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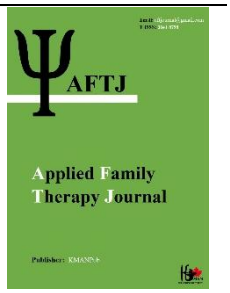

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Random Forest Prediction of Family Functioning Based on Emotional Availability, Family Communication, Psychological Well-Being, and Coping Self-Efficacy

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A B S T R A C T

Objective: The present study aimed to develop and evaluate a Random Forest machine learning model for predicting family functioning based on emotional availability, family communication, psychological well-being, and coping self-efficacy among Canadian adults.

Methods and Materials: This cross-sectional predictive study was conducted among 768 adults residing in Canada who were recruited through community organizations, social media platforms, and online advertisements. Data were collected using the Family Assessment Device (FAD), Brief Emotional Availability Scale (BEAS), Family Communication Scale (FCS), Ryff's Psychological Well-Being Scale (PWB), and the Coping Self-Efficacy Scale (CSE). Following data screening and preprocessing procedures, descriptive statistics and Pearson correlations were calculated. The dataset was randomly divided into training (80%) and testing (20%) subsets. A Random Forest regression model was developed using five-fold cross-validation and hyperparameter optimization procedures. Model performance was evaluated using the coefficient of determination (R^2), root mean square error (RMSE), mean absolute error (MAE), and mean squared error (MSE). Feature importance and SHAP (Shapley Additive Explanations) analyses were employed to determine the relative contribution of each predictor variable.

Findings: Significant associations were observed between family functioning and all predictor variables. Family communication demonstrated the strongest negative correlation with family dysfunction ($r = -.76$, $p < .001$), followed by emotional availability ($r = -.71$, $p < .001$), psychological well-being ($r = -.68$, $p < .001$), and coping self-efficacy ($r = -.64$, $p < .001$). The Random Forest model achieved strong predictive performance, yielding an R^2 of .847 on the testing dataset and a cross-validation R^2 of .836. Feature importance analysis identified family communication (37.2%) as the most influential predictor, followed by emotional availability (28.6%), psychological well-being (20.4%), and coping self-efficacy (13.8%). Permutation importance and SHAP analyses confirmed the stability of this predictor hierarchy and revealed that communication and emotional availability exerted the greatest impact on model predictions.

Conclusion: The findings indicate that family functioning can be predicted with high accuracy using emotional availability, family communication, psychological well-being, and coping self-efficacy. Relational factors, particularly communication quality and emotional availability, emerged as the most influential determinants of family functioning. The results support the application of machine learning approaches in family psychology and highlight key targets for interventions designed to strengthen family relationships and promote adaptive family functioning.

Keywords: *Family Functioning; Random Forest; Emotional Availability; Family Communication; Psychological Well-Being; Coping Self-Efficacy*

1. Introduction

Family functioning is widely recognized as one of the most influential determinants of psychological adjustment, emotional development, resilience, and overall well-being across the lifespan. Family systems provide the primary context in which individuals develop interpersonal competencies, emotion regulation skills, coping strategies, and perceptions of self-worth. Healthy family functioning is characterized by effective communication, emotional responsiveness, supportive relationships, adaptive problem-solving, and mutual respect among family members, whereas dysfunctional family environments are associated with increased psychological distress, maladaptive behaviors, and reduced well-being among both parents and children (Guillén et al., 2023; Hoang et al., 2024). Contemporary family psychology increasingly conceptualizes family functioning as a multidimensional construct influenced by dynamic interactions among emotional, cognitive, behavioral, and relational factors operating within the family system.

Recent social and economic changes have intensified the challenges faced by modern families. Increasing work demands, financial pressures, technological transformations, and societal uncertainties have created new stressors that affect family relationships and household functioning. Research has demonstrated that exposure to chronic stress can undermine emotional availability, disrupt communication patterns, weaken coping resources, and compromise psychological well-being among family members (O'Brien et al., 2023; J. Yang, 2025). Consequently, understanding the factors that contribute to healthy family functioning has become a major priority for researchers, clinicians, educators, and policymakers seeking to promote individual and collective well-being.

Among the factors associated with family functioning, emotional availability has emerged as a particularly important relational resource. Emotional availability refers to the capacity of family members to be emotionally responsive, accessible, supportive, and attuned to one another's needs. Families characterized by high emotional availability provide secure emotional environments that facilitate trust, emotional expression, and adaptive coping. Emotional availability enables family members to experience validation and support during stressful circumstances, thereby fostering psychological resilience and relational stability. Research indicates that emotionally supportive family environments contribute significantly to children's emotional development, psychological adjustment, and long-term mental health outcomes (Lin et al., 2023; Tietbohl-Santos et al., 2024). Moreover, emotionally available family relationships serve as protective factors against depression, anxiety, behavioral difficulties, and various forms of psychological maladjustment (Fares-Otero et al., 2025; Ge, 2025).

The importance of emotional processes within families is further supported by studies examining resilience and adaptation in challenging life circumstances. Systematic reviews have demonstrated that emotional support and family cohesion constitute critical components of family resilience across diverse populations, including caregivers, individuals facing chronic illness, and families exposed to significant stressors (X. Yang, 2025). Similarly, investigations into parental burnout and adolescent resilience have shown that emotionally intrusive or emotionally unavailable parenting practices can undermine resilience and adaptive functioning among young people (Zhou, 2025). These findings suggest that emotional availability may play a central role in shaping family functioning by promoting adaptive emotional exchanges and strengthening interpersonal bonds.

Family communication represents another fundamental dimension of healthy family functioning. Communication processes enable family members to exchange information, express emotions, negotiate roles, resolve conflicts, and maintain relational closeness. Effective communication is characterized by openness, active listening, empathy, clarity, and mutual respect. Conversely, ineffective communication

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contributes to misunderstandings, conflict escalation, emotional distancing, and family dysfunction. Family communication has consistently been identified as one of the strongest predictors of family adaptation, relationship satisfaction, and psychological adjustment across developmental stages (Gorla et al., 2026; Hoang et al., 2024).

Evidence suggests that communication processes influence a broad range of developmental and psychological outcomes. Research examining parent-child interactions has demonstrated that effective communication facilitates emotional regulation, social competence, and psychological well-being among children and adolescents (Lin et al., 2023). Furthermore, family communication plays a crucial role in preventing emotional and behavioral problems by fostering supportive relationships and enhancing problem-solving capacities. Studies have shown that communication quality significantly influences adolescents' resilience, emotional adjustment, and capacity to cope with stress (Harsono & Febriyana, 2026; Strasser et al., 2023). In multigenerational family contexts, communication patterns also influence long-term family outcomes by shaping parental self-efficacy, emotional support, and relational stability (Gorla et al., 2026).

Psychological well-being constitutes another important determinant of family functioning. Psychological well-being encompasses positive psychological states such as self-acceptance, purpose in life, autonomy, personal growth, environmental mastery, and positive interpersonal relationships. Individuals with higher levels of psychological well-being tend to exhibit greater emotional stability, adaptive coping, resilience, and relationship satisfaction. These characteristics contribute directly to healthier family interactions and more effective responses to family-related stressors (Hu et al., 2025; Voltmer & Salisch, 2023). In contrast, diminished psychological well-being may impair communication, increase emotional reactivity, and reduce individuals' ability to contribute positively to family processes.

Recent empirical evidence highlights the central role of psychological well-being in promoting adaptive functioning across various contexts. Studies have demonstrated that subjective well-being is positively associated with resilience, self-efficacy, and psychological resources that facilitate adaptation to adversity (Gkargkavouzi & Halkos, 2025; Voltmer & Salisch, 2023). Furthermore, interventions designed to enhance psychological well-being have been shown to improve emotional functioning, reduce psychological distress, and strengthen coping capacities among both parents and children (Tobe et al., 2022; J. Yang, 2025). These findings suggest that psychological well-being may contribute substantially to healthy family functioning by enhancing individuals' capacities to manage challenges and maintain supportive relationships.

Closely related to psychological well-being is coping self-efficacy, which refers to individuals' beliefs regarding their ability to effectively manage stressors and overcome challenges. Self-efficacy theory proposes that individuals who possess stronger confidence in their coping abilities are more likely to engage in adaptive behaviors, persist in the face of difficulties, and utilize effective problem-solving strategies. Within family contexts, coping self-efficacy may influence how family members respond to conflict, stress, caregiving responsibilities, and interpersonal challenges (Cao et al., 2023; Chong et al., 2024). Higher levels of coping self-efficacy enable individuals to regulate emotions more effectively, seek social support when needed, and contribute positively to family interactions.

Research consistently demonstrates the protective role of self-efficacy in psychological and relational functioning. Self-efficacy has been associated with reduced depression, enhanced resilience, improved emotional adjustment, and greater psychological well-being across diverse populations (Gkargkavouzi & Halkos, 2025; Zhang & Zhang, 2024). Among parents, self-efficacy contributes to more effective parenting behaviors, improved stress management, and greater competence in addressing family challenges (Cao et al., 2023; Chong et al., 2024). Additionally, studies examining family resilience have identified self-efficacy as a key psychological resource that strengthens families' capacities to adapt successfully to adversity (X. Yang, 2025). Consequently, coping self-efficacy represents a theoretically meaningful predictor of family functioning.

Recent research has increasingly emphasized the interconnected nature of emotional, cognitive, and relational processes within family systems. Studies examining coparenting relationships, parental stress, mindful parenting, and psychological flexibility suggest that adaptive family functioning emerges from complex interactions among multiple psychological and interpersonal variables rather than from isolated influences (Finkelstein, 2025; Sparpana & Brock, 2025; Taştekin et al., 2025). Emotional availability, communication quality, psychological well-being, and coping self-efficacy may therefore function synergistically to influence family outcomes. Understanding the relative contributions of these factors requires analytical

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approaches capable of modeling complex and potentially nonlinear relationships.

Traditional statistical approaches such as correlation and regression analyses have contributed substantially to family psychology research; however, they may be limited in their ability to capture intricate interactions among multiple predictors. In recent years, machine learning methods have gained increasing attention within psychological and behavioral sciences due to their capacity to identify complex patterns, accommodate nonlinear relationships, and enhance predictive accuracy (Ma et al., 2025; Zhang et al., 2025). Machine learning approaches have been successfully applied to predict various psychological outcomes, including academic emotions, mental health risks, self-injurious behaviors, and resilience-related processes (Ge, 2025; Ma et al., 2025; Zhang et al., 2025). These methodologies offer valuable opportunities for advancing predictive models of family functioning.

Among machine learning algorithms, Random Forest has emerged as one of the most robust and interpretable predictive techniques. Random Forest combines multiple decision trees to improve prediction accuracy, reduce overfitting, and estimate variable importance. The algorithm is particularly well suited for psychological and family research because it can model complex interactions among variables without requiring strict assumptions regarding linearity or normality. Furthermore, Random Forest provides feature importance metrics that allow researchers to identify the relative influence of different predictors on outcome variables (Ma et al., 2025; Zhang et al., 2025). Such capabilities make Random Forest an appropriate methodological approach for investigating the combined effects of emotional availability, family communication, psychological well-being, and coping self-efficacy on family functioning.

Although previous studies have independently examined emotional availability, communication quality, psychological well-being, and self-efficacy, relatively few investigations have integrated these constructs within a comprehensive predictive framework. Moreover, most existing research has relied on traditional analytical methods, leaving a gap in understanding how advanced machine learning techniques can be utilized to identify the most influential determinants of family functioning. Given the growing recognition of family functioning as a critical predictor of psychological adjustment, resilience, and mental health outcomes, there is a need for research that simultaneously examines multiple relational and psychological factors using sophisticated predictive methodologies (Baldini et al., 2025; Lin & Guo, 2024; Postigo-Zegarra et al., 2025).

Therefore, the aim of the present study was to develop and evaluate a Random Forest model for predicting family functioning based on emotional availability, family communication, psychological well-being, and coping self-efficacy among Canadian adults.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a cross-sectional predictive research design utilizing a machine learning approach to examine the extent to which emotional availability, family communication, psychological well-being, and coping self-efficacy could predict family functioning among Canadian adults. The study was conducted between January and June 2026 across several provinces in Canada, including Ontario, British Columbia, Alberta, and Quebec. Participants were recruited using a combination of online advertisements, community outreach programs, social media platforms, and family-oriented community organizations. Eligibility criteria included being at least 18 years of age, residing in Canada, possessing sufficient English language proficiency to complete the questionnaires, and currently living within a family system, whether nuclear, extended, or blended. Individuals with severe cognitive impairments or incomplete survey responses exceeding 20% of the questionnaire items were excluded from the final analyses.

A total of 812 participants initially responded to the online survey. After data screening procedures, including the removal of incomplete responses, duplicate entries, and cases with excessive missing data, the final sample consisted of 768 participants. The participants ranged in age from 18 to 72 years, with a mean age of 39.84 years (SD = 11.27). The sample included both men and women from diverse socioeconomic and educational backgrounds. Prior to participation, all respondents provided informed consent electronically and were informed about the voluntary nature of participation, confidentiality of responses, and their right to withdraw from the study at any stage without penalty.

2.2. Measures

Family functioning was assessed using the Family Assessment Device (FAD), developed by Epstein, Baldwin, and Bishop (1983). The FAD is one of the most widely used

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instruments for evaluating family functioning and is based on the McMaster Model of Family Functioning. The instrument consists of 60 items distributed across seven dimensions, including problem solving, communication, roles, affective responsiveness, affective involvement, behavior control, and general functioning. Participants rate each statement on a four-point Likert scale ranging from strongly agree to strongly disagree. Higher scores indicate poorer family functioning, while lower scores reflect healthier family dynamics. The instrument has demonstrated satisfactory psychometric properties across diverse populations, with previous studies reporting acceptable levels of internal consistency, construct validity, and test-retest reliability.

Emotional availability was measured using the Brief Emotional Availability Scale (BEAS), which assesses the perceived emotional accessibility, responsiveness, and emotional connection among family members. The scale contains 24 items rated on a five-point Likert scale ranging from never to always. The measure evaluates emotional sensitivity, emotional responsiveness, emotional support, and emotional closeness within interpersonal relationships. Higher scores indicate greater perceived emotional availability. Previous research has consistently demonstrated strong internal consistency coefficients and evidence supporting convergent and discriminant validity across community and family-based samples.

Family communication was assessed using the Family Communication Scale (FCS) developed by Olson and Barnes as part of the Circumplex Model of Marital and Family Systems. The scale consists of 10 items designed to evaluate the quality of communication among family members, including openness, empathy, active listening, respect, and clarity of expression. Responses are recorded on a five-point Likert scale ranging from strongly disagree to strongly agree. Higher scores indicate more effective and constructive family communication. Numerous studies have confirmed the reliability and validity of the FCS in diverse cultural and demographic contexts.

Psychological well-being was measured using Ryff's Psychological Well-Being Scale (PWB). The version employed in this study consisted of 42 items assessing six major dimensions of psychological well-being: autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance. Participants responded using a six-point Likert scale ranging from strongly disagree to strongly agree. Higher total scores reflect greater psychological well-being. The scale has been extensively validated in both clinical and non-clinical populations and has consistently demonstrated satisfactory reliability coefficients and robust construct validity.

Coping self-efficacy was evaluated using the Coping Self-Efficacy Scale (CSE) developed by Chesney and colleagues. This instrument contains 26 items measuring an individual's confidence in performing behaviors necessary for coping with life challenges and stressful situations. The scale assesses three primary domains: problem-focused coping, emotional regulation, and social support utilization. Participants indicate their confidence level on an eleven-point scale ranging from 0 (cannot do at all) to 10 (certain can do). Higher scores indicate greater perceived coping capability. Previous psychometric investigations have reported excellent internal consistency and substantial evidence for criterion-related and construct validity.

2.3. Data Analysis

Data analysis was performed using Python version 3.12 and the Scikit-learn machine learning library. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were calculated to characterize the sample and study variables. Pearson correlation coefficients were initially examined to explore bivariate associations among emotional availability, family communication, psychological well-being, coping self-efficacy, and family functioning.

The primary analytical procedure involved the development of a Random Forest regression model to predict family functioning. Random Forest was selected because of its ability to model complex nonlinear relationships, manage interactions among predictors, reduce overfitting through ensemble learning, and provide robust estimates of variable importance. Prior to model construction, all predictor variables were inspected for multicollinearity, and feature distributions were examined. The dataset was randomly divided into training and testing subsets, with 80% of the observations allocated to model training and 20% reserved for out-of-sample testing. Hyperparameter optimization was conducted using five-fold cross-validation and grid search procedures to identify the optimal number of trees, maximum tree depth, minimum samples per split, and minimum samples per leaf.

Model performance was evaluated using multiple predictive accuracy indices, including the coefficient of determination (R^2), mean absolute error (MAE), root mean square error (RMSE), and mean squared error (MSE).

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Feature importance analysis was subsequently performed to determine the relative contribution of emotional availability, family communication, psychological well-being, and coping self-efficacy in predicting family functioning. To enhance interpretability, permutation importance scores and SHAP (Shapley Additive Explanations) values were additionally examined to identify the most influential predictors and to visualize their individual contributions to model predictions. Statistical significance for preliminary correlational analyses was evaluated at the 0.05 level, while machine learning performance was assessed primarily through predictive accuracy and model generalizability indicators.

3. Findings and Results

The final dataset consisted of 768 Canadian adults. Of the participants, 412 (53.6%) were women and 356 (46.4%) were men. The mean age of the sample was 39.84 years (SD = 11.27), with ages ranging from 18 to 72 years. Regarding marital status, 71.4% were married, 12.6% were cohabiting, 9.1% were divorced or separated, and 6.9% were single but residing within a family household. Approximately 64.8% of participants held a university degree, 23.3% had completed college education, and 11.9% had a high school diploma or equivalent. The average duration of family co-residence was 13.42 years (SD = 8.76). Preliminary data screening revealed no severe violations of normality, and missing data accounted for less than 3% of observations, which were addressed using multiple imputation procedures before model development.

Table 1

Descriptive Statistics and Correlations Among Study Variables

Variable	Mean	SD	1	2	3	4	5
1. Family Functioning	2.18	0.49	—				
2. Emotional Availability	3.84	0.67	-.71**	—			
3. Family Communication	3.76	0.61	-.76**	.69**	—		
4. Psychological Well-Being	4.42	0.73	-.68**	.58**	.62**	—	
5. Coping Self-Efficacy	6.89	1.44	-.64**	.53**	.57**	.66**	—

Table 1 presents the descriptive statistics and Pearson correlation coefficients among the principal study variables. The findings demonstrated that emotional availability, family communication, psychological well-being, and coping self-efficacy were all significantly associated with family functioning. Family communication exhibited the strongest relationship with family functioning ($r = -.76$, $p < .001$), followed by emotional availability ($r = -.71$, $p < .001$), psychological well-being ($r = -.68$, $p < .001$), and coping self-efficacy ($r = -.64$, $p < .001$). Because higher scores on the Family Assessment Device reflect poorer family functioning, the negative correlations indicate that higher levels of emotional availability, communication quality, well-being, and coping efficacy were associated with healthier family functioning. Significant positive correlations were also observed among all predictor variables, suggesting that families characterized by stronger emotional connections and communication patterns tended to report greater psychological well-being and coping confidence. None of the intercorrelations exceeded .80, indicating that multicollinearity was not a major concern for subsequent machine learning analyses.

Table 2

Random Forest Model Performance Indicators for Predicting Family Functioning

Performance Metric	Training Set	Test Set
R^2	0.923	0.847
Adjusted R^2	0.922	0.845
RMSE	0.132	0.211
MAE	0.098	0.164
MSE	0.017	0.045
Cross-Validation R^2 (5-Fold Mean)	0.836	—

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The predictive performance of the Random Forest model is presented in Table 2. The model demonstrated excellent predictive capability across both training and testing datasets. The training dataset yielded an R^2 value of .923, indicating that approximately 92.3% of the variance in family functioning was explained by the predictor variables. More importantly, the model maintained strong performance on the independent testing dataset, achieving an R^2 of .847. This finding indicates a high degree of generalizability and suggests that the model successfully learned meaningful patterns rather than merely memorizing the training data. The relatively small differences between training and testing performance metrics further indicate limited overfitting. The root mean square error (RMSE = 0.211) and mean absolute error (MAE = 0.164) obtained for the testing dataset reflect a low level of prediction error. Furthermore, the five-fold cross-validation mean R^2 of .836 confirmed the robustness and stability of the model across different subsets of the data. Collectively, these results demonstrate that emotional availability, family communication, psychological well-being, and coping self-efficacy provide substantial predictive information regarding family functioning and support the effectiveness of Random Forest algorithms for modeling complex family-system outcomes.

Table 3

Feature Importance Scores in the Random Forest Model

Predictor Variable	Mean Decrease in Impurity	Relative Importance (%)
Family Communication	0.372	37.2
Emotional Availability	0.286	28.6
Psychological Well-Being	0.204	20.4
Coping Self-Efficacy	0.138	13.8

Table 3 summarizes the relative importance of the predictor variables in the Random Forest model. Family communication emerged as the most influential predictor, accounting for 37.2% of the overall predictive contribution. This finding suggests that the quality of communication among family members plays a central role in determining family functioning and represents the most powerful indicator of adaptive family processes in the present sample. Emotional availability was identified as the second most important predictor, contributing 28.6% to model performance. This result highlights the importance of emotional responsiveness, accessibility, and support within family relationships. Psychological well-being ranked third, accounting for 20.4% of predictive importance, indicating that individuals' positive psychological functioning contributes substantially to family-system health. Coping self-efficacy, while the least influential predictor among the four variables, still contributed 13.8% of the model's predictive power and remained an important determinant of family functioning. The distribution of feature importance scores demonstrates that family functioning is shaped by a combination of relational and individual psychological factors, with relational processes appearing particularly influential.

Table 4

Permutation Importance Analysis

Predictor Variable	Mean Importance	Standard Deviation
Family Communication	0.291	0.021
Emotional Availability	0.238	0.019
Psychological Well-Being	0.174	0.016
Coping Self-Efficacy	0.119	0.014

The permutation importance analysis shown in Table 4 further confirmed the pattern observed in the Random Forest feature importance results. Family communication remained the most influential predictor, demonstrating the largest reduction in model accuracy when randomly permuted. Emotional availability also exhibited substantial importance, indicating that disrupting information related to emotional accessibility significantly impaired predictive performance. Psychological well-being and coping self-efficacy continued to contribute meaningfully to prediction accuracy, although their effects were comparatively smaller. The consistency between the impurity-based importance metrics and

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permutation importance findings provides strong evidence for the stability and reliability of the identified predictor hierarchy. These results indicate that both family-level relational dynamics and individual psychological resources contribute to family functioning, but interpersonal communication processes appear to be the dominant factor within the current predictive framework.

Figure 1

SHAP Summary Plot Showing the Relative Contributions of Emotional Availability, Family Communication, Psychological Well-Being, and Coping Self-Efficacy to Family Functioning Predictions

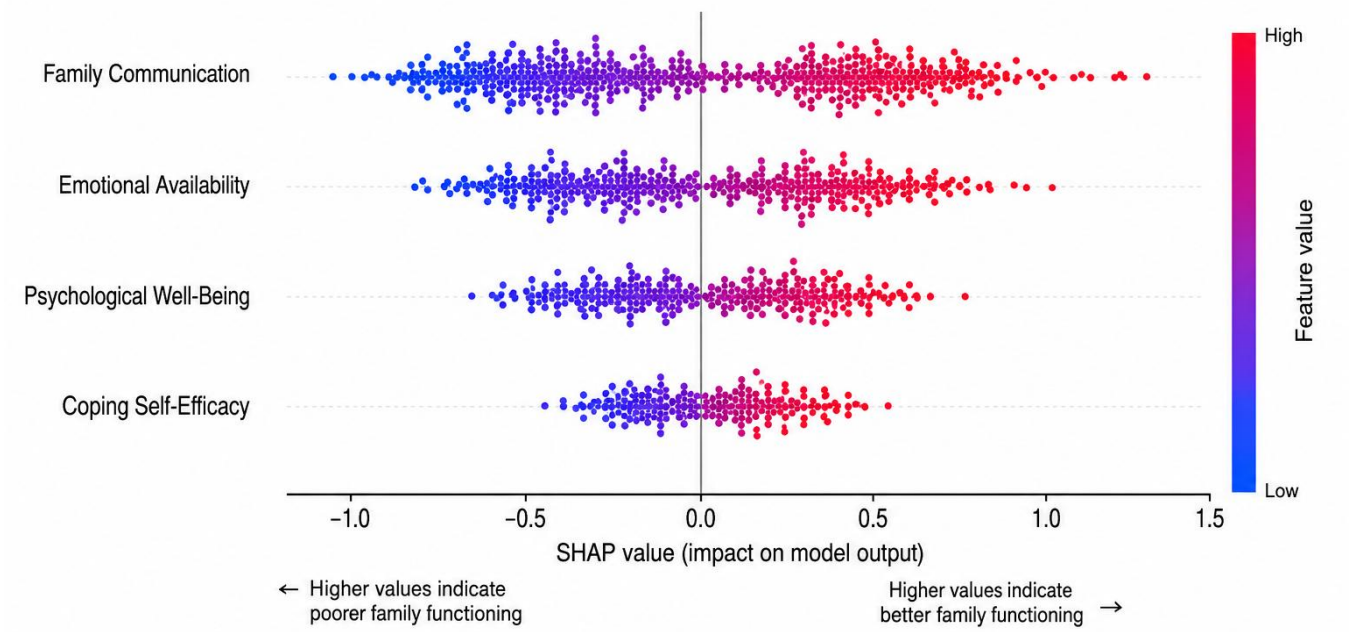

Figure 1 presents the SHAP summary analysis used to enhance the interpretability of the Random Forest model. The SHAP values demonstrated that family communication exerted the largest overall impact on prediction outcomes, followed by emotional availability, psychological well-being, and coping self-efficacy. Higher values of family communication and emotional availability consistently shifted predictions toward healthier family functioning, whereas lower scores increased the likelihood of poorer family functioning outcomes. The SHAP distribution further revealed considerable variability in individual-level effects, indicating that the influence of predictor variables differed across participants and supporting the presence of complex nonlinear relationships captured by the Random Forest algorithm. Psychological well-being demonstrated moderate but consistent effects across observations, while coping self-efficacy exerted smaller yet still meaningful influences. The SHAP analysis provided additional confirmation that family communication and emotional availability represent the primary determinants of family functioning in this sample and illustrated how machine learning techniques can offer both high predictive accuracy and interpretable insights into family-system processes. Overall, the findings from the feature importance and SHAP analyses converged to show that healthy family functioning is most strongly associated with effective communication patterns and emotionally available relationships, supported by positive psychological functioning and strong coping resources.

4. Discussion

The present study aimed to develop and evaluate a Random Forest model for predicting family functioning based on emotional availability, family communication, psychological well-being, and coping self-efficacy among Canadian adults. The findings demonstrated that all four predictor variables were significantly associated with family functioning, with family communication exhibiting the strongest relationship, followed by emotional availability, psychological well-being, and coping self-efficacy. Furthermore, the Random Forest model achieved high predictive performance, explaining approximately 84.7% of the variance in family functioning within the testing dataset.

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Feature importance analyses and SHAP interpretations consistently identified family communication and emotional availability as the most influential determinants of family functioning. These findings underscore the central importance of relational processes within family systems while simultaneously highlighting the meaningful contributions of individual psychological resources.

One of the most important findings of the present study was the strong predictive role of family communication. Family communication emerged as the most influential variable across all machine learning analyses and demonstrated the strongest correlation with family functioning. This finding is highly consistent with contemporary family systems theories, which conceptualize communication as the primary mechanism through which family members negotiate roles, regulate emotions, resolve conflicts, and maintain interpersonal connections. Effective communication allows family members to exchange emotional and practical support, clarify expectations, and collaboratively address challenges. When communication is characterized by openness, empathy, and mutual understanding, families are better equipped to adapt to stressors and preserve relational stability.

The importance of communication observed in the present study aligns closely with previous empirical findings. Research has demonstrated that parent-child communication significantly influences psychological adjustment, emotional development, and resilience among children and adolescents (Gorla et al., 2026). Similarly, systems-oriented approaches to family development emphasize that healthy communication strengthens connections among families, schools, and communities, thereby promoting adaptive outcomes across multiple ecological contexts (Hoang et al., 2024). Meta-analytic evidence further indicates that family-related factors exert substantial effects on children's emotional regulation capacities, which in turn influence psychological well-being and adjustment (Lin et al., 2023). The current findings extend this literature by demonstrating that communication is not only associated with family functioning but also represents the most influential predictor when examined alongside multiple psychological and relational variables within a machine learning framework.

Emotional availability emerged as the second most important predictor of family functioning. Families characterized by high emotional availability provide environments in which individuals feel understood, valued, and supported. Emotional availability facilitates trust, emotional security, and interpersonal responsiveness, all of which contribute to healthier family relationships. The strong predictive contribution of emotional availability observed in this study suggests that family functioning is deeply rooted in the quality of emotional exchanges among family members. Families that maintain emotionally supportive interactions are likely to experience greater cohesion, lower conflict, and more effective adaptation to life stressors.

These findings are consistent with evidence demonstrating the protective role of emotionally supportive family environments. Studies have shown that family factors significantly influence children's emotion regulation and psychological adjustment (Lin et al., 2023). Research examining protective factors against depression has similarly identified supportive family relationships and emotional resources as critical contributors to positive developmental outcomes (Tietbohl-Santos et al., 2024). Moreover, resilience-focused investigations indicate that emotionally supportive family environments enhance adaptive functioning following adversity and reduce vulnerability to psychological difficulties (Fares-Otero et al., 2025; Ge, 2025). The current study contributes to this growing body of evidence by demonstrating that emotional availability remains a highly influential determinant of family functioning even when considered simultaneously with communication, well-being, and self-efficacy.

Psychological well-being was also found to be a substantial predictor of family functioning. Individuals with higher levels of psychological well-being tend to demonstrate greater emotional stability, positive affect, self-regulation, and interpersonal competence. These characteristics facilitate constructive family interactions and improve the ability to manage relational challenges. The present findings suggest that psychologically healthy individuals contribute positively to family environments by fostering supportive communication, adaptive problem-solving, and emotional responsiveness.

This finding corresponds with prior research linking psychological well-being to resilience, adaptive functioning, and relationship quality. Studies have demonstrated that psychological resources such as subjective well-being and positive mental health contribute significantly to resilience and successful adaptation to stress (Voltmer & Salisch, 2023). Research examining psychological capital has similarly shown that positive psychological functioning promotes favorable developmental and behavioral outcomes (Hu et al., 2025). Furthermore, interventions targeting

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psychological well-being have been associated with improvements in emotional functioning and family adjustment among parents facing challenging circumstances (J. Yang, 2025). Collectively, these findings support the interpretation that psychological well-being enhances family functioning by strengthening individuals' capacities to engage effectively within family relationships.

The present study also identified coping self-efficacy as a significant predictor of family functioning. Although coping self-efficacy contributed less variance than communication and emotional availability, it nevertheless demonstrated meaningful predictive value. Individuals who believe they can effectively manage stressors are more likely to utilize adaptive coping strategies, maintain emotional regulation, and seek support when necessary. Such behaviors contribute directly to healthier family interactions and more constructive responses to family-related challenges.

The role of coping self-efficacy observed in this study is strongly supported by previous literature. Self-efficacy has been repeatedly identified as a key psychological resource associated with resilience, psychological well-being, and adaptive functioning (Gkargkavouzi & Halkos, 2025). Research has shown that self-efficacy influences parenting competence, emotional adjustment, and effective management of caregiving responsibilities (Cao et al., 2023; Chong et al., 2024). Studies examining adolescent mental health have likewise demonstrated that self-efficacy serves as a protective factor against depression and emotional difficulties (Strasser et al., 2023; Zhang & Zhang, 2024). The current findings extend these observations by indicating that coping self-efficacy contributes not only to individual adaptation but also to broader family functioning outcomes.

An important contribution of the present study lies in its use of machine learning methodology. The Random Forest model achieved high predictive accuracy, suggesting that family functioning can be effectively predicted through a combination of relational and psychological variables. Traditional statistical approaches often focus on linear relationships and may fail to capture complex interactions among predictors. In contrast, Random Forest algorithms can accommodate nonlinear relationships and higher-order interactions, providing a more comprehensive understanding of family dynamics. The strong performance of the model is consistent with emerging evidence supporting the application of machine learning techniques within psychological and behavioral sciences (Ma et al., 2025; Zhang et al., 2025).

The SHAP analyses provided additional insights into the mechanisms underlying family functioning. These analyses revealed that family communication and emotional availability exerted the greatest influence across individual predictions, indicating that relational processes remain central determinants of family outcomes even when accounting for individual psychological characteristics. This finding aligns with contemporary family systems perspectives, which emphasize the primacy of interpersonal interactions in shaping family adaptation and well-being (Guillén et al., 2023; Hoang et al., 2024). While psychological well-being and coping self-efficacy contributed meaningfully to prediction accuracy, their effects appeared to operate within broader relational contexts characterized by communication quality and emotional connection.

The findings also have implications for understanding resilience within family systems. Family resilience has increasingly been conceptualized as a dynamic process involving emotional support, effective communication, adaptive coping, and positive psychological functioning (X. Yang, 2025). Research examining parental burnout, parenting stress, and family adaptation has demonstrated that supportive relational processes can buffer the negative effects of stress and promote positive outcomes (Finkelstein, 2025; Sparpana & Brock, 2025; Taştekin et al., 2025). Similarly, investigations into parental psychological intrusion and burnout suggest that disruptions in family relationships can undermine resilience and functioning (Zhou, 2025). The current study reinforces these perspectives by demonstrating that family functioning is most strongly influenced by variables that reflect relational support and emotional connectedness.

5. Conclusion

The results contribute to broader discussions concerning mental health promotion and prevention. Family functioning has been linked to numerous psychological outcomes, including resilience, emotional regulation, depression, academic achievement, and behavioral adjustment (Harsono & Febriyana, 2026; Lin & Guo, 2024). Consequently, identifying the strongest predictors of family functioning may facilitate the development of more targeted preventive interventions. The present findings suggest that interventions focusing on communication enhancement, emotional responsiveness, psychological well-being, and coping self-efficacy may have substantial potential for

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strengthening family systems and improving long-term psychological outcomes.

6. Suggestions and Limitations

Several limitations should be acknowledged when interpreting the findings of this study. First, the cross-sectional design prevents causal conclusions regarding the relationships among emotional availability, family communication, psychological well-being, coping self-efficacy, and family functioning. Second, all variables were measured using self-report instruments, which may be influenced by social desirability bias, response tendencies, and subjective perceptions. Third, although the sample included participants from multiple Canadian provinces, the findings may not be fully generalizable to other cultural, socioeconomic, or geographic contexts. Fourth, additional variables known to influence family functioning, such as socioeconomic status, marital satisfaction, parenting styles, social support, and family structure, were not included in the predictive model. Finally, while Random Forest provides excellent predictive accuracy, it cannot fully explain the causal mechanisms underlying observed relationships.

Future studies should employ longitudinal designs to examine the temporal and causal relationships among family communication, emotional availability, psychological well-being, coping self-efficacy, and family functioning. Researchers may also investigate additional predictors, including family resilience, attachment security, parenting practices, socioeconomic conditions, and cultural factors. Comparative studies across different countries and cultural groups would enhance understanding of contextual influences on family functioning. Future research could also compare the predictive performance of alternative machine learning algorithms, such as XGBoost, LightGBM, CatBoost, Support Vector Machines, and deep learning models. Furthermore, integrating qualitative methodologies with machine learning approaches may provide richer insights into the mechanisms through which family relationships influence overall family functioning.

The findings suggest that practitioners should prioritize interventions aimed at improving family communication skills, emotional responsiveness, and supportive interpersonal interactions. Family counselors, psychologists, and social workers may benefit from incorporating communication training, emotional awareness exercises, and conflict-resolution strategies into family intervention programs. Programs designed to enhance psychological well-being and coping self-efficacy may also indirectly strengthen family functioning by improving individuals' abilities to manage stress and maintain healthy relationships. Educational institutions and community organizations can support families through workshops and preventive programs focused on emotional literacy, resilience-building, and effective communication. Finally, the successful application of machine learning in the present study suggests that predictive analytics may serve as a valuable tool for identifying families at risk of dysfunction and facilitating early intervention efforts.

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.

References

Baldini, V., Gnazzo, M., Varallo, G., Vincenzo, M. D., Scorza, M., Franceschini, C., Ronchi, D. D., Fiorillo, A., & Plazzi, G. (2025). A Comprehensive Approach to Adolescent Suicide

Prevention: Insights From a Narrative Review Perspective. *Frontiers in psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1612067

Cao, H., Leerkes, E. M., & Zhou, N. (2023). Origins and Development of Maternal Self-Efficacy in Emotion-Related Parenting During the Transition to Parenthood: Toward an Integrative Process Framework Beyond Bandura's Model. *Psychological review*, *130*(6), 1612-1652. https://doi.org/10.1037/rev0000382

Chong, Y. Y., Yau, P. T., Kwan, J. Y. M., & Chien, W. T. (2024). Roles of Psychological Flexibility, Parenting Competence, and Asthma Management Self-Efficacy in the Functioning Outcomes of Parents of Children With Asthma Co-Occurring With Attention-Deficit/Hyperactivity Disorder. *European Journal of Investigation in Health Psychology and Education*, *14*(11), 2835-2849. https://doi.org/10.3390/ejihpe14110186

Fares-Otero, N. E., Carranza-Neira, J., Womersley, J. S., Schalinski, I., Vieta, E., Spies, G., & Seedat, S. (2025). Child Maltreatment and Resilience in Adulthood: A Systematic Review and Meta-Analysis. *Psychological medicine*, *55*. https://doi.org/10.1017/s0033291725001205

Finkelstein, S. D. (2025). Does Coparenting Quality Mediate the Link Between Postpartum Parenting Stress and Perceptions of Emotion Regulation During Parenting? *Family Process*, *64*(4). https://doi.org/10.1111/famp.70084

Ge, X. (2025). Bullying Victimization, Suicidal Behavior, and Help-Seeking in Chinese Adolescents: A Legal-Psychological Study of Resilience and Responsibility. *Frontiers in psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1625188

Gkargkavouzi, A., & Halkos, G. (2025). Psychological Resilience to Climate Change: The Role of Self-Efficacy, Mindfulness, Perceived Nature Restorativeness, and Subjective Well-Being. *Sustainable Development*. https://doi.org/10.1002/sd.70401

Gorla, L., Lansford, J. E., Godwin, J., & Dodge, K. A. (2026). Parent–child Communication and Third Generation's Difficulties: Roles of Parental Depression and Self-Efficacy. *Journal of Family Psychology*, *40*(4), 544-554. https://doi.org/10.1037/fam0001399

Guillén, V., Arnal, A., Pérez, S., García-Alandete, J., Fernández-Felipe, I., Grau, A., Botella, C., & Marco, J. (2023). Family Connections in the Treatment of Relatives of People With Eating Disorders and Personality Disorders: Study Protocol of a Randomized Control Trial. *BMC psychology*, *11*(1). https://doi.org/10.1186/s40359-023-01138-x

Harsono, C. S., & Febriyana, N. (2026). Understanding and Addressing Bullying in Children and Adolescents. *Journal of Korean Academy of Child and Adolescent Psychiatry*, *37*(1), 51-62. https://doi.org/10.5765/jkacap.250040

Hoang, A., Sanders, M. R., Turner, K., Morawska, A., Cobham, V. E., Chainey, C., & Simmons, E. (2024). Connecting Families, Schools, and Communities: <scp>A</Scp> Systems-contextual Approach to Sustainable Futures for Children. *Sustainable Development*, *32*(5), 4505-4517. https://doi.org/10.1002/sd.2911

Hu, Y., Weng, Y., Ning, P., Han, L., & Zhang, Y. (2025). The Relationship Between Psychological Capital and Subjective Academic Achievement Among Middle School Students: The Chain Mediating Role of Adolescent Internalizing Problems and Life Attitude. *BMC psychology*, *13*(1). https://doi.org/10.1186/s40359-025-03495-1

Lin, J., & Guo, W. (2024). The Research on Risk Factors for Adolescents' Mental Health. *Behavioral Sciences*, *14*(4), 263. https://doi.org/10.3390/bs14040263

Lin, S. C., Kehoe, C. E., Pozzi, E., Liontos, D., & Whittle, S. (2023). Research Review: Child Emotion Regulation Mediates the Association Between Family Factors And internalizing Symptoms in Children and Adolescents – A Meta-analysis. *Journal of Child Psychology and Psychiatry*, *65*(3), 260-274. https://doi.org/10.1111/jcpp.13894

Ma, S., Jia, N., & Zhang, W. (2025). Constructing a Predictive Model of Negative Academic Emotions in High School Students Based on Machine Learning Methods. *Scientific reports*, *15*(1). https://doi.org/10.1038/s41598-025-04146-6

O'Brien, K. E., Shepard, A., & Donnelly, L. I. (2023). Coworker Support Amplifies Strain in the <scp>COVID</Scp>-19 Pandemic for Working Parents. *Scandinavian journal of psychology*, *65*(3), 421-432. https://doi.org/10.1111/sjop.12988

Postigo-Zegarra, S., Valero-Moreno, S., Romero-Reignier, V., & Schoeps, K. (2025). Teachers' Perceived Interplay Between Emotional Intelligence, School Climate and Burnout: A Mixed-Method Study. *Psychology in the Schools*, *62*(6), 1841-1851. https://doi.org/10.1002/pits.23435

Sparpana, A., & Brock, R. L. (2025). The Interplay Between Prenatal Psychological Flexibility and Couple Secure Base in Promoting Postpartum Parenting. *Journal of Family Psychology*, *39*(7), 929-941. https://doi.org/10.1037/fam0001389

Strasser, K., Arias, P., Alessandri, F., Turner, P., Villarroel, T. E. E., Aldunate, C. P., & Montt, M. E. (2023). Adolescents' Academic Self-Efficacy and Emotions During the COVID-19 Pandemic: A Latent Profile Analysis of Family and School Risk Factors. *School Psychology*, *38*(2), 88-99. https://doi.org/10.1037/spq0000523

Taştekin, E., Kaymaz, Ç., Işik-Uslu, A. E., Yüksel-Doğan, R., Bozkurt-Yükçü, Ş., & Tok, A. İ. (2025). Coparenting and Mindful Parenting Partially Mediate the Relationship Between Mothers' Stress and Parental Burnout. *Family Relations*. https://doi.org/10.1111/fare.70027

Tietbohl-Santos, B., Shintani, A. O., Montezano, B. B., Biazin, P., Signori, G. M., Pulice, R. F., Vecchia, G. F. D., Bebber, J. C., Noronha, L. T., & Passos, I. C. (2024). Protective Factors Against Depression in High-Risk Children and Adolescents: A Systematic Review of Longitudinal Studies. *Brazilian Journal of Psychiatry*. https://doi.org/10.47626/1516-4446-2023-3363

Tobe, H., Sakka, M., Kita, S., Ikeda, M., & Kamibeppu, K. (2022). The Efficacy of a Resilience-Enhancement Program for Mothers Based on Emotion Regulation: A Randomized Controlled Trial in Japan. *International journal of environmental research and public health*, *19*(22), 14953. https://doi.org/10.3390/ijerph192214953

Voltmer, K., & Salisch, M. v. (2023). Promoting Subjective Well-Being and a Sustainable Lifestyle in Children and Youth by Strengthening Their Personal Psychological Resources. *Sustainability*, *16*(1), 134. https://doi.org/10.3390/su16010134

Yang, J. (2025). Influencing Factors of Family Resilience in Stroke Patients and Family Caregivers: A Systematic Review and Meta-Analysis. *Frontiers in Public Health*, *13*. https://doi.org/10.3389/fpubh.2025.1716213

Yang, X. (2025). Effectiveness of Digital Health on Psychological Well-Being in Parents of Children With Cancer: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *BMC Cancer*, *25*(1). https://doi.org/10.1186/s12885-025-15050-7

Zhang, B., & Zhang, X. (2024). Correlation Between Self-Efficacy, Parental Parenting Patterns, and Severe Depression in Adolescents. *World journal of psychiatry*, *14*(12), 1827-1835. https://doi.org/10.5498/wjp.v14.i12.1827

AFTJ Applied Family Therapy Journal
E-ISSN: 3041-8798

Zhang, Z., Chen, H., Ye, Y., Chen, H., Guo, H., & Zhou, J. (2025). Entropy-Based Risk Network Identification in Adolescent Self-Injurious Behavior Using Machine Learning and Network Analysis. *Translational psychiatry*, *15*(1). https://doi.org/10.1038/s41398-025-03511-3

Zhou, Y.-B. (2025). Effects of Parental Burnout and Psychological Intrusion on Adolescent Resilience. *Scientific reports*, *15*(1). https://doi.org/10.1038/s41598-025-22522-0

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