Xu Y et al. (2024) FAMILY RESILIENCE AND PHYSICAL RECOVERY IN NEWLY DIAGNOSED PULMONARY TUBERCULOSIS PATIENTS: A CROSS-SECTIONAL STUDY ON ADAPTATION, WELL-BEING, AND PHYSICAL ACTIVITY PARTICIPATION. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 24 (96) pp. 605-625.
DOI: https://doi.org/10.15366/rimcafd2024.96.037

ORIGINAL

FAMILY RESILIENCE AND PHYSICAL RECOVERY IN NEWLY DIAGNOSED PULMONARY TUBERCULOSIS PATIENTS: A CROSS-SECTIONAL STUDY ON ADAPTATION, WELL-BEING, AND PHYSICAL ACTIVITY PARTICIPATION

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Recibido 13 de octubre de 2023 **Received** October 13, 2023
Aceptado 25 de puede de 2024 **Accepted** May 25, 2024

ABSTRACT

Background & Objective: Pulmonary Tuberculosis (PTB) not only poses significant health challenges but also impacts physical activity, rehabilitation, and overall well-being. The diagnosis of PTB in a family can introduce psychosocial stress, disrupt daily routines, and reduce participation in physical activities, affecting both the patient and their family members. Family resilience plays a crucial role in the adaptation process, influencing recovery, adherence to physical rehabilitation, and overall functional health. This study applies McCubbin's Resilience Model of Family Adjustment and Adaptation to analyze the factors influencing family resilience in newly diagnosed PTB patients and its impact on their physical recovery, social reintegration, and ability to engage in physical activities. **Methods:** A cross-sectional study was conducted with 237 patients and their families recruited through convenience sampling at Nanjing Public Health Medical Center between August 2022 and April 2023. The Chinese version of the Family Resilience Assessment Scale was used alongside other standardized indicators to evaluate resilience factors.

Structural equation modeling (SEM) was employed to assess relationships among stigma, family burden of disease, individual resilience, internal and external support systems, and family function. The study also explored how these factors influence physical adaptation, rehabilitation, and engagement in physical activity. **Results:** A total of 251 questionnaires were distributed, yielding a 94.4% response rate, with 237 valid responses. Individual resilience, internal support systems, and family function were positively correlated with higher levels of family resilience. In contrast, stigma, family burden of disease, and external support systems showed indirect associations with resilience. Statistical analysis confirmed that individual resilience (coefficient: 0.605) and internal support systems (coefficient: 0.419) were the strongest predictors of family resilience ($P < 0.05$). **Conclusions:** The findings underscore the critical role of individual resilience and internal family support in facilitating adaptation to PTB, enabling better physical rehabilitation, adherence to treatment regimens, and reintegration into physical activity and daily routines. This study highlights the need for targeted interventions in sports and rehabilitation medicine to enhance mental and physical resilience in PTB patients and their families. By addressing stigma and promoting self-acceptance, families can create a supportive environment that encourages physical activity, social participation, and improved quality of life. Healthcare providers, sports therapists, and rehabilitation specialists should incorporate family resilience strategies into rehabilitation programs to ensure comprehensive recovery and long-term physical well-being for PTB patients.

KEYWORDS: Family Resilience, Pulmonary Tuberculosis, Initially Diagnosed Patient, Structural Equation Model

1. INTRODUCTION

Pulmonary Tuberculosis (PTB) remains a global public health challenge, affecting millions worldwide and leading to significant physical, psychological, and social burdens. Patients diagnosed with PTB experience not only respiratory limitations but also reduced physical activity levels, social stigma, and emotional distress, all of which influence their recovery trajectory. Given that physical activity plays a key role in immune function, lung rehabilitation, and overall well-being, understanding how family resilience impacts PTB patients' adaptation to physical challenges, adherence to rehabilitation, and reintegration into active lifestyles is of great importance (Organization, 2013). Family resilience, defined as the ability of a family unit to withstand and recover from crises, is crucial in helping patients cope with the physical, emotional, and social stressors associated with PTB. Families play an integral role in supporting adherence to treatment, encouraging engagement in physical activity, and promoting psychosocial well-being, thereby directly influencing disease outcomes and functional recovery. However, when a family experiences high levels of stress, stigma, or burden due to the disease, it can

lead to disruptions in daily routines, decreased motivation for rehabilitation, and overall diminished health outcomes for the patient. Therefore, exploring family resilience as a determinant of physical recovery and rehabilitation engagement is essential for improving long-term functional outcomes in PTB patients (AlHamawi et al., 2024; Alipanah et al., 2018).

1.1 Impact of Family Resilience on Physical Activity and Rehabilitation

PTB patients often face significant physical limitations, including chronic fatigue, dyspnea (shortness of breath), reduced lung function, and muscle deconditioning due to prolonged illness. These factors can severely restrict participation in daily activities and exercise, leading to physical inactivity and further deterioration of health. Engaging in physical rehabilitation programs, pulmonary exercises, and moderate physical activity has been shown to improve lung function, increase oxygen uptake, and enhance muscle endurance in patients recovering from respiratory diseases. However, adherence to such interventions depends largely on the patient's motivation and the availability of strong family support systems (Awad et al., 2024). A supportive family environment can play a critical role in helping PTB patients overcome physical and psychological barriers to engage in regular movement, pulmonary rehabilitation exercises, and gradual reintegration into active lifestyles. Conversely, when a family experiences high levels of stress, stigma, and disease burden, it may result in reduced encouragement for physical activity, increased social withdrawal, and psychological distress, ultimately delaying recovery. Understanding how family resilience interacts with physical rehabilitation outcomes is essential for designing holistic recovery strategies that integrate sports science, rehabilitation medicine, and psychosocial support for PTB patients (Barrett, 2007; Fu et al., 2022).

Theoretical Framework: McCubbin's Resilience Model of Family Adjustment and Adaptation. This study is based on McCubbin's Resilience Model of Family Adjustment and Adaptation, a framework that explains how families adapt to crises and develop coping strategies to restore balance. The model suggests that family resilience depends on multiple interrelated factors, including:

Individual Resilience: The personal capacity of the patient to withstand stress, remain motivated, and engage in health-promoting behaviors such as physical activity and rehabilitation (Campbell‐Sills & Stein, 2007).

Internal Support Systems: The emotional and practical support provided by immediate family members, influencing treatment adherence and participation in recovery programs.

External Support Systems: Community-based resources, healthcare services, and sports rehabilitation programs that contribute to patient well-being.

Family Functioning: The ability of the family unit to maintain stability, communication, and collective problem-solving in the face of a health crisis.

Stigma and Disease Burden: The psychological and social challenges associated with PTB, including discrimination, self-isolation, and reduced participation in community and physical activities (Caparso et al., 2023).

Furthermore, even after recovering from Tuberculosis, there remains a possibility of relapse or reinfection (Chapman & Veras-Estévez, 2021), thereby prolonging its influence on the family system. When accumulated pressure and demands exceed a family's capacity to cope effectively, economic stability and internal and external relationships may be jeopardized. Additionally, long-term negative emotions can lead to physical and mental exhaustion among family members, ultimately contributing to dysfunctional family dynamics (Chen et al., 2024). Therefore, for families affected by Tuberculosis, developing strategies to manage risks and adapt during crises assumes paramount importance.

2. Background

Within the tuberculosis patient population, individuals lacking a prior history of the disease may experience feelings of hopelessness regarding their future treatment prospects due to initial exposure. This can impede their ability to complete treatment and accept diagnosis, thereby increasing the likelihood of poor prognosis and placing family members at heightened risk (Cox & Loveday, 2021). As such, scholars in family systems have focused on understanding how families cope with this stress and interact during these situations. McCubbin and Patterson's longitudinal study examining successful adaptation cases among war-affected soldiers inspired the evolution of family resilience theory based on family stress theory and family systems theory (Daftary et al., 2021; Ennis & Bunting, 2013). Family resilience is a core concept within this framework that has been approached from two perspectives. Walsh et al. view it as an active process involving dynamic adaptation to crises or challenges (Gable & Bedrov, 2022), while McCubbin et al. consider it as characteristics, dimensions, and attributes that enable families to withstand change and adapt in times of crisis (McCubbin et al., 1980; McCubbin & Patterson, 2014). The research integrates these two perspectives to obtain a more comprehensive insight into family resilience. Conversely, Hawley and DeHaan reviewed existing research from a life-span and family perspective, building upon these perspectives. They argued that family resilience is the trajectory of positive adaptation and recovery from stressful environments within a family (Give et al., 2024). Resilient families can positively adapt and proactively respond to stress based on factors such as the environment, developmental level, interaction between protective and risk factors, and the family's outlook. While family resilience is influenced by factors like the life stage when facing challenges or crises, duration spent in adversity, and available

resources within the family system, it effectively fosters proactive crisis response within families while promoting recovery and development based on past experiences - ultimately strengthening them (Hawley & DeHaan, 1996). Currently, research on family resilience has been extensively applied in stroke (Han et al., 2024), cancer (Henseler & Sarstedt, 2013), and COVID-19 (Herdiana et al., 2018) disease types, which sufficiently validate its accuracy and scientific nature. However, Tuberculosis remains an area with limited involvement despite existing studies primarily focusing on patients themselves. In contrast, research on families mainly revolves around interventions targeting their roles to enhance patient treatment compliance (Jiang et al., 2022). There is a dearth of research explicitly examining changes within the familial system along with processes involved in adapting to stress when a member contracts tuberculosis. The family resilience model is a crucial element of the family resilience theory, and its emergence has enhanced the concreteness of the theory. Currently, several models are associated with family resilience, including the ABC-X model, the resilience model of family adjustment and adaptation (FAAR), and Walsh's family resilience framework. FAAR, developed by McCubbin, is one of the most widespread theoretical models in empirical studies. It integrates family stress theory, research on family strengths, and related research achievements from various teams while evolving through multiple theoretical changes. In this model, two types of outcomes are identified. When a family's demands surpass its current capabilities in daily life, it strives to adjust them in a relatively stable pattern to achieve family adaptation. However, if these demands significantly exceed their capabilities to an extent where fine-tuning cannot restore balance anymore, then the family enters into crisis mode. In such cases, proactive transformation is necessary for adaptation (Juniarti & Evans, 2011). The process of family adaptation involves considering three ecosystems: the individual, the family unit, and the community. The process of family adaptation is accomplished through reciprocal relationships, wherein the demands of one unit are met by the capabilities of another to simultaneously achieve a state of "balance" at two primary levels of interaction. This implies achieving a harmonious balance within the family's internal and external support systems, as well as its structure, function beliefs, and available resources (Kim & Ahn, 2022; Krishnan & Chaisson, 2024). Perceived social support reflects the family's cognition and understanding of available resources, enhancing their adaptability to difficulties. Existing literature has consistently demonstrated that the social support system influences family resilience (Kuang et al., 2023). Moreover, there exists a significant association between individual resilience levels and social support (Li et al., 2016). This model further categorizes social support into internal support (provided by family members) and external support (from friends, leaders, and others). Previous research has established a confirmed association between internal and external support and family resilience (Li et al., 2024; Li et al., 2018; Lu et al.,

2021). Additionally, Kuang et al.'s meta-analysis on qualitative studies of families with patients requiring long-term care underscores the significance of intrinsic resources in conjunction with external support (McCubbin et al., 1980). Building upon these findings, we propose the following hypotheses:

H1: Individual resilience demonstrates a positive association with both internal and external social support;

H2: Both internal and external support exhibit a positive correlation with family resilience;

H3: External support manifests a positive correlation with intrafamilial support. In the process of managing the disease, both the family unit and its members will encounter a variety of physiological and psychological stressors as well as changes resulting from the illness.

The cumulative impact of these pressures can disrupt normal family functioning and hinder the family's ability to adapt, thus becoming a risk factor for family resilience. Therefore, assessing these stressors is an essential and valuable aspect to consider in this model (McCubbin & Patterson, 2014). Previous studies predominantly focused on testing caregiver burden (Menezes et al., 2024). From the perspective of those who bear them, the experience of stressors is commonly encountered by patients and their family members. Nevertheless, it manifests within the family as a unit. The caregiver burden is just one component of the disease's overall burden on a family. From a patient's viewpoint, after role transition due to disease, stressors primarily stem from negative emotions such as stigma, which can have an impact on prognosis and social relationships (Moscibrodzki et al., 2021). Tuberculosis is often perceived as a contagious disease associated with uncleanliness or immoral behavior; these deeply ingrained perceptions further stigmatize patients (Nuttall et al., 2022), leading to similar feelings among their family members. Some scholars have already discovered that the transmission of Tuberculosis may be attributed to the breakdown of family relationships (Olson, 2000). When a family member is afflicted with Tuberculosis, the family burden of disease (FBD) manifests in various dimensions, including economic, psychological, physical, and other aspects. The relapse of disease and financial strain can impact the family's function and structure, diminishing family resilience and rendering it more susceptible to shocks while impeding recovery efforts. Furthermore, as the level of burden increases, individual resilience tends to decline. In individuals affected by AIDS, an escalation in stigma often coincides with a decrease in personal psychological resilience; however, there is limited literature on this topic concerning tuberculosis patients. Consequently, we put forth the subsequent hypotheses: H4: Stigma negative makes a correlation with individual resilience; H5: Stigma demonstrates a positive correlation with the

FBD;

H6: FBD negatively correlates with individual resilience.

Examining the correlation between individual and family resilience remains worthy of scholarly discourse. In a longitudinal study, Wang et al. found that the level of family resilience at the three-month follow-up significantly predicted the hemodialysis patient's psychological resilience at the six-month evaluation point. However, the patient's resilience at the three-month follow-up could not predict the level of family resilience. Therefore, Wang et al. posit that during crises, family strength influences individual development within the family rather than vice versa. Various factors influence the levels of both individual resilience and family resilience. McCubbin's model suggests that individuals and families are closely interconnected. A resilient individual serves as a foundation for a stable family, with each person's contribution to coping with familial difficulties reflected in overall family characteristics. Additionally, an individual's strengths serve as resources for regulating stressors within the family. Exploring the relationship between these two variables is also one of this study's main objectives. Amongst numerous scholars who have studied family resilience, few have focused on transactions between the multiple sources of protectors in individual, family, and community ecosystems; most scholars primarily consider internal relational processes within families. Based on this literature review, the above hypothesis is formulated:

H7: Individual resistance has a positive correlation with Family Resistance.

Family function is an essential component in the patient-centered holistic care model. According to McCubbin's model, family function results from the family members' joint efforts to maintain harmony and unity when facing adversity. Zhang (Zhang, 2018) summarized the concept of family function in his analysis, stating that family function pertains to a family member's ability to maintain relationships within the family, fulfill family roles, handle family problems, adapt to new family routines, and communicate efficiently. Family resilience shares the same characteristics as family function, including emotional bonding and communication skills. In addition, family resilience, as an advantage, can effectively counteract and alleviate the difficulties faced in maintaining family function. In their study, Han et al. (Han et al., 2024) found that the impact of family functioning on the resilience of stroke survivors is a paramount influencing factor. Furthermore, existing studies have also demonstrated the connections between family function and other parts of the model. Zhang's longitudinal study on the trajectory of family function evolution and its predictive factors in stroke caregivers found that promoting social support systems can effectively restore family function in the early post-stroke

recovery period (Zhang, 2018). In their study, Tsai et al. (Tsai et al., 2024) also confirmed the connection between individual resilience and family functioning. Thus, the present hypothesis is posited:

H8: Family function is positively correlated with family resilience;

H9: Internal and external support positively correlate with family functioning.

H10: Individual resilience is positively correlated with family function.

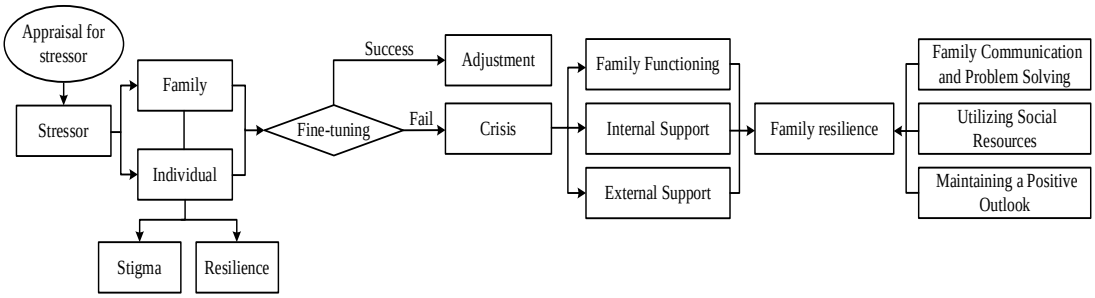

Figure 1: Analysis of Family Problems

3. Methods

3.1 Study Design and Setting

This cross-sectional study was conducted between August 2022 and April 2023 in a public health center in Nanjing province, China.

3.2 Ethical Consideration

The present study was conducted under the principles of the Declaration of Helsinki. The study received ethical approval from the hospital's Medical Ethics Committee. (2022-LS-ky044). Prior to survey participation, all participants were provided with an informed consent form, ensuring their voluntary and anonymous involvement while retaining the right to withdraw from the study at any given point.

3.3 Participants

This study recruited PTB patients and their families through convenience sampling. The eligibility criteria for patient inclusion were as follows: (1) aged exceeding 18 years; (2) diagnosed with PTB by healthcare professionals following the national TB program guidelines; (3) initially diagnosed patients; (4) individuals without psychosis; (5) possessing average communication skills and capable of comprehending the questionnaire effectively; (6) voluntarily participate in the study and make the honest choice and expression regarding

the items of scales. The inclusion criteria excluded patients with extrapulmonary Tuberculosis, drug-resistant Tuberculosis, and psychological disorders. The eligibility criteria for family members were as follows: (1) aged 18 years or older; (2) demonstrated comprehension of the questionnaire content; (3) expressed voluntary participation in this research. Family members with psychological disorders were excluded. This study used the structural equation model (SEM) for statistical analysis. The construction of the SEM using the maximum likelihood method requires a minimum sample size of 200, as suggested by Barrett (Barrett, 2007). The baseline assessment included two hundred fifty patients, and 237 patients completed the study. The response rate achieved a high level of effectiveness at 94.4%.

3.4 Procedure

Eligible participants were invited to complete scales. Initially, participants were presented with a comprehensive elucidation of the study's objectives and procedures, followed by obtaining informed consent through signature. Subsequently, they were escorted by a trained nurse into a designated quiet room. If participants encountered difficulties comprehending the questionnaire content during completion, clear instructions would be readily available. The participants were required to allocate 20-30 minutes for the task, and the researchers conducted an immediate review upon completion. In case of any missed items, the participants would be contacted for a refill. The questionnaires with more than 10% missing and irrelevant data were excluded.

3.5 Instrument

The selection of all instruments was meticulously conducted based on their well-established reliability and validity. The researchers employed the following instruments to evaluate tuberculosis-related stigma, individual resilience, FBD, perceived social support, family functioning, and family resilience.

3.6 Tuberculosis-Related Stigma Scale

The scale comprises three dimensions: negative experience (4 items), emotional reactions (2 items), and coping style (3 items), totaling nine items. Each item utilizes a Likert 4-point rating scale, ranging from 0 to 3, representing "strongly disagree" to "strongly agree." The total score ranges from 0 to 27, with higher scores indicating greater levels of stigma. The Cronbach's α coefficient in this study was 0.93.

3.7 10-Item Conner-Davidson Resilience Scale

This scale comprises ten items, each utilizing a Likert 5-point scoring system ranging from "not true at all" to "true all the time," with scores ranging

from 1 to 5, respectively. The total score is computed by aggregating the scores of each item, with a higher aggregate score indicating more significant levels of personal resilience. In this study, patients completing the scale demonstrated a Cronbach's α coefficient of 0.95, while family members completing the scale exhibited a Cronbach's α coefficient of 0.96.

3.8 Family Burden Scale of Diseases

It consists of seven dimensions encompassing a total of 28 items, which include the impact on the patient's family economy (6 items), the impact on patient's family's routine life (5 items), the impact on patient family's entertainment (4 items), the impact on the relationship between the members of patient's family (5 items), the impact on the social relationship out of patient's family (4 items), the impact on the physiological health of the members of the patient's family (2 items), and the impact on the psychological health of the members of the patient's family (2 items). Each item is assessed using a three-point Likert scale ranging from 0="no burden" to 2="severe burden." Higher scores indicate a more significant family burden (Pai & Kapur, 1981). Based on the findings obtained in this study, the scale demonstrated high reliability with a coefficient alpha value of 0.93.

3.9 Perceived Social Support Scale

The scale evaluates the assistance and support received from family members, relatives, friends, and significant others through 12 items categorized into three dimensions: family support, friend support, and additional support networks. Family support represents internal support and friend support, and other support represents external support. It uses a Likert-7-point rating scale, with scores ranging from "strongly disagree" to "strongly agree," corresponding to 1-7. The higher the score indicates that the individual receives more support, and based on the data analysis of this study, Cronbach's α coefficient is 0.93.

3.10 Family Adaptation, Partnership, Growth, Affection, Resolve Index (APGAR)

The assessment tool employs a 3-point rating scale, assigning 2 points for "usually," 1 point for "sometimes," and 0 points for " almost rare." Subsequently, it is categorized based on the overall score: scores of 7-10 indicate good family functioning, 4-6 suggest moderate levels of family dysfunction, and scores ranging from 0 to 3 signify severe family dysfunction. Moreover, the internal consistency coefficient in this study stands at 0.76.

3.11 Shortened Chinese Version of The Family Resilience Assessment Scale (FRAS-C)

It encompasses three dimensions: family communication and problem

solving (FCPS), utilizing social resources (USR), and maintaining a positive outlook (MPO), comprising a total of 32 items. The scale employs a Likert 4-point rating system, with scores ranging from 1 to 4, where higher scores indicate more likelihood of a family successfully adapting diversities. In the present study, the Cronbach's α coefficient for the scale was calculated as 0.97.

3.12 Data analysis

The sociodemographic data were analyzed using SPSS 29.0 (IBM Corp., Armonk, NY, USA) and presented through frequency and percentage distributions. Harman's single factor test was employed to examine the presence of common method bias. Confirmatory factor analysis (CFA) was conducted using AMOS 28.0 (IBM Corp., Armonk, NY, USA). Subsequently, the collected data were substituted into the model, and revisions were made until the model met the required standards for goodness of fit. After validating the final model, the total effects of factors were calculated based on standardized regression coefficients obtained from Amos 28.0 output. The observed difference achieved statistical significance at a level of $P<0.05$.

4. Result

4.1 Demographic Characteristics

The mean age of patients with PTB and their family members is 43.63±18.90 and 48.50±13.33, respectively. The supplementary information is presented in Table 1.

Table 1(a): Demographic and Disease-Related Characteristics

VARIABLE	PTB PATIENTS(N=237)	FAMILY MEMBERS(N=237)
	N(%)	N(%)
GENDER		
MALE	117(49.4)	93(39.2)
FEMALE	120(50.6)	144(60.8)
AGE(YEARS)		
18-44	122(51.5)	86(36.3)
45-59	55(23.2)	105(44.3)
⩾60	60(25.3)	46(19.4)
EDUCATIONAL LEVEL		
ELEMENTARY SCHOOL AND BELOW	35(14.8)	63(26.6)
JUNIOR HIGH SCHOOL	65(27.4)	70(29.5)
HIGH SCHOOL/VOCATIONAL SCHOOL	54(22.8)	51(21.5)
JUNIOR COLLEGE	33(13.9)	28(11.8)

Table 1(b): Demographic and Disease-Related Characteristics

VARIABLE	PTB PATIENTS(N=237)	FAMILY MEMBERS(N=237)
	N(%)	N(%)
BACHELOR'S DEGREE OR HIGHER	50(21.1)	25(10.5)
MARITAL STATUS		
MARRIED	155(65.4)	
UNMARRIED	73(30.8)	
DIVORCED/WIDOWED	9(3.8)	
RESIDENCE		
RURAL	94(39.7)	
URBAN	143(60.3)	
FAMILY MONTHLY INCOME (CNY)		
＜1000	68(28.7)	
1000-2999	37(15.6)	
3000-4999	53(22.4)	
＞5000	79(33.3)	
OCCUPATION		
FARMER	26(11.0)	56(23.6)
WORKER	27(11.4)	39(16.5)
OFFICE CLERK	66(27.8)	76(32.1)
TEACHER	8(3.4)	3(1.3)
STUDENT	28(11.8)	5(2.1)
RETIREE	42(17.7)	26(11.0)
UNEMPLOYED OR DIMISSION	31(13.1)	26(11.0)
OTHER	9(3.8)	5(2.1)
COMORBIDITY		
NONE	184(77.6)	
YES	53(22.4)	
RELATIONSHIP WITH PATIENT		
PARENT		68(28.7)
SPOUSE		94(39.7)
GROWN-UP CHILDREN		53(22.4)
OTHERS(BROTHERS/SISTERS)		22(9.3)

4.2 Common Method Bias Test results

The data utilized in this study were obtained exclusively from a single source, employing a questionnaire format based on self-perceived self-reporting. It should be noted that such a methodology is prone to potential common method bias. Analysis revealed that out of the total number of factors examined, only 18 exhibited eigenvalues exceeding 1; moreover, the initial unrotated principal component explained merely 23.817% of the overall

variance—falling below the established threshold of 40%. These findings suggest that any influence stemming from common method bias on this investigation can be considered insignificant.

4.3 Hypothesis Test

In the model, family resilience was positively influenced by individual resilience (β=0.250, P<0.05), internal support (β=0.227, P<0.05), and family function (β=0.241, P<0.05). The association between external support and family resilience exhibits no significance, thus supporting H7 and H8 and verifying H2 that "internal support is positively related to family resilience." Individual resilience is negatively influenced by stigma (β=-0.211, P<0.05) and the burden of disease on the family (β=-0.232, P<0.05), with a mutual influence observed between the burden of disease on the family and stigma (β=0.195, P<0.005), thus supporting H4, H5, and H6. Internal support positively indicates individual resilience (β=0.480, P<0.001) and external support (β=0.246, P<0.001), while external support has a positive correlation with individual resilience (β=0.479, P <0.001), thus supporting H1 and H3. Finally, the results showed that individual resilience had a positive impact on both family function (β=0.435, P＜0.001) and internal support (β=0.397, P＜0.001). Based on previous articles and data from this study, the non-significant pathways were deleted, and then the model was reconstructed. The final research model's path diagram is shown in Figure 2.

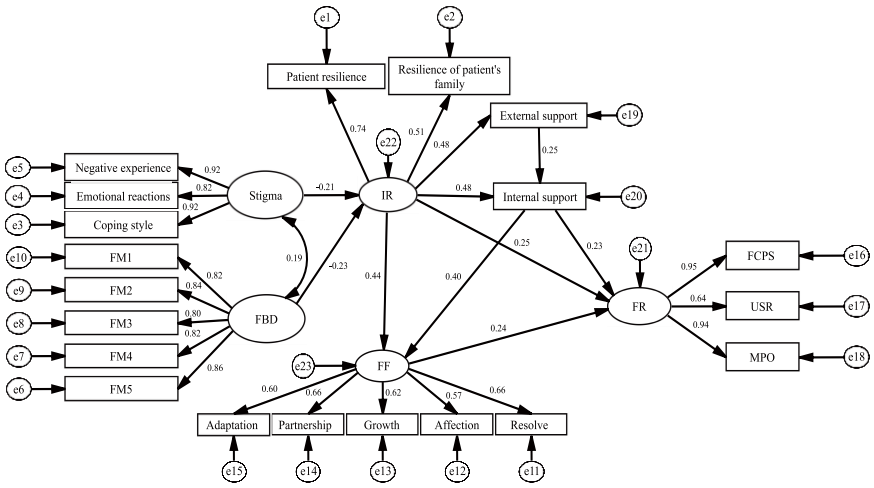

Figure 2: Family Resilience Model of Initially Diagnosed Pulmonary Tuberculosis Patient's Family

Note: FBD, family burden of disease; FM1, the impact on patient's family economy; FM2, the impact on patient family's routine life; FM3, the impact on patient family's entertainment; FM4, the impact on the relationship between the members of patient's family; FM5, the impact on the social relationship out of patient's family; IR, individual resilience; IS, internal support; ES, external support; FF, family function; FR, family resilience; FCPS, family communication and problem solving; USR, utilizing social resources; MPO, maintaining a positive outlook.

The pathways through which various variables in the model directly or indirectly impact family resilience are presented in Table 2. The path coefficients indicating the overall influence of each variable on family resilience, ranked by magnitude, are as follows: individual psychological resilience (0.605), family support (0.419), family function (0.241), stigma (0.157), disease family burden (-0.149), and external support (0.103).

Table 2: Effects of Factors and Pathways Associated with Family Resilience

	STANDARDIZED DIRECT EFFECTS		STANDARDIZED INDIRECT EFFECTS			STANDARDIZED TOTAL EFFECT
FACTOR	PATHWAYS	DIRECT EFFECT VALUE	PATHWAYS	INDIRECT EFFECT VALUE	TOTAL INDIRECT EFFECT VALUE	
STIGMA	-	-	Stigma→ The pathway from IR to FR→FR	-0.128=-0.211×0.605	-0.157	-0.157
			Stigma→ The pathway from FBD to FR→FR	-0.029=0.195×-0.149		
FBD	-	-	FBD→ The pathway from IR to FR→FR	-0.140=-0.232×0.605	-0.149	-0.149
			FBD→ The pathway from Stigma to FR→FR	-0.022=0.195×-0.115		
IR	IR-FR	0.250	IR→ The pathway from ES to FR→FR	0.049=0.479×0.103	0.355	0.605
			IR→ The pathway from IS to FR→FR	0.201=0.480×0.419		
	-	-	IR→ The pathway from FF to FR→FR	0.105=0.435×0.241		
IS	IS→FR	0.323	IS→ The pathway from FF to FR→FR	0.096=0.397×0.241	0.096	0.419
ES	-	-	ES→ The pathway from IS to FR→FR	0.103=0.246×0.419	0.103	0.103
FF	FF→FR	0.241	-	-	-	0.241

Note: *FBD, family burden of disease; IR, individual resilience; IS, internal support; ES, external support; FF, family function; FR, family resilience*

4.4 Fit Indices

The fit indices were calculated for both the research and measurement models. Referring to past related literature, these indices are generally acceptable (Table 3)

Table 3: Fit indices

FIT INDICES	CMIN/DF	RMSEA	GFI	AGFI	CFI	TLI
MEASUREMENT MODEL	1.128	0.023	0.941	0.919	0.993	0.991
RESEARCH MODEL	1.113	0.022	0.933	0.913	0.993	0.991
RECOMMENDED VALUES	＜3.000	＜0.080	＞0.900	＞0.900	＞0.900	＞0.900

Note: *CMIN Chi-Square Minimum Fit Function, DF Degrees of Freedom, CMIN/DF Chi-Square to Degrees of Freedom ratio, AGFI Adjusted Goodness of Fit Index, CFI Comparative Fit Index, TLI Tucker-Lewis Index, RMSEA Root Mean Square Error of Approximation.*

5. Discussion

Adverse outcomes, such as delayed diagnosis, treatment failure, and drug-resistant Tuberculosis, can occur in patients with PTB, influenced by various factors, including treatment-related, psychological, economic, and family-related factors. The combined or individual impact of these determinants significantly affects the overall family system of PTB patients. Nurses have the potential to effectively intervene in addressing psychological and family issues among these determinants. Therefore, this study analyzes important factors influencing family adaptation based on FAAR while incorporating the patient's primary negative emotions into the model. The result of this study underscores the significance of FBD and stigma as pivotal factors that stimulate the entire family system to adapt. The family burden of disease and stigma interact with each other, directly impacting the individual resilience of patients and their families while also indirectly influencing the level of family resilience. Based on data analysis, FBD primarily manifests in five dimensions: economic, routine life, entertainment, family relationships, and social relationships out of the family. Among these dimensions, "the impact on social relationships beyond patient's immediate family" emerges as the most prominent factor with a substantial effect size of 0.86, closely followed by "the impact on routine life within patient's immediate family" with an effect size of 0.84. These findings support previous research highlighting patient and family isolation. This phenomenon aligns with the current situation faced by Chinese PTB patients, where young and middle-aged individuals constitute a significant proportion who experience multiple burdens, such as financial strain and lack of emotional support. Whether it is the FBD or stigma, these factors exert their influence on patients and family members, manifesting as individual psychological resilience and externalizing within the entire family unit. As demonstrated by Ennis et al.'s study, the health profile of a family and family burden are predictors of mental health issues in individuals. These factors indicate susceptibility to personal mental health problems, and as psychological vulnerability increases, individual resilience decreases accordingly. Therefore, when facing crises brought about by disease, enhancing the overall balance of the family system can improve members' problem-solving abilities. For instance, Li et al. revealed that elevated family

resilience effectively enhances individual resilience among breast cancer patient's families. Our study's findings demonstrate that the level of individual resilience also influences their family resilience. A resilient individual is a strong foundation for families to overcome difficulties and address stressors. This distinction sets our study apart from previous research results. The impact of cancer and Tuberculosis on the family can both be stressors; however, these two diseases differ in terms of their context and manifestation. PTB has a more significant influence on patients and their families as a communicable disease than other diseases. The nature of PTB brings about feelings of shame, isolation, and fear of social consequences that affect individuals and their families. To prevent the family from falling into crisis, a resilient individual within the family should lead them toward overcoming negative states and restoring balance among individuals, family members, and the community ecosystem. Stigma has always been a detrimental factor impacting the mental health of PTB patients; however, there is limited quantitative research validating the link between stigma and individual resilience of PTB patients. Furthermore, this study's findings also demonstrate an association between stigma and FBD. This indicates that levels of stigma are mutually influenced by the burden of disease on families with a positive correlation. Relevant illustrations in current articles about this relationship also indicate that levels of stigma positively influence family burden. Of course, further research needs to use diverse methodologies and larger sample sizes to verify our hypothesis regarding these two constructs. In the model, individual resilience is the most influential variable impacting family resilience. Moreover, apart from its direct impact on family resilience, individual resilience also indirectly influences family function and internal and external support systems. Family function encompasses emotional bonds, daily routines, communication patterns, and the efficacy of the family system in responding to external circumstances. Shao et al. in their study on adolescent and young adult (AYA) cancer patients, discovered that family function is a significant external factor affecting individual resilience. Individuals belonging to families with well-functioning dynamics experience fewer challenges related to internalizing or externalizing emotions and behaviors while exhibiting enhanced levels of individual resilience (Shao et al., 2022). The findings of this study suggest that individual resilience significantly impacts family functioning, in contrast to the previous research. Specifically, individuals with better family function possess higher individual resilience. A similar conclusion was reached by Rosenberg et al.(Rosenberg et al., 2014) when examining the influence of individual resilience resources on psychosocial outcomes among parents of children with cancer. These results imply that resilient family functioning can create a supportive environment and mitigate the adverse effects of crises. At the same time, individuals with high levels of resilience can contribute to collective crisis management and enhance overall family resilience. In line with these findings, Park et al.(Park et al., 2023) developed a family resilience-promoting program based on Walsh's Family

Resilience Framework for parents of children with cancer, which resulted in significantly improved family function compared to a control group. This further confirms the association between family function and family resilience. In the ABC-X model, social support is defined as information about whether a family receives care, affection, esteem, and value and whether it belongs to a network of shared responsibility and understanding. It constitutes an essential component of the family's adaptive resources and can mitigate the detrimental effects of adverse events and stressors. Families equipped with access to and the capacity to cultivate sources of social support are better prepared to endure significant crises and recover from them, thereby restoring stability within the family system. Family of PTB patients often experience diminished levels of internal support due to factors such as social isolation and limited availability of external assistance, ultimately leading to reduced levels of social support. The findings from this study also validate that internal family support assumes greater significance in scenarios where external support is restricted. While external support may not directly impact the family's adaptation process, it does influence internal support, which collectively enhances family resilience. When a family possesses sufficient adaptive resources, it can foster the resilience necessary for weathering crises. The existing literature predominantly combines internal and external support as a unified entity of family social support to examine the association between family social support and family resilience. However, it is essential to acknowledge that this discourse varies depending on the disease and study design employed. Instead of establishing a hierarchy, this study aims to investigate which factor - internal or external support - exerts a more significant impact on the process of PTB family adaptation.

6. Conclusion

This study highlights the critical role of family resilience in influencing physical recovery, rehabilitation adherence, and engagement in physical activity among newly diagnosed pulmonary tuberculosis (PTB) patients. Applying McCubbin's Resilience Model of Family Adjustment and Adaptation, we identified key determinants that impact family resilience, including individual resilience, internal and external support systems, family function, stigma, and disease burden. The findings underscore that strong individual resilience and internal family support are the most significant predictors of successful adaptation, which in turn facilitates better adherence to treatment regimens, participation in physical rehabilitation programs, and overall functional recovery.

7. Key Findings and Implications

Family Resilience as a Predictor of Physical Rehabilitation Engagement. Patients with higher family resilience were more likely to adhere to pulmonary rehabilitation programs, maintain consistent physical activity levels, and

recover faster from the physical and psychological impacts of PTB. A supportive home environment plays a vital role in encouraging mobility, adherence to exercise regimens, and maintaining a positive mindset toward recovery. Individual Resilience and Its Influence on Physical Recovery. Individual resilience emerged as the most significant factor affecting physical and psychological adaptation (coefficient: 0.605), emphasizing that patients who maintain a positive outlook and strong coping mechanisms are more likely to engage in rehabilitation and physical activities. Enhancing self-efficacy through patient education, mental health support, and structured rehabilitation programs can further improve patient engagement in exercise and sports-based rehabilitation strategies.

8. The Role of Stigma and Disease Burden in Limiting Physical Activity

Social stigma and the burden of disease negatively impacted patients' motivation to participate in sports and exercise, often leading to social isolation, decreased self-confidence, and physical inactivity. Addressing stigma through community education, psychosocial counseling, and public health campaigns is essential to help PTB patients reintegrate into physical and social environments. Integration of Family-Centered Strategies in Pulmonary Rehabilitation. The study highlights the need for family-centered rehabilitation programs that integrate physical therapy, psychological support, and social reintegration strategies. Encouraging family members to actively participate in physical rehabilitation sessions, promote outdoor activities, and foster a positive recovery environment can significantly improve treatment outcomes and long-term physical function.

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