Study on Stress Level and Coping Strategies among Women Entrepreneurs through Machine Learning Algorithms

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Abstract: Women entrepreneurs play an inevitable role in the economic development of their communities, yet they often face unique challenges that can contribute to increased stress levels. The pandemic turned business activities upside down, impacting global negative growth and causing stress among entrepreneurs. Understanding women's sources of stress among these groups and finding effective coping mechanisms could provide insights for support programs and policy development, thereby helping manage their overall well-being. This research aims to investigate the stress levels experienced by women entrepreneurs in Vellore District, Tamil Nadu, India, and the coping strategies they employ to manage this stress. The results exhibit the highest mean score, role overload, 55.84 ($\pm$6.23) on the stress scale among the entrepreneurs and 58.60 ($\pm$6.56) in the Acceptance category of coping strategies. Additionally, it indicates that stress and coping strategies could explain around 1% of the variance in health ($R2 = 0.010$). Based on the p-value, the results revealed the coping strategies as predictors of general health ($P = 0.001$, beta = 0.093). The results highlight the significance of coping strategies for predicting mental health among women entrepreneurs. Machine learning models trained with the collected information revealed the important factors determining the stress conditions. The best feature subset is selected using the minimum-redundancy maximum-relevance (mRMR) algorithm. The random forest algorithm attained the best accuracy with a higher accuracy rate (93.74%), precision (94.51%), and recall (93.91%), outperforming state-of-the-art methods. The need to prevent stressful effects is an urge; support programs and policies must be developed for entrepreneurial stress.

Keywords: Coping behavior, entrepreneurship, machine learning, mental health, psychology, stress

1. Introduction

Women entrepreneurs in India have steadily increased over the past few decades, contributing significantly to the country's economic growth [1-3]. However, the entrepreneurial journey can be stressful, with women facing many challenges, including gender bias, work-life balance, financial pressures, and societal expectations [4-5]. This study seeks to explore the stressors experienced by women entrepreneurs in Vellore District and their strategies to cope with them. In the dynamic world of entrepreneurship, women have emerged as formidable contributors, driving innovation and economic growth. Still, the path to success in the business realm can be fraught with unique challenges for women entrepreneurs [6-8]. Balancing the demands of business ownership, societal expectations, and, often, familial responsibilities can lead to elevated stress levels [9-10]. Understanding the nature of these stressors and the coping strategies employed by women entrepreneurs is pivotal in providing targeted support and fostering their continued success. This article delves into the stress levels experienced by women entrepreneurs and explores the diverse range of coping mechanisms they employ to navigate their entrepreneurial journeys effectively with statistical methods.

1.1. Objectives

- To identify the sources of stress experienced by women entrepreneurs in the Vellore district through questionnaires.

- To statistically examine the coping strategies employed by women entrepreneurs to manage stress.

- To assess the effectiveness of various coping mechanisms in reducing stress levels.

- To provide recommendations for support programs and policies that can help alleviate stress among women entrepreneurs.

1.2. Study Design

The initial data collection for this study is performed from the participants of the Vellore district, with the primary criteria being "women entrepreneurs." No exclusion criteria are followed; anyone above age 18 is considered eligible. In total, 258 participants' data was collected concerning the questionnaire prepared for this study. SPSS v22 software is used to perform descriptive statistics and regression tests.

2. Materials and Methods

This study employs a mixed-methods approach. Data is collected through surveys and in-depth interviews. The

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sample will consist of women entrepreneurs in different locations of Vellore district, including those from various industries and business sizes. The survey includes questions about demographics, sources of stress, and coping strategies. Interviews provided more in-depth insights into individual experiences, but the information is not included for analysis.

2.1. Data Analysis

Quantitative data analysis uses statistical methods to identify patterns and correlations between stressors, coping strategies, and demographic variables. Interview data will be evaluated thematically to extract common themes and narratives related to stress and coping mechanisms. Descriptive statistical analysis, such as frequency distribution, standard deviation, mean, and regression tests, were conducted with Statistical Package for Social Sciences (SPSS) version 22. The Kolmogorov-Smirnov statistical test examines the normality distribution [12].

2.2. Questionnaires

Four tables representing the study factors in the questionnaire pattern are provided below. Table 1 shows the characteristics and the subgroups among the participants. The entrepreneurial role stress scale is listed in Table 2, with stressors subcategorized as Self-Role Distance, Role Overload, Challenge Stress, Resource Inadequacy, Role Isolation, Role Irrelevance, and Inter-role Distance, and Table 3 contains the possible coping strategies with different scales categorizing into positive and negative scale. The perceived performance is estimated for the business development, and growth is explained in Tables 4 and 5. Each metric is measured based on five entities such as "Never bothers," "Occasionally bothers," "Bothers Sometimes," "Often bothers," and "Very Often bothers." The pipeline of processes involved in the proposed system is depicted in Figure 1.
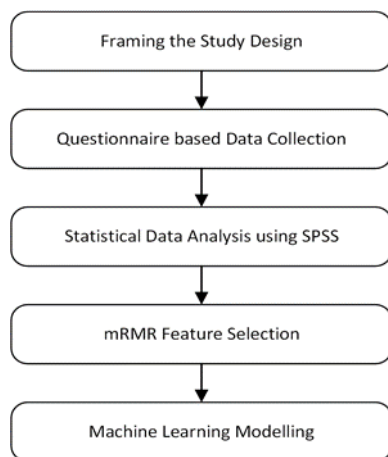
Fig 1. Workflow of the proposed system

Table 1: Characteristics of the participants enrolled in this study

Factors	Subgroups (Participants in %)
Age	18-29 (23%)
	30-39 (45%)
	40-49 (21%)
	50-59 (6%)
	60+ (5%)
Marital Status	Married (69%)
	Unmarried (31%)
No. of Dependents	One (9%)
	Two (53%)
	Three (36%)
	More than 3 (2%)
Education	No formal Education (26%)
	High School (44%)
	Under Graduate (13%)
	Post Graduate (17%)
Age of Business	Less than 1 year (33%)
	1-5 years (45%)
	6-10 years (20%)
	More than 10 years (2%)
Sector	Manufacturing (38%)
	Services (37%)
	Trading (25%)
	Others (0%)
Business Entity	Sole Proprietorship (34%)
	Partnership (56%)
	LLPs (3%)
	Company (3%)
	NGOs (4%)
Total No. of Employees	Less than 10 (12%)
	10-19 (25%)
	20-29 (30%)
	30-39 (22%)
	40-49 (6%)
	More than 50 (5%)

Number of Women Working	Less than 5 (12%)
	5-10 (30%)
	10-15 (23%)
	16-20 (20%)
	More than 20 (15%)
Main Customer Group	Businesses (30%)
	Retail Consumers (50%)
	Government (5%)
	Others (15%)

Table 2: Entrepreneurial Role Stress Scale

S.No	Stressors	Items
1	Self-Role Distance	Having to do things that are against my better judgment
2		Not having confidence to share my ideas and problems
3		Lack of opportunity to do some service for those in need.
4	Role Overload	Not being able to spend enough time with my family
5		Heavy workload
6		Having to take all decisions and follow-up on them myself
7		Self-induced pressure to perform tasks
8		Restlessness in my work
9	Challenge Stress	Taking risks
10		Lack of quality in my products and services.
11		Reputation of customers
12		Growth of the business
13		Sales turnover or profit
14	Result Inadequacy	Not getting the results I want
15		Lack of adequate finances
16		Competition of others in the field
17		Poor selling of my products
18	Role Inadequacy	Lack of adequate information needed for business
19		Lack of time to pay attention to different aspects
20		Uncertain issues in the business
21	Resource Inadequacy	Difficulty in getting raw material or other needed material.
22		Lack of adequate machinery and other means
23		Staffs issues in the workplace
24		Availability of Physical work location
25	Role Isolation	Loneliness in my role as an entrepreneur
26		Not being able to pursue some other interests (religious, social, political, cultural etc.)
27		Going into something new, not yet tried out
28	Role Irrelevance	Lack of social usefulness of the work I do
29		Not being able to use expertise, training or my strengths
30		Conflict between what I do and my concern for doing for others and for society
31		Lack of relevant technical knowledge
32		Lack of expertise in management, marketing, finance, etc.

S.No		Items
33	Inter-role Distance	conflict of my role as an entrepreneur with my social life and family obligations
34		Lack of joint and collaborative work
35		Conflict between my values and what I do

Table 3: Coping Strategies: Questionnaire

S.No	Coping strategies	Scale
1		Self-Distraction
2	Positive coping	
3		Active Coping
4	Positive coping	
5		Denial
6	negative coping	
7		Emotional Support
8	Positive coping	
9		Behavioural Disengagement
10	Negative coping	
11		Venting
12	Negative coping	
13		Instrumental Support
14	Positive coping	
15		Positive Reframing
16	Positive coping	
17		Self-Blame
18	Negative coping	
19		Planning
20	Positive coping	
21		Acceptance
22	Positive coping	
23		Humour
24	Positive coping	
25		Religion
26	Positive coping	

Table 4: Perceived Performance: Business Development

S.No	Items
1	In our business, employees are viewed as the most valuable asset of the business.
2	Our employees are highly committed to our business.
3	The morale (job satisfaction) of our employees has improved over the past few years.
4	The image (stature) of our business, relative to our competitors, has grown over the past few years.
5	Our business's effectiveness (doing the right things) has improved over the past few years.
6	During difficult economic periods, investments in research and development/ innovative projects continue and no significant financial cuts are made.
7	Our business's efficiency (doing things right) has improved over the past few years.

Table 5: Perceived Performance: Business Growth

S.No	Items
1	Our business has experienced growth in profits over the past few years.
2	Our business has experienced growth in turnover over the past few years.
3	Our business has experienced growth in market share over the past few years. The competitive position of our business has improved over the past few years.

2.3. Feature Selection

This study selects the most relevant features with the Minimum Redundancy Maximum Relevance (mRMR) algorithm. It is a filter-based statistical feature selection method intended to choose a subset of important features from a larger set to minimize redundancy among the selected features and maximize the relevance of the selected features to the target variable (stress/no stress) [13]. The mild and no stress groups are merged, whereas moderate and severe are grouped as stress with 33 and 225 samples, respectively. This algorithm identified three features as the most important predictors: financial pressure, work-life balance, and market competition.

A pseudocode representation of mRMR Algorithm:

Initialization:

Initialize an empty set to store the selected features S.

Calculate and store the mutual information (MI) between each feature and the target variable (Y). These MI values represent the relevance scores.

Initialize an empty set to store the selected features' redundancy scores (e.g., R). Initially, R is empty.

Feature Selection Loop:

While the number of selected features (|S|) is less than the desired number of features to select (k):

a. Calculate mRMR Scores:

For each feature not in S, calculate its mRMR score using the formula: $mRMR\_score(x_i) = MI(x_i, Y) - (1/|S|) * \Sigma MI(x_i, x_j) \forall x_j$ in S.

Select the feature with the highest mRMR score and add it to S.

b. Update Redundancy Scores:

Calculate the mutual information between the selected feature and all other selected features and store it in R. This step ensures that redundancy is properly tracked with each newly added feature.

$$R(x_i) = (1/|S|) * \Sigma MI(x_i, x_j) \forall x_j \text{ in } S.$$

Final Selection:

The loop terminates when |S| reaches k. The selected features in S are your final feature subset that maximizes relevance to the target variable while minimizing redundancy among the selected features.

2.4. Machine Learning

The feature subset mRMR identifies is trained with naïve Bayes, support vector machines, and a random forest algorithm [14]. These models are trained with the dataset containing three features and 258 samples, reduced after feature selection. The dataset is trained using a 5-fold cross-validation method. Accuracy, precision, and recall metrics evaluate the model prediction performance. The scores of the machine learning algorithms are listed in Table 8.

3. Results and Discussion

The initial data collection is performed for this study from the participants of the Vellore district with the primer criteria as "women entrepreneurs." No exclusion criteria are followed; anyone above age 18 is considered eligible. In total, 258 participants' data was collected concerning the questionnaire prepared for this study.

The study identified common stressors among women entrepreneurs in the Vellore District, such as role overload,

resource inadequacy, and challenge stress, with high mean scores of 55.84 (±6.23), 48.96 (±7.21), and 43.47 (±7.64) respectively. The research also assesses the effectiveness of these strategies in reducing stress levels. Of the 258 participants, the majority were aged 18-29 (23%) and 30-39 (45%) considered significant. The marital status shows that married women are (69%) and the unmarried remains (31%)

The highest mean for coping strategies is associated in terms of scale with Acceptance as the high mean score of 58.60 (±6.56), with emotional support with 52.64 (±5.81) standing second and planning with 42.86 (±7.73). Table 6 shows the stress level among the women entrepreneurs who participated in this study, highlighting that most are facing moderate stress as reported highest. Table 7 lists the regression analysis report of the participants' mental health based on the identified coping factors. The parameters represent R-squared value (R2), regression coefficient (β), and statistical significance based on p-value (P).

Table 6: Stress level and frequency among women entrepreneurs

Levels	Frequency
No Stress	6
Mild	27
Moderate	196
Severe	29

The common stressors and coping factors are categorized based on the scores, with the top listed in the subsections below.

3.1. Common Sources of the Stressors Identified among Women Entrepreneurs

Gender Bias and Stereotypes: Women entrepreneurs may encounter gender bias and stereotypes that undermine their credibility and hinder their access to funding and resources.

Work-Life Balance: Balancing the demands of entrepreneurship with family responsibilities can be particularly challenging for women, leading to increased stress.

Financial Pressures: The financial challenges of starting and running a business, including securing capital and managing cash flow, can be a significant source of stress.

Market Competition: Navigating a competitive market can be daunting, especially for women entrepreneurs who may perceive it as less supportive or inclusive.

Societal Expectations: Societal expectations related to traditional gender roles and family dynamics can add pressure on women entrepreneurs.

3.2. Coping Strategies Employed by Women Entrepreneurs

Building a Support Network: Women entrepreneurs often rely on support networks, including mentors, peers, and business associations, to gain advice, share experiences, and receive emotional support.

Time Management and Prioritization: Effective time management and task prioritization help women entrepreneurs balance work and personal life.

Self-Care Practices: Engaging in self-care routines, such as exercise, meditation, and hobbies, allows women entrepreneurs to manage stress and maintain their physical and mental well-being.

Seeking Professional Help: Some women entrepreneurs seek the assistance of business coaches, counselors, or therapists to address stress-related issues and develop coping strategies.

Adaptive Problem-Solving: Entrepreneurs often employ problem-solving skills to tackle the specific stressors they face in their businesses, which can involve adjusting business strategies or seeking alternative solutions.

Networking and Collaboration: Collaborating with other entrepreneurs and forming strategic partnerships can provide emotional support and open up new growth opportunities.

Table 7. Regression analysis of mental health (n = 258; healthy = 180; with disorder = 78)

Parameter	R2	B	P
Stress	0.010	-0.019	0.26
Coping strategies	-	0.112	0.001

The results shown in Table 7 exhibit that the stress and coping mechanisms could jointly account for around 1% of the variance in general health (R2 = 0.010) when it came to the concurrent function of stress and coping mechanisms in predicting the general health of nursing staff. However, the findings of this study imply that coping mechanisms are a predictor of overall health (P = 0.001, beta = 0.093) based on the statistically significant level. Therefore, the coping mechanisms identified are a good indicator of general health.

Table 8. Performance scores of machine learning algorithms.

Models	Accuracy (%)	Precision (%)	Recall (%)
Support Vector Machines	90.25	91.80	91.24
Random Forest	93.74	94.51	93.91
Naïve Bayes	89.62	86.54	89.87

3.3. Effectiveness of Coping Strategies

The effectiveness of coping strategies can vary from one woman entrepreneur to another and may depend on factors such as the nature of the business, personal resilience, and available resources. While support networks and self-care practices are generally effective, they may not eliminate stressors like financial pressures or market competition. Adaptive problem-solving and seeking professional help can be particularly beneficial in addressing specific challenges.

3.4. Support programs and policies for women entrepreneurs to balance and cope with the stress

It is essential to help women entrepreneurs balance their responsibilities and cope with their stressors. These initiatives can contribute significantly to the success and well-being of women entrepreneurs. Some key support programs and policies that can be implemented are listed below.

Mentorship Programs: Establish mentorship programs that connect experienced women entrepreneurs with newcomers. These mentors can provide guidance, share their experiences, and offer emotional support, helping mentees navigate challenges and reduce stress.

Networking Opportunities: Create networking events, workshops, and conferences for women entrepreneurs. These platforms allow women to connect, collaborate, and share coping strategies with their peers.

Access to Funding and Financial Resources: Develop financial support programs that provide women entrepreneurs with grants, loans, or venture capital. Financial stability can significantly reduce stress related to funding challenges.

Business Incubators and Accelerators: Establish business incubators and accelerators that focus on supporting women-led startups. These programs can provide access to resources, mentorship, and training, enabling women entrepreneurs to grow their businesses more effectively.

Work-Life Balance Initiatives: Encourage flexible work arrangements and family-friendly policies that allow women entrepreneurs to balance their professional and personal lives more effectively. This can include flexible hours, remote work options, and on-site childcare facilities.

Mental Health Support: Offer mental health resources and counseling services tailored to women entrepreneurs. Stress management and coping skills workshops can help women entrepreneurs address their mental health needs.

By combining these support programs and policies, society can help women entrepreneurs manage stress, balance their responsibilities, and thrive. These initiatives can empower women entrepreneurs and contribute to economic growth and innovation.

4. Conclusion

Understanding women entrepreneurs' stress levels and coping strategies in the Vellore District is essential for promoting their well-being and sustaining their entrepreneurial ventures. The findings of this study can inform the development of support programs, training, and policies that address the unique challenges women entrepreneurs face, ultimately contributing to their success and economic empowerment. Stress levels among women entrepreneurs can vary widely based on individual circumstances and the nature of their businesses. Recognizing the unique stressors they face and understanding their coping strategies is crucial for providing support and creating a conducive environment for their entrepreneurial endeavors. By addressing these stressors and promoting effective coping mechanisms, society can empower women entrepreneurs to thrive, contribute to economic growth, and shatter gender-related barriers in the business world. Additionally, support systems, mentorship programs, and policies that address gender bias and work-life balance can further enhance the resilience of women entrepreneurs. These findings emphasize the need to consider coping mechanisms among women entrepreneurs when characterizing their overall health.

Author contributions

R. Krithiga: Conceptualization, Methodology, Software, Field study, Data curation, Writing-Original draft preparation, Software, Validation, Field study, Visualization. **G. Velmurugan:** Investigation, Writing-Reviewing and Editing.

Conflicts of interest

The authors have no conflicts of interest to declare. There is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

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