surprisingly, among those who had not experienced cyber threats, many still faced challenges like high cost (24) and time/resource limitations (23). This consistent pattern across both groups and locations highlights systemic challenges in cybersecurity implementation. Whether or not entrepreneurs have faced actual attacks, they often lack the tools, time, or knowledge needed to take preventive action. This underscores the importance of institutional and educational interventions beyond just awareness.

Table 14: Challenges in Implementing Cybersecurity Measures by Location and Threat Experience

Location	Threat Experience	High Cost	Lack of Knowledge	Lack of Time/Resources	No Perceived Threat	Total
Delhi	No	10	5	12	4	31
	Yes	40	23	36	20	119
Total		**50**	**28**	**48**	**24**	**150**
Faridabad	No	24	11	23	13	71
	Yes	34	7	22	16	79
Total		**58**	**18**	**45**	**29**	**150**

4.6 Statistical Significance of Cybersecurity Challenges by Threat Experience

Table 15 reports the results of Chi-square tests examining the relationship between entrepreneurs' experience of cybersecurity threats and the challenges they face in implementing preventive measures. For both Delhi and Faridabad, the Pearson Chi-square and Likelihood Ratio values are **not statistically significant** ($p > 0.05$), suggesting no meaningful association between experiencing cyber threats and perceiving implementation challenges. This implies that **cybersecurity barriers—such as high cost, limited knowledge, or lack of time/resources—exist independently of whether entrepreneurs have faced actual attacks.** These findings indicate structural challenges in cybersecurity readiness that need to be addressed systemically, not just reactively.

Table 15: Chi-Square Test Results for Association Between Threat Experience and Challenges in Cybersecurity Implementation

Location	**Test Type**	**Value**	**df**	**Asymptotic Significance (2-sided)**
Delhi	Pearson Chi-Square	0.932	3	0.818
	Likelihood Ratio	0.924	3	0.820
Faridabad	Pearson Chi-Square	2.526	3	0.471
	Likelihood Ratio	2.535	3	0.469

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.96.
b. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.52.

4.7 Experience of Negative Cybersecurity Impact

Cybersecurity threats are not just hypothetical risks—they have tangible and widespread effects on digital businesses, particularly those led by women entrepreneurs. This subsection focuses on the actual impact these threats have had on the study's participants.

Table 16: Frequency of Respondents Reporting Negative Cybersecurity Impact

Response	Frequency	Percent	Valid Percent	Cumulative Percent
No	102	34.0%	34.0%	34.0%
Yes	198	66.0%	66.0%	100.0%
Total	**300**	**100%**	**100%**	**100%**

Description: Table 16 shows that **198 out of 300 respondents (66%)** reported experiencing negative impacts on their business as a result of cybersecurity threats. These impacts included data loss, revenue loss, and reputational harm. The remaining **34% (102 respondents)** reported no such negative experience. The data underscores the widespread prevalence and seriousness of cyber threats in women-led e-commerce ventures, reinforcing the importance of targeted preventive measures and institutional support frameworks.

Figure 4 presents a pie chart illustrating the proportion of women entrepreneurs who experienced negative impacts due to cybersecurity threats such as data breaches, revenue loss, or reputational harm. The chart reveals that a substantial **66%** of respondents reported being affected, while **34%** indicated no such experience. This visual representation reinforces the findings shown in Table 17, emphasizing the high prevalence of cybersecurity-related disruptions in women-led e-commerce ventures. The dominance of the affected segment in the chart highlights the urgency for more inclusive cybersecurity interventions, institutional safeguards, and policy frameworks tailored to support digital resilience among female entrepreneurs.

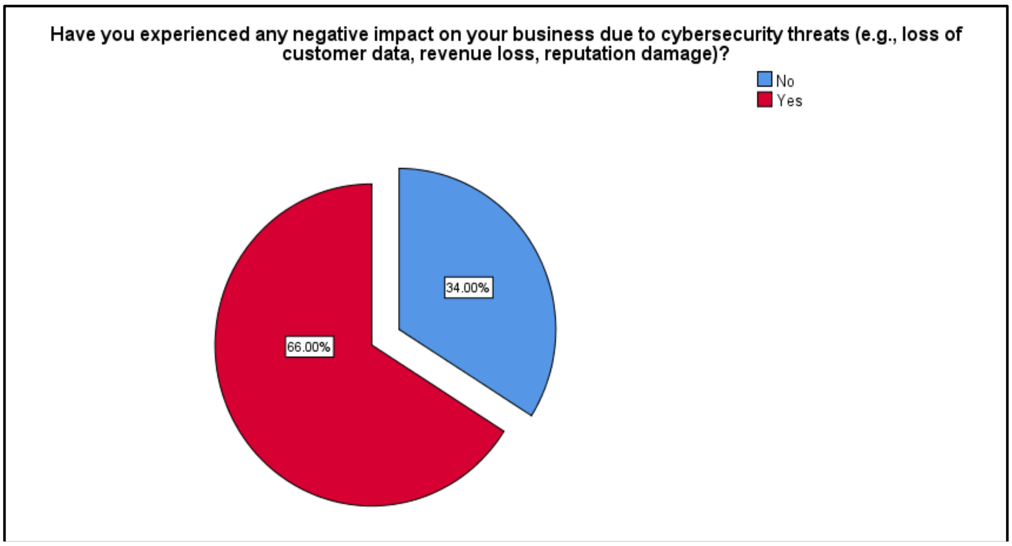

Figure 4: Pie Chart Showing Experience of Negative Cybersecurity Impact

Perceived Impact of Cybersecurity Threats

Cybersecurity threats, whether realized or anticipated, have varying levels of operational and strategic impact on digital businesses. This section explores how women entrepreneurs perceive the influence of cyber threats on the resilience and growth of their e-commerce enterprises. The responses provide insight into the intensity of disruption faced across a spectrum ranging from negligible to severe. Table 18 summarizes respondents' ratings of how cybersecurity threats have impacted the resilience and growth of their e-commerce businesses. The majority of respondents perceived the impact to be **low (37.3%)** or **moderate (33.7%)**, while **15.7%** considered the threats to have a high impact on their operations. A smaller proportion, **13.3%**, reported no noticeable impact. These findings indicate that while the direct consequences may vary, most women entrepreneurs acknowledge cybersecurity as a factor affecting their business continuity and growth trajectory.

Table 17: Perceived Impact of Cybersecurity Threats on Business Operations

Impact Level	Frequency	Percent	Valid Percent	Cumulative Percent
High Impact	47	15.7%	15.7%	15.7%
Low Impact	112	37.3%	37.3%	53.0%
Moderate Impact	101	33.7%	33.7%	86.7%
No Impact	40	13.3%	13.3%	100.0%
Total	**300**	**100%**	**100%**	**100%**

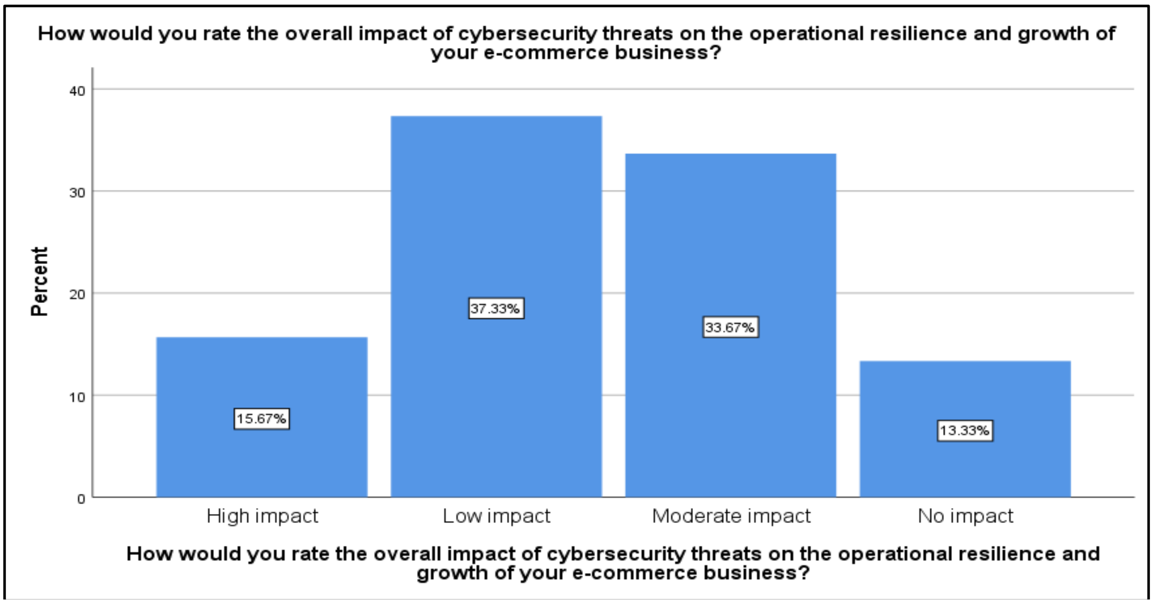

Figure 5: Bar Graph Showing Perceived Impact of Cybersecurity Threats

Figure 5 illustrates the perceived severity of cybersecurity threats on the operational resilience and growth of women-led e-commerce businesses. The graph shows that the largest proportion of respondents—37.33%—rated the impact as low, followed closely by 33.67% who considered it moderate. A smaller yet noteworthy 15.67% perceived a high impact, indicating severe disruptions such as financial loss, reputational damage, or service downtime. Meanwhile, 13.33% of the respondents reported experiencing no impact. This distribution suggests that while the majority of women entrepreneurs have not faced extreme consequences, a considerable number still recognize cybersecurity as a limiting factor in their digital operations. The findings reflect both the resilience of the sector and the growing awareness that cyber threats are not always immediately visible, but may still pose long-term strategic risks.

Challenges in Implementing Cybersecurity Measures

In addition to identifying the extent and impact of cybersecurity threats, the study also investigated the key obstacles women entrepreneurs face while attempting to implement protective measures. Cybersecurity readiness is not merely a matter of awareness—it also depends on access to financial, technical, and human resources. Respondents were asked to identify the most pressing challenges they encountered when trying to secure their e-commerce operations. The responses reveal the presence of widespread structural and resource-based barriers, many of which persist regardless of prior exposure to cyber threats. This section analyzes these barriers both at the aggregate level and in relation to regional and experiential variations.

Table 19: Frequency Distribution of Cybersecurity Implementation Challenges

Challenge Type	Frequency	Percent	Valid Percent	Cumulative Percent
High Cost of Cybersecurity Tools	**108**	**36.0%**	**36.0%**	**36.0%**
Lack of Knowledge or Expertise	**46**	**15.3%**	**15.3%**	**51.3%**
Lack of Time or Resources	**93**	**31.0%**	**31.0%**	**82.3%**
No Perceived Threat	**53**	**17.7%**	**17.7%**	**100.0%**
Total	**300**	**100%**	**100%**	**100%**

Description: Table 19 provides an aggregate view of the challenges faced by women e-commerce entrepreneurs when trying to implement cybersecurity safeguards. The most frequently reported barrier was the high cost of cybersecurity tools (36%), followed closely by lack of time or resources (31%). A notable 17.7% indicated that they did not perceive cybersecurity as a necessary concern, while 15.3% pointed to lack of technical knowledge or expertise. These findings reflect the practical difficulties women entrepreneurs face in adopting cybersecurity measures—even when they are aware of the risks. Cost, time, and skill barriers must be addressed through policy reforms, financial assistance, and capacity-building programs to promote broader adoption of digital safety practices.

Figure 6 depicts the major challenges faced by women entrepreneurs in implementing cybersecurity measures within their e-commerce businesses. The most frequently reported barrier is the high cost of cybersecurity tools, cited by 36% of respondents. This is followed closely by lack of time or resources (31%), which reflects the operational burden small enterprises often face in balancing business growth with digital security practices. A notable 17.67% of participants expressed no perceived threat, suggesting a psychological or knowledge-based gap in recognizing cyber risks. The least cited challenge was lack of knowledge or expertise at 15.33%, although this still represents a meaningful constraint. The chart highlights that resource limitations—both financial and logistical—are the primary deterrents, emphasizing the need for targeted capacity-building and subsidized cybersecurity support programs.

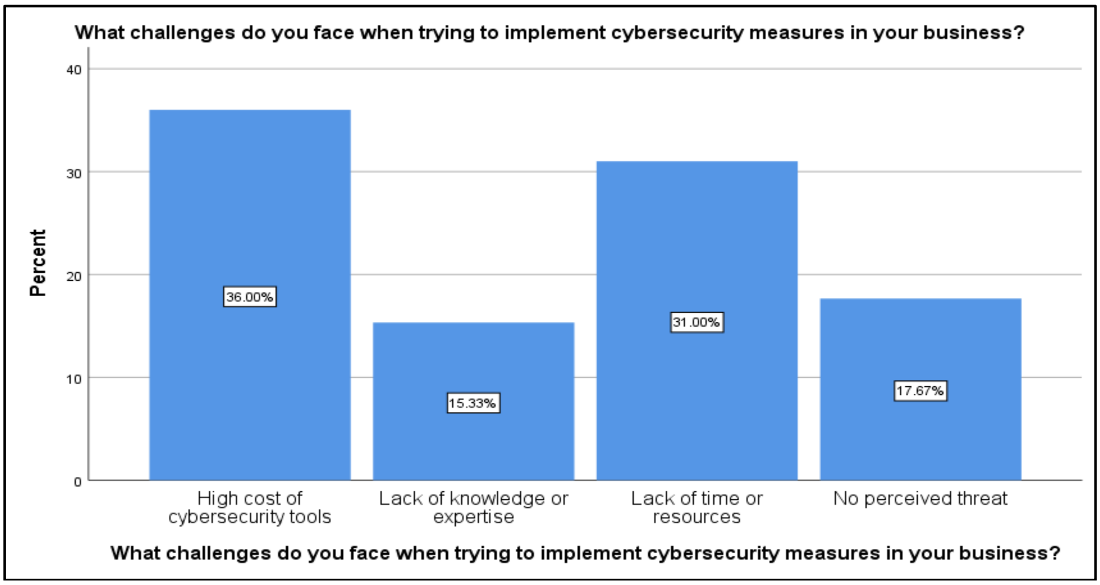

Figure 6: Bar Graph Showing Challenges in Implementing Cybersecurity Measures

Interpretation and Summary of Statistical Results

The findings clearly indicate that:

- Awareness does not automatically translate into effective protection.
- Cybersecurity threats are widespread and vary regionally.
- Institutional schemes like DIC are underutilized and inconsistently accessed.
- Cost and lack of knowledge are major impediments.

The statistically significant Chi-square values across awareness, impact, and institutional engagement **support Hypotheses H1, H2, H3, and H4**, confirming that:

- Cyber threats affect operational efficiency (H1)
- Exposure levels vary significantly across regions (H2)
- Resource limitations impede mitigation (H3)
- Threats influence business reputation and trust (H4)

Section V: Conclusion and Future Directions

Conclusion

This study has provided an empirically grounded, region-specific exploration of the cybersecurity landscape among women-led e-commerce businesses in Delhi and Faridabad. Drawing on responses from 300 entrepreneurs, the research has confirmed that cybersecurity threats are not only prevalent but also significantly affect the operational resilience, digital confidence, and reputational stability of these ventures. A key contribution of this study is its gendered lens, which brings to light the unique challenges women entrepreneurs face—including low technical literacy, institutional inaccessibility, and persistent digital insecurity. The study also confirms that institutional mechanisms like DIC are underutilized, often due to lack of awareness and process inefficiencies. Even when awareness exists, it does not necessarily result in proactive implementation of cybersecurity safeguards. Moreover, challenges such as the high cost of tools, time/resource constraints, and a perception of low threat continue to act as formidable barriers. Through robust statistical validation, the research supports all four hypotheses and underscores the urgent need for targeted, regionally tailored interventions. These should go beyond generic digital literacy and aim for comprehensive support systems—including subsidized tools, personalized consultations, and regular cyber-readiness training programs.

Future Research Directions

Building on the current findings, future research can adopt broader comparative frameworks that include rural women entrepreneurs and participants from other emerging Indian cities to deepen understanding of regional disparities in digital access and cybersecurity resilience. Longitudinal studies should be conducted to evaluate the long-term effectiveness of institutional interventions—such as District Industries Centre (DIC) initiatives—in improving awareness and adoption of protective measures. Additionally, qualitative research methods like case studies and narrative interviews could complement this survey-based approach by revealing the lived realities, challenges, and adaptive strategies of women entrepreneurs in the digital space. Future scholarship should also explore the active role of private-sector entities, including e-commerce platforms, fintech companies, and cybersecurity service providers, in co-creating affordable, scalable, and gender-responsive security solutions for small and medium women-led enterprises.

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