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Machine-Learning Identification of Family Adaptation Patterns During Economic Stress Based on Coping Strategies and Couple Communication

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ABSTRACT

Objective: This study aimed to identify distinct family adaptation patterns during economic stress by applying unsupervised machine-learning to the interplay of coping strategies and couple communication behaviors.

Methods and Materials: A quantitative, cross-sectional design was employed with 452 married couples from Malaysia experiencing varying degrees of economic stress. Data were collected via self-report instruments measuring perceived economic pressure, coping mechanisms (problem-focused, emotion-focused, and avoidant), and couple communication patterns (constructive and demand-withdraw). An unsupervised K-Means clustering algorithm was applied to the multidimensional data to segment the couples into naturally occurring adaptation profiles, followed by post-hoc statistical analyses to evaluate the characteristics of each profile and their associations with objective socio-economic factors.

Findings: The K-Means clustering analysis ($k = 3$) successfully delineated three distinct family adaptation patterns. Cluster 1, the “Resilient-Constructive Adapters” ($n = 168, 37.17\%$), exhibited high problem-focused coping and constructive communication, reporting the lowest perceived economic stress ($M = 32.40, SD = 4.80$). Cluster 2, the “Distressed-Avoidant Adapters” ($n = 124, 27.43\%$), was characterized by heavy reliance on avoidant coping and demand-withdraw communication, experiencing the highest levels of economic stress ($M = 44.80, SD = 5.25$) and showing a disproportionate representation from the lowest income bracket (78.22%). Cluster 3, the “Ambivalent-Emotion-Focused Adapters” ($n = 160, 35.40\%$), displayed moderate communication quality with a high reliance on emotion-focused coping and social support seeking, reporting moderate economic stress ($M = 38.65, SD = 6.10$). A statistically significant association was found between cluster membership and objective household income ($\chi^2 = 48.62, p < .001$).

Conclusion: Unsupervised machine-learning successfully revealed that families navigate financial hardship through interconnected behavioral typologies, highlighting the necessity for tailored interventions that address both objective financial realities and dyadic relationship dynamics to foster resilience.

Keywords: Family Adaptation, Economic Stress, Coping Strategies, Couple Communication

1. Introduction

The family unit stands as the foundational institution of society, serving as the primary context for individual development, emotional regulation, and socialization (Nigam, 2023). The overall health and stability of this unit are profoundly influenced by its socioeconomic context, with family socioeconomic status (SES) emerging as one of the most powerful predictors of life outcomes, from academic performance to long-term psychological development (Shi, 2024; Wilkinson et al., 2024; Yu, 2024). In an era of increasing global economic volatility, families worldwide are frequently confronted with significant financial pressures, including income instability, unemployment, debt, and the inability to meet basic needs. This pervasive condition, broadly termed economic stress, is not merely an objective measure of financial capital but a subjective and deeply psychological experience of strain, uncertainty, and perceived hardship (Asadi et al., 2024; Fanta et al., 2025). The experience of economic stress reverberates through every aspect of family life, influencing everything from parental mental health to adolescent behavioral outcomes (Ahmadi et al., 2024; Yang et al., 2023). Understanding how families navigate these financial challenges is therefore of paramount importance for both researchers and practitioners dedicated to promoting familial well-being and preventing negative developmental trajectories (Finch et al., 2025).

A leading theoretical framework for understanding these dynamics is the Family Stress Model (FSM). The FSM posits that economic hardship does not exert a direct, deterministic effect on family or child outcomes. Instead, its influence is mediated through a cascade of psychosocial processes within the family system (Fanta et al., 2025). According to this model, objective economic hardship increases parents' subjective experience of economic pressure, which in turn elevates their psychological distress, such as symptoms of depression and anxiety (Lee et al., 2024). This parental distress subsequently erodes the quality of interpersonal relationships within the family, most notably by increasing marital conflict and disrupting sensitive and responsive parenting practices (Lam et al., 2025; Oftedal et al., 2025). It is this degradation of core family processes—the dyadic interactions and adaptive mechanisms—that ultimately translates financial strain into adverse outcomes for both adults and children, such as increased internalizing behavior problems (Lee et al., 2024) or diminished cognitive performance (Finch et al., 2025).

The FSM thus shifts the analytical focus from the stressor itself to the family's internal adaptive processes, highlighting the critical importance of understanding *how* families respond to economic adversity.

Central to this network of family processes is the quality of couple communication. The marital or romantic dyad is often considered the executive subsystem of the family, and the quality of communication within this dyad sets the emotional tone for the entire household (Gunawan & Krisnatuti, 2022). Under conditions of economic stress, communication patterns can become a powerful conduit for either resilience or dysfunction. Constructive communication, characterized by mutual listening, validation, collaborative problem-solving, and emotional support, can serve as a potent buffer, enabling couples to jointly appraise their financial situation, strategize solutions, and maintain marital satisfaction despite external pressures (Asadi et al., 2024). Conversely, economic strain is a well-documented catalyst for destructive communication patterns, such as hostility, criticism, and the particularly corrosive demand-withdraw cycle, where one partner pressures for change while the other retreats or disengages (Lee et al., 2022). This negative reciprocity not only exacerbates couple conflict but also depletes the emotional resources needed to cope effectively, ultimately undermining the family's capacity to function. The influence of socioeconomic factors on these fundamental interpersonal communication dynamics is a critical area of investigation (Svyntozelska, 2023).

Alongside communication, the specific coping strategies that family members employ are another crucial determinant of their adaptation to economic stress. Coping refers to the constantly changing cognitive and behavioral efforts to manage specific external and internal demands that are appraised as taxing or exceeding the resources of the person. These strategies are not monolithic and can be broadly categorized into several types, each with different implications for family well-being. Problem-focused coping involves direct efforts to alter the stressful situation, such as budgeting, seeking new employment, or acquiring financial literacy. Emotion-focused coping is aimed at regulating the emotional distress associated with the stressor, through methods like seeking emotional support, positive reframing, or engaging in distracting activities. Social support seeking involves turning to others for instrumental or emotional aid (Yuan et al., 2025). While these strategies are often adaptive, families may also resort to avoidant coping, which includes denial, mental disengagement, and substance use. Research

suggests that reliance on active, problem-focused strategies and the ability to maintain resilience in the face of adversity are linked to better outcomes, whereas a heavy reliance on avoidant coping tends to amplify psychological distress and perpetuate the cycle of stress (Wu et al., 2023; Yang et al., 2023).

While extensive research has examined communication and coping as separate mediators of economic stress, a significant limitation of the existing literature is its tendency to analyze these factors in isolation using variable-centered approaches like regression. Such methods are invaluable for identifying the independent predictive power of a given strategy (e.g., constructive communication reduces conflict), but they fail to capture the holistic and synergistic way in which these behaviors manifest within a family system. In reality, families do not employ single, discrete strategies; rather, they exhibit a dynamic interplay of multiple coping and communication behaviors that coalesce into coherent, overarching patterns or typologies of adaptation. For instance, a couple might simultaneously engage in high levels of problem-focused coping, constructive communication, and social support seeking, representing a resilient, collaborative adaptation style. Another couple might be characterized by a combination of demand-withdraw communication, avoidant coping, and high emotional reactivity, representing a distressed, disengaged pattern. These complex configurations are more ecologically valid representations of family life than any single variable can provide. The failure to adopt a person-centered approach that identifies these distinct adaptation profiles has limited our ability to understand the multifaceted nature of family resilience and vulnerability, potentially leading to family collapse if not properly addressed (Arami et al., 2023). This holistic understanding is essential for designing effective family economic models and educational curricula that reflect the lived realities of families from diverse backgrounds (Fakhari et al., 2023; Hosseini et al., 2023; Khorri et al., 2025).

The advent of machine-learning methodologies, particularly unsupervised clustering algorithms, offers a powerful new lens through which to address this gap. Unlike traditional statistical methods that test pre-specified hypotheses, unsupervised learning is a data-driven approach that excels at discovering intrinsic structures and natural groupings within complex datasets. By treating each family as a multi-dimensional data point defined by its unique combination of coping and communication scores, a clustering algorithm can partition the sample into distinct,

internally homogenous groups without prior assumptions about how many patterns exist or what they will look like. This approach is ideally suited for moving beyond a variable-focused perspective to a person-centered, typological understanding of family adaptation. Identifying these empirical patterns is a crucial first step toward developing more nuanced theories and targeted interventions tailored to a family's specific adaptive profile. Such an approach can account for the complex interplay of financial, social, and cultural capital that shapes family life in diverse contexts, such as Malaysia, where economic development coexists with significant income disparities (Juhaidi et al., 2024). The insights gained can inform policies and practices related to family economics, including considerations of gendered roles such as women's employment (Mohammad Ali et al., 2022), and the influence of parental factors like psychological capital and autonomy support on children's outcomes (Qiu & Ye, 2023; Yuan et al., 2025) across various life stages and during crises (Xiang et al., 2025).

Therefore, the present study aims to utilize an unsupervised machine-learning approach to identify distinct family adaptation patterns during economic stress based on the interplay of coping strategies and couple communication behaviors among a sample of Malaysian couples.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a quantitative, cross-sectional design to identify distinct patterns of family adaptation among married couples in Malaysia experiencing economic stress. The research focused on elucidating how combinations of coping strategies and couple communication behaviors coalesce into specific profiles. A purposive sampling strategy, supplemented by snowball sampling, was utilized to recruit participants primarily from the Klang Valley region, an area characterized by a diverse socioeconomic landscape. The final sample consisted of 452 heterosexual married couples, resulting in a total of 904 individual participants. Inclusion criteria stipulated that couples must have been married for a minimum of two years, be cohabiting, and have self-reported experiencing moderate to high levels of economic stress within the 12 months prior to data collection. Couples currently undergoing formal marital therapy or financial counseling were excluded to mitigate potential confounding effects on communication and coping behaviors.

2.2. Measures

Data were gathered using a secure online survey platform, which administered a comprehensive questionnaire composed of several validated instruments. A preliminary section collected demographic information, including participants' age, gender, ethnicity, educational attainment, household income, duration of marriage, and number of children. To measure the primary contextual variable, the Perceived Economic Stress Scale (PESS) was used. This 10-item scale assesses individuals' subjective appraisal of financial strain, including difficulties in meeting household expenses and worries about future financial stability, with responses rated on a 5-point Likert scale from 'never' to 'always'. The scale demonstrated high internal consistency in the present sample. Family coping strategies were evaluated using the Brief-COPE inventory, a widely recognized 28-item measure that assesses a broad range of adaptive and maladaptive coping responses. Participants rated the frequency with which they used specific strategies on a 4-point scale. For this study, subscales were grouped into broader categories representing problem-focused coping, emotion-focused coping, social support seeking, and avoidant coping to serve as input variables for the machine-learning model. Couple communication patterns were assessed using the Communication Patterns Questionnaire-Short Form (CPQ-SF). This instrument measures participants' perceptions of communication during conflict, yielding scores on two primary dimensions: Constructive Communication and Demand-Withdraw Communication. The reliability and validity of all employed scales were confirmed through pilot testing within a similar demographic prior to full-scale data collection.

2.3. Data Analysis

The data analysis was conducted in two main phases, beginning with preliminary descriptive statistics followed by an unsupervised machine-learning approach for pattern identification. Initially, all data were cleaned and screened for missing values and outliers in SPSS version 28. Descriptive statistics, including means, standard deviations, and frequencies, were calculated to summarize the demographic characteristics of the sample and the primary study variables. The core of the analysis involved the application of a K-Means clustering algorithm, executed using the scikit-learn library in Python 3.9, to identify distinct family adaptation patterns. The input features for the clustering model were the standardized scores from the key

subscales of the Brief-COPE inventory and the Communication Patterns Questionnaire. This unsupervised learning technique was chosen for its efficacy in partitioning the dataset into a predetermined number of non-overlapping clusters based on the intrinsic structure of the data, thereby revealing natural groupings of families with similar profiles of coping and communication. To determine the optimal number of clusters (k), both the Elbow method, which assesses the within-cluster sum of squares, and Silhouette analysis, which measures how similar an object is to its own cluster compared to other clusters, were employed. Once the optimal number of clusters was established, the final K-Means algorithm was executed to assign each couple to a specific adaptation pattern. Subsequently, one-way analysis of variance (ANOVA) was conducted to profile and validate the resulting clusters by comparing the mean scores of the input variables across the identified groups, thereby allowing for a substantive interpretation and labeling of each unique family adaptation pattern.

3. Findings and Results

The sociodemographic characteristics of the sample reflect a diverse group of married couples residing in the Klang Valley region of Malaysia. As presented in Table 1, the mean age of the participants was $M = 36.45$ years ($SD = 6.82$), with an average marriage duration of $M = 8.30$ years ($SD = 4.15$). The monthly household income distribution indicated that a significant portion of the sample (58.4%) fell into the B40 (bottom 40%) national income classification, reporting less than 4,850MYR (Malaysian Ringgit) per month, which aligns with the study's focus on economic stress. The mean Perceived Economic Stress Scale (PESS) score across the entire sample was $M = 38.64$ ($SD = 7.12$), indicating a moderate-to-high level of financial strain. Prior to the machine-learning analysis, bivariate Pearson correlations were conducted to examine the linear relationships among coping strategies, communication patterns, and perceived economic stress. As detailed in Table 2, Constructive Communication was positively correlated with Problem-Focused Coping ($r = .52$, $p < .01$) and negatively correlated with Perceived Economic Stress ($r = -.41$, $p < .01$). Conversely, Demand-Withdraw Communication showed a strong positive association with Avoidant Coping ($r = .48$, $p < .01$) and Perceived Economic Stress ($r = .56$, $p < .01$). These preliminary correlations confirmed the interrelatedness of the variables,

justifying their inclusion as multivariate input features for the clustering algorithm.

Table 1

Sociodemographic Characteristics of the Sample (N=452 Couples)

Variable	Category	Frequency (n)	Percentage (%)	Mean (M)	Standard Deviation (SD)
Age (Years)				36.45	6.82
	Husbands			38.12	7.05
	Wives			34.78	6.21
Marriage Duration	Years			8.30	4.15
Household Income (MYR)	< 4,850(B40)	264	58.41		
	4,850 – 10,959(M40)	156	34.51		
	≥ 10,960(T20)	32	7.08		
Number of Children	None	48	10.62		
	1 – 2	215	47.57		
	≥ 3	189	41.81		

To identify distinct typologies of family adaptation under economic stress, an unsupervised K-Means clustering algorithm was applied to the standardized scores of the four coping subscales (Problem-Focused, Emotion-Focused, Social Support Seeking, Avoidant) and the two communication subscales (Constructive, Demand-Withdraw). To determine the optimal number of clusters (*k*), the Elbow method and Silhouette analysis were evaluated.

The plot of the within-cluster sum of squares revealed a distinct “elbow” at *k* = 3. Furthermore, the average Silhouette coefficient reached its highest point at *k* = 3 (*S* = 0.54), indicating that a three-cluster solution provided the most cohesive and well-separated grouping of couples. The algorithm converged after 14 iterations, effectively classifying the *N* = 452 couples into three non-overlapping adaptation patterns.

Table 2

Bivariate Correlations Among Coping Strategies, Communication Patterns, and Economic Stress

Variables	1	2	3	4	5	6	7
1. Perceived Economic Stress	–						
2. Problem-Focused Coping	-.34**	–					
3. Emotion-Focused Coping	.12*	.28**	–				
4. Social Support Seeking	-.08	.41**	.35**	–			
5. Avoidant Coping	.46**	-.18**	.22**	-.11*	–		
6. Constructive Communication	-.41**	.52**	.15**	.38**	-.29**	–	
7. Demand-Withdraw Comm.	.56**	-.24**	.18**	-.15**	.48**	-.55**	–

To profile and label these three clusters, a series of one-way analyses of variance (ANOVAs) were conducted to compare the mean scores of the input features across the identified groups. As presented in Table 3, the overall *F*-tests indicated highly significant differences across all six clustering variables (*p* < .001 for all). Post-hoc comparisons using Tukey’s Honestly Significant Difference (HSD) test were conducted to elucidate the specific differences between the clusters.

Cluster 1 (*n* = 168, 37.17% of the sample) was labeled the “Resilient-Constructive Adapters.” Couples in this cluster were characterized by significantly higher levels of Problem-Focused Coping (*M* = 14.85) and Constructive

Communication (*M* = 18.42) compared to the other two clusters (*p* < .001). They also demonstrated the lowest utilization of Avoidant Coping (*M* = 6.12) and Demand-Withdraw Communication (*M* = 8.35). Cluster 2 (*n* = 124, 27.43%) was designated the “Distressed-Avoidant Adapters.” This profile exhibited maladaptive adaptation mechanisms, reporting the highest mean scores for Avoidant Coping (*M* = 13.54) and Demand-Withdraw Communication (*M* = 19.68), while scoring the lowest on Constructive Communication (*M* = 9.21) and Problem-Focused Coping (*M* = 8.15). Finally, Cluster 3 (*n* = 160, 35.40%) was identified as the “Ambivalent-Emotion-Focused Adapters.” This group displayed a mixed profile,

characterized by moderate scores on both constructive and maladaptive communication, but notably the highest reliance on Emotion-Focused Coping ($M = 15.30$) and

Social Support Seeking ($M = 14.22$) compared to the other clusters.

Table 3

K-Means Cluster Centers and One-Way ANOVA Results for Coping and Communication Variables

Variable	Cluster 1: Resilient (n = 168)	Cluster 2: Distressed (n = 124)	Cluster 3: Ambivalent (n = 160)	F(2, 449)	p-value	η^2
Coping Strategies						
Problem-Focused	14.85(2.10)	8.15(2.45)	11.40(2.25)	352.14	<.001	.61
Emotion-Focused	11.20(2.35)	13.65(2.50)	15.30(2.15)	118.45	<.001	.34
Social Support Seeking	12.45(2.60)	9.10(2.10)	14.22(2.40)	156.78	<.001	.41
Avoidant Coping	6.12(1.85)	13.54(2.30)	9.85(2.10)	445.62	<.001	.66
Communication Patterns						
Constructive Comm.	18.42(3.15)	9.21(2.80)	14.15(3.05)	388.90	<.001	.63
Demand-Withdraw Comm.	8.35(2.20)	19.68(3.45)	13.20(2.95)	482.35	<.001	.68

To validate the real-world implications of the machine-learning derived clusters, further analyses were conducted to determine if these family adaptation patterns differed significantly in their actual experience of economic stress and underlying sociodemographic factors. Table 4 presents the results of these comparative analyses. An ANOVA revealed a highly significant difference in Perceived Economic Stress across the three clusters, $F(2,449) = 184.55, p < .001$. Tukey post-hoc tests confirmed that the “Distressed-Avoidant Adapters” (Cluster 2) experienced significantly higher levels of economic stress ($M = 44.80, SD = 5.25$) compared to the “Ambivalent-Emotion-Focused Adapters” ($M = 38.65, SD = 6.10$), while the “Resilient-Constructive Adapters” (Cluster 1) reported the lowest economic stress ($M = 32.40, SD = 4.80$).

Furthermore, chi-square tests of independence were performed to examine the distribution of income categories

across the clusters. A significant association was found between household income class and cluster membership, $\chi^2(4, N = 452) = 48.62, p < .001$. Couples in the B40 income bracket were disproportionately overrepresented in the “Distressed-Avoidant” cluster (78.2% of Cluster 2 belonged to the B40 category) compared to the “Resilient-Constructive” cluster (45.8% belonging to B40). Conversely, M40 and T20 households were more frequently classified into Cluster 1. While economic stress and income showed strong differentiating power, a one-way ANOVA indicated no significant differences among the clusters concerning the duration of marriage, $F(2,449) = 1.12, p = .328$, suggesting that these adaptation patterns are strongly tied to financial context rather than merely the length of the marital relationship.

Table 4

Comparison of Perceived Economic Stress and Sociodemographic Factors Across Adaptation Clusters

Variable	Cluster 1: Resilient	Cluster 2: Distressed	Cluster 3: Ambivalent	Test Statistic	p-value
Perceived Economic Stress	32.40(4.80)	44.80(5.25)	38.65(6.10)	$F = 184.55$	<.001
Marriage Duration (Years)	8.50(4.25)	7.90(3.95)	8.45(4.20)	$F = 1.12$.328
Household Income %				$\chi^2 = 48.62$	<.001
< 4,850MYR (B40)	45.83%	78.22%	56.25%		
4,850 – 10,959MYR (M40)	44.05%	18.55%	38.75%		
≥ 10,960MYR (T20)	10.12%	3.23%	5.00%		

4. Discussion

The primary objective of this study was to move beyond traditional, variable-centered analyses to identify holistic,

ecologically valid patterns of family adaptation during economic stress. By applying an unsupervised machine-learning K-Means algorithm to a sample of 452 married couples, the analysis successfully delineated three distinct

adaptation typologies: the Resilient-Constructive Adapters, the Distressed-Avoidant Adapters, and the Ambivalent-Emotion-Focused Adapters. These empirical findings demonstrate that families do not react to financial hardship in uniform or isolated ways. Instead, their coping strategies and communication behaviors coalesce into specific, highly consequential profiles that are intimately tied to their socio-economic realities and ultimately dictate their capacity to weather economic adversity.

The identification of Cluster 1, the “Resilient-Constructive Adapters” (37.17%), highlights a highly adaptive systemic response to economic pressure, characterized by elevated problem-focused coping and constructive communication. Couples in this cluster reported the lowest levels of perceived economic stress, despite a significant portion of them belonging to the lower-income B40 bracket. This confirms the buffering hypothesis, suggesting that active, collaborative problem-solving and mutual validation during conflicts can significantly attenuate the subjective and psychological experience of financial strain (Asadi et al., 2024). These results align seamlessly with previous literature demonstrating that constructive husband-wife interactions are critical for preserving marital satisfaction and family harmony amidst severe economic pressure (Gunawan & Krisnatuti, 2022). Furthermore, the ability of these couples to maintain healthy functioning reflects a high degree of intrinsic resilience, a psychological asset that substantially bolsters the subjective well-being of parents facing chronic, compounding stressors (Wu et al., 2023). The capacity for such resilient adaptation is frequently fostered by higher family socio-economic status, which equips individuals with the psychological capital and autonomy necessary to navigate crises effectively (Qiu & Ye, 2023; Yuan et al., 2025). Ultimately, this resilient cluster exemplifies how effective interpersonal communication and unified, positive family functioning can serve as a potent protective shield against external economic adversity and prevent the transmission of stress into aggressive behavioral outcomes (Ahmadi et al., 2024).

In stark contrast, Cluster 2, the “Distressed-Avoidant Adapters” (27.43%), represents a highly vulnerable typology defined by pervasive avoidant coping and the toxic demand-withdraw communication pattern. This group reported the highest levels of perceived economic stress and was disproportionately composed of families from the lowest income bracket. These empirical findings provide robust, multidimensional support for the Family Stress Model, illustrating how objective economic hardship

drastically exacerbates perceived stress, which in turn degrades dyadic relationship quality and fosters destructive conflict patterns (Fanta et al., 2025; Lee et al., 2022; Oftedal et al., 2025). When couples lack the financial and psychological resources to confront stress directly, they frequently resort to avoidance and withdrawal, mechanisms that only deepen financial insecurity and psychological distress (Lee et al., 2024). Left unaddressed, this specific confluence of profound economic deprivation and severe communication breakdown establishes a perilous developmental trajectory that frequently culminates in complete family collapse and institutional dissolution (Arami et al., 2023). Moreover, the detrimental effects of this distressed pattern extend far beyond the marital dyad; chronic family economic stress and the resulting hostile home environment are well-documented catalysts for adverse youth outcomes, including diminished cognitive development, internalizing problems, and increased externalizing behaviors such as peer aggression and cyberbullying (Finch et al., 2025; Yang et al., 2023).

Cluster 3, the “Ambivalent-Emotion-Focused Adapters” (35.40%), presents a more nuanced, hybrid profile. These couples exhibited moderate levels of economic stress and communication quality but were distinguished by their heavy reliance on emotion-focused coping and social support seeking. This suggests a pattern where families attempt to manage the immediate emotional fallout of financial strain through external networks and internal emotional regulation, rather than aggressively tackling the structural financial problems. The prominent role of social support seeking in this cluster underscores the vital importance of social and cultural capital, particularly within indigenous or community-oriented family structures where extended networks provide critical, life-sustaining safety nets (Juhaidi et al., 2024). The overall efficacy of this adaptation pattern may heavily depend on parental emotional intelligence, which plays a pivotal role in mitigating anxiety and maintaining household stability during periods of prolonged systemic distress or external crisis (Xiang et al., 2025). While emotion-focused strategies can provide necessary temporary relief, the long-term sustainability of this adaptation style may require supplementary, targeted interventions, such as cultivating mindful parenting practices, which have been proven to mediate the association between family economic pressure and long-term child adjustment (Lam et al., 2025).

Across all identified clusters, the present study revealed a profound, statistically significant association between

machine-learning adaptation patterns and objective household income brackets. This robust finding unequivocally reiterates that family socio-economic status is not a peripheral variable, but a central, organizing force that shapes interpersonal communication, coping capacities, and the broader psychological development of family members (Shi, 2024; Wilkinson et al., 2024; Yu, 2024). The socioeconomic context directly influences the cognitive bandwidth and resources available to families, inherently shaping the frequency and quality of interpersonal interactions within the home and with external systems, such as primary healthcare providers or educational institutions (Svynozelska, 2023). Addressing these deep-seated systemic disparities requires a fundamental paradigm shift in how family institutions are analyzed, supported, and protected within modern socio-economic frameworks (Nigam, 2023). To cultivate resilience proactively, policymakers and educators must prioritize the deliberate design and validation of culturally sensitive family economic models (Fakhari et al., 2023) and integrate comprehensive family economics curricula directly into upper secondary education (Hosseini et al., 2023). Furthermore, localized, community-level initiatives that implement focused family education programs can empower parents with the specific character-based skills necessary to navigate economic challenges constructively (Khorri et al., 2025). Finally, any comprehensive approach to improving family adaptation and resilience must account for shifting structural dynamics, particularly acknowledging and facilitating the pivotal role of women's employment, which fundamentally alters the economic, subjective, and legal landscape of the contemporary family unit (Mohammad Ali et al., 2022).

5. Conclusion

The application of unsupervised machine-learning in this study provided a critical, person-centered perspective on how married couples navigate the pervasive challenge of economic stress. By moving beyond isolated variables, the analysis revealed three distinct typologies of family adaptation: Resilient-Constructive, Distressed-Avoidant, and Ambivalent-Emotion-Focused. These profiles underscore that financial hardship is not merely a mathematical deficit in a household ledger, but a complex psychological stressor that forces couples into specific behavioral and communicative pathways. The stark overrepresentation of lower-income families in the most

distressed, maladaptive cluster highlights the compounded vulnerability of socioeconomically disadvantaged populations. Ultimately, this study demonstrates that while objective economic conditions set the stage for family functioning, the intricate interplay of dyadic communication and shared coping strategies determines whether a family will succumb to the pressure or adapt with resilience.

6. Suggestions and Limitations

Despite its robust methodological approach, this study is subject to several limitations. First, the cross-sectional design precludes the ability to establish definitive causal relationships; while we can identify distinct adaptation clusters, we cannot ascertain whether prolonged economic stress inherently causes a shift from a resilient to a distressed profile over time. Second, the reliance on self-reported questionnaires for measuring highly sensitive topics such as perceived financial strain and marital conflict may introduce social desirability and recall biases. Third, the sample was drawn exclusively from the Klang Valley region of Malaysia. While socioeconomically diverse, this urban-centric demographic may not accurately reflect the adaptation patterns of couples in rural areas or distinct cultural contexts globally. Finally, the clusters generated by the K-Means algorithm are inherently constrained by the specific input variables selected for the model.

Future research should prioritize longitudinal study designs to track how family adaptation patterns evolve in response to fluctuating macroeconomic conditions, such as recessions or periods of rapid inflation. Such designs would illuminate the stability or fluidity of these clusters over the family life cycle. Additionally, researchers should incorporate objective physiological markers of stress or observational dyadic data—such as laboratory recordings of couples discussing finances—to overcome the limitations of self-report surveys and capture real-time communication dynamics. There is also a pressing need to expand this machine-learning approach to more diverse, cross-cultural samples to determine the universal versus culture-specific nature of these adaptation typologies. Finally, future studies should directly link these specific parental adaptation clusters to longitudinal developmental and psychological outcomes in children to map the intergenerational transmission of economic stress.

The identification of these distinct adaptation profiles offers critical, actionable insights for clinical practice and social policy. Financial counselors and marital therapists

must abandon one-size-fits-all interventions and instead assess a couple's specific typological profile. For "Distressed-Avoidant" couples, therapy must urgently focus on de-escalating hostility and breaking the demand-withdraw cycle before financial planning can even be effective. Conversely, "Ambivalent-Emotion-Focused" couples may benefit most from psychoeducation aimed at translating their emotional support networks into actionable, problem-solving financial behaviors. Community organizations should implement integrated workshops that teach financial literacy alongside interpersonal communication skills, recognizing that the two are inextricably linked. On a systemic level, policymakers must recognize that economic aid to lower-income brackets is not merely a matter of financial welfare, but a necessary public health intervention to prevent the psychological and relational collapse of the family unit.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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