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Family Stress and Physical Rehabilitation Adherence in Adolescents: The Mediating Role of Health Beliefs

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A B S T R A C T

Objective: The objective of this study was to examine the relationship between family stress and physical rehabilitation adherence among adolescents, with health beliefs considered as a mediating variable.

Methods and Materials: This descriptive correlational study included 399 adolescents aged 12–18 years who were undergoing physical rehabilitation programs in Minnesota. The sample size was determined using the Krejcie and Morgan table to ensure sufficient statistical power. Data were collected using standardized and validated instruments: the Medical Outcomes Study General Adherence Scale for adherence, the Health Belief Model Scale for health beliefs, and the Family Inventory of Life Events and Changes for family stress. Data analysis was conducted using SPSS version 27 and AMOS version 21. Descriptive statistics were computed, Pearson's correlations were used to examine bivariate associations, and a structural equation model (SEM) was applied to test the hypothesized mediating role of health beliefs.

Findings: Results indicated that family stress was significantly and negatively associated with physical rehabilitation adherence ($r = –.39$, $p < .001$) and health beliefs ($r = –.29$, $p < .001$). Health beliefs were positively correlated with adherence ($r = .47$, $p < .001$). Family stress had a significant negative direct effect on adherence ($\beta = –0.26$, $p < .001$) and an indirect effect through health beliefs ($\beta = –0.12$, $p = .002$), with a total effect of $\beta = –0.38$ ($p < .001$), confirming partial mediation.

Conclusion: Strengthening adolescents' health beliefs may serve as a buffer against the adverse effects of family stress and improve rehabilitation outcomes.

Keywords: *Family stress; health beliefs; rehabilitation adherence; adolescents*

1. Introduction

Adolescence represents a critical period of development marked by biological, psychological, and social transitions that significantly influence health behaviors and long-term well-being. During this period, adherence to medical and rehabilitative treatments becomes particularly complex, as adolescents are simultaneously striving for autonomy while remaining embedded in family structures and broader social contexts (Alexander, 2025). Physical rehabilitation adherence among adolescents is an especially important area of focus, as non-adherence to prescribed programs not only diminishes treatment effectiveness but may also lead to chronic impairment, recurrent health problems, and reduced quality of life (Amaricăi, 2018; Rathleff et al., 2018). The present study seeks to investigate the impact of family stress on adolescents' adherence to physical rehabilitation, while also exploring the mediating role of health beliefs, recognizing that these cognitive frameworks are deeply intertwined with both individual behavior and family dynamics.

The significance of treatment adherence in adolescent health has been emphasized across various chronic and rehabilitative conditions. For instance, in the context of type 1 diabetes, numerous studies have highlighted how adolescence is marked by reduced adherence due to psychosocial and developmental challenges (Azar et al., 2024; Bombaci et al., 2024). These findings are not limited to diabetes management; they extend to other conditions where consistent engagement in therapy or rehabilitation is required. Importantly, adherence is not merely an individual responsibility but is influenced by structural, familial, and psychological dimensions (Condeço, 2025). Family environments characterized by stress, conflict, or instability have been shown to compromise adolescents' capacity to sustain long-term treatment adherence (Damulira et al., 2019).

The role of family functioning in adolescent health behaviors is critical. Research suggests that family support, cohesion, and healthy communication patterns enhance adherence across multiple chronic conditions, whereas family stress undermines adolescents' ability to maintain consistent therapeutic engagement (Almeida et al., 2020; Nabunya et al., 2020). In fact, studies have shown that stress within the family system can spill over into adolescents' health management, increasing the risk of missed treatments, poor motivation, and reduced belief in the effectiveness of health-related behaviors (Almeida et al., 2023; Mohamed et al., 2022). By contrast, families that maintain supportive environments even under stressful conditions foster resilience in adolescents, improving adherence outcomes.

Health beliefs, grounded in frameworks such as the Health Belief Model, provide a theoretical explanation for why adolescents choose to adhere—or fail to adhere—to health regimens. Perceptions of susceptibility, severity, benefits, and barriers strongly influence motivation to comply with prescribed treatments. For example, adolescents with stronger beliefs in the benefits of therapy and fewer perceived barriers are more likely to remain engaged in physical rehabilitation (Amalia, 2021). These cognitive appraisals are themselves influenced by both family and social environments. Family stress can distort adolescents' health beliefs, making them perceive barriers as insurmountable, or reducing their confidence in the benefits of consistent adherence (Condeço, 2025).

Research across various health domains supports the mediating role of health beliefs in the adherence process. In the field of type 1 diabetes, it has been shown that adolescents' adherence behaviors are significantly determined by their beliefs about treatment efficacy, which are often shaped by the family and school contexts (Almeida et al., 2023; Bombaci et al., 2024). Similarly, studies on adherence to antiretroviral therapy among HIV-positive adolescents highlight that family cohesion and social support positively influence adherence self-efficacy, largely through shaping adolescents' health-related cognitions (Damulira et al., 2019; Nabunya et al., 2020). These findings highlight the importance of investigating how family stress might indirectly impact rehabilitation adherence by influencing the health beliefs adolescents hold.

Adherence research in other health conditions also offers valuable insights. Among adolescents with transfusion-dependent thalassemia, barriers to adherence are often related to family and social pressures, alongside personal beliefs about the necessity or burden of therapy (Mohamed et al., 2022). Similar patterns have been documented in adolescents living with HIV in African contexts, where stressors such as poverty, stigma, and family disruption diminish adherence partly through undermining psychological well-being and self-belief (Okawa et al., 2018; Rencken et al., 2021). The cumulative evidence suggests that adherence cannot be fully understood without considering the broader interplay between family functioning and adolescent cognitions.

Physical rehabilitation represents a distinct but related adherence challenge for adolescents. While chronic disease

JARAC Assessment and Research in Applied Counseling
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management involves medication routines and lifestyle adjustments, rehabilitation often requires sustained effort, repeated exercises, and motivation to continue despite delayed or incremental progress. In this regard, adherence is vulnerable to fluctuations in motivation and family support (Amaricăi, 2018; Rathleff et al., 2018). Moreover, physical rehabilitation often requires integration into daily routines, where parental encouragement, logistical support, and reduced family stress can determine whether adolescents remain consistent with their prescribed regimens (Wright et al., 2021).

Beyond the family, broader contextual factors also shape adolescents' adherence and health beliefs. For instance, socioeconomic stressors and cultural environments play a significant role in shaping adolescents' perceptions of health and their capacity to follow through with medical recommendations (García et al., 2020; Papadaki & Carayanni, 2022). Similarly, belief in social mobility and self-regulation capacities has been found to influence health outcomes among socioeconomically disadvantaged adolescents, suggesting that personal beliefs about life opportunities and efficacy extend to health behaviors (Zuo et al., 2024). This points to the interconnectedness of family stress, societal pressures, and adolescents' individual belief systems.

Adolescent health research has also highlighted the role of psychosocial interventions in modifying health beliefs and improving adherence. Cognitive-behavioral interventions and family-based therapies, for instance, have been shown to strengthen therapeutic alliance and enhance adolescents' adherence across different conditions (Ibrahim et al., 2021). In the domain of obesity interventions, multidisciplinary approaches that target both adolescents and families have yielded positive outcomes, underscoring the necessity of family involvement in shaping long-term adherence (Ahsan et al., 2020). These findings further support the view that addressing family stress and cognitive determinants is central to improving adherence in rehabilitation contexts.

Family stress not only undermines adherence directly but also affects adolescents' broader psychosocial well-being. Elevated family stress has been associated with higher risk of psychological distress, reduced quality of life, and diminished resilience, all of which compromise adolescents' ability to engage in treatment (Azar et al., 2024; Bombaci et al., 2024). Conversely, families that are able to buffer adolescents against stress foster higher self-efficacy and adherence confidence. Evidence from studies on ART adherence in African contexts demonstrates that adolescents receiving strong peer and family support are more motivated to continue therapy despite external challenges (Rencken et al., 2021). These findings highlight parallels between medical treatment adherence and physical rehabilitation adherence, suggesting that similar mechanisms may be at play.

Furthermore, the literature suggests that adolescents' adherence behaviors should not be viewed in isolation but rather as embedded in the complex interplay between family, individual cognition, and broader social contexts (Alexander, 2025; Condeço, 2025). Adolescents are particularly vulnerable to the combined effects of stress and underdeveloped self-regulation, making them reliant on family support structures. At the same time, their growing autonomy means that health beliefs increasingly guide their behaviors (Amalia, 2021; Zuo et al., 2024). It is this developmental tension that makes adolescence a unique period for studying the interaction between family stress, health beliefs, and adherence.

The cumulative evidence across conditions—from diabetes management (Almeida et al., 2020; Almeida et al., 2023; Azar et al., 2024; Bombaci et al., 2024) to HIV treatment (Foster et al., 2020; Nabunya et al., 2020; Okawa et al., 2018; Rencken et al., 2021) to obesity and lifestyle interventions (Ahsan et al., 2020; García et al., 2020; Papadaki & Carayanni, 2022)—converges on the idea that adherence is multidimensional, influenced by family, personal beliefs, and psychosocial factors. Yet, research specifically addressing the mechanisms through which family stress influences physical rehabilitation adherence in adolescents remains limited. By exploring health beliefs as a mediator, the present study seeks to fill this gap, providing a more nuanced understanding of the adherence process in rehabilitation contexts.

In sum, adherence to physical rehabilitation programs during adolescence is a multifaceted phenomenon shaped by the interplay of family stress, health beliefs, and broader contextual influences. Building on prior research across chronic illness, infectious diseases, and psychosocial interventions, the current study proposes a model in which family stress exerts both direct and indirect effects on rehabilitation adherence, with health beliefs serving as a critical mediating factor.

2. Methods and Materials

JARAC Assessment and Research in Applied Counseling
E-ISSN: 3041-8518

2.1. Study Design and Participants

This study employed a descriptive correlational design to investigate the relationship between family stress and physical rehabilitation adherence in adolescents, with health beliefs considered as a mediating variable. The study population consisted of adolescents undergoing physical rehabilitation in Minnesota. A total of 399 participants were recruited based on the sample size recommendation from the Krejcie and Morgan (1970) table, which ensures adequate statistical power for correlational and structural modeling analyses. Participants were selected through a purposive sampling strategy from rehabilitation centers and clinics across the state. Inclusion criteria required participants to be adolescents aged 12–18 years, currently prescribed a physical rehabilitation program, and able to provide informed assent with parental consent.

2.2. Measures

Adherence to physical rehabilitation was measured using the Medical Outcomes Study General Adherence Scale (MOS-GAS) developed by DiMatteo, Hays, and Sherbourne in 1992. The scale consists of 5 items that assess the extent to which individuals follow their prescribed treatment or rehabilitation regimen. Items are scored on a 6-point Likert scale ranging from "none of the time" to "all of the time," with higher scores reflecting greater adherence to rehabilitation activities. Although originally designed for general medical adherence, this instrument has been widely applied in rehabilitation contexts, including physical therapy, due to its brevity and sensitivity. Previous research has reported satisfactory psychometric properties, with Cronbach's alpha coefficients typically exceeding 0.80 and strong evidence for both construct and predictive validity across diverse clinical populations.

The construct of health beliefs was assessed using the Health Belief Model Scale (HBMS) developed by Champion in 1984 and subsequently revised in 1993 for broader health contexts. The revised scale comprises 42 items distributed across six subscales: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. Items are rated on a 5-point Likert scale from "strongly disagree" to "strongly agree." Scoring is obtained by summing subscale responses, with higher scores indicating stronger health beliefs in each domain. The HBMS has been extensively used in studies of adolescent health behaviors and treatment compliance. Its validity and reliability have been consistently supported, with reported Cronbach's alpha values ranging from 0.70 to 0.89 across subscales, and factor analyses confirming its theoretical structure in various populations.

Family stress was measured using the Family Inventory of Life Events and Changes (FILE) developed by McCubbin, Patterson, and Wilson in 1983. This instrument contains 71 items that assess the cumulative stressors and strains experienced by families over the past year, covering domains such as intra-family conflict, financial difficulties, work-family transitions, and health-related challenges. Respondents indicate whether each event has occurred, and scores are calculated by summing the endorsed items, with higher scores reflecting greater family stress exposure. The FILE is grounded in family stress theory and has been widely applied in adolescent health research, particularly in relation to coping and adaptation. Its psychometric properties are well-established, with internal consistency coefficients typically above 0.80, and both construct and criterion-related validity confirmed in multiple cultural and clinical contexts.

2.3. Data Analysis

Data analysis was conducted using SPSS version 27 and AMOS version 21. First, descriptive statistics, including means, standard deviations, frequencies, and percentages, were calculated to summarize demographic variables and main study constructs. To examine bivariate associations, Pearson correlation coefficients were computed between physical rehabilitation adherence (dependent variable), family stress, and health beliefs. To test the hypothesized mediating role of health beliefs, a structural equation model (SEM) was specified and estimated in AMOS. Model fit was evaluated using multiple indices, including the chi-square statistic (χ^2), the root mean square error of approximation (RMSEA), the comparative fit index (CFI), and the Tucker–Lewis index (TLI). Statistical significance was set at $p < 0.05$.

3. Findings and Results

Of the 399 adolescents who participated in the study, 210 (52.6%) were female and 189 (47.4%) were male. The mean age of participants was 15.4 years (SD = 1.86), ranging from 12 to 18 years. Regarding grade level, 86 participants (21.6%) were in 7th grade, 102 (25.6%) in 8th grade, 97 (24.3%) in 9th grade, 69 (17.3%) in 10th grade, and 45 (11.3%) in 11th or 12th grade. In terms of socioeconomic background, 158 adolescents (39.6%) reported low-income family status, 167 (41.9%) reported middle-income status,

JARAC Assessment and Research in Applied Counseling
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and 74 (18.5%) reported high-income status. Additionally, 241 participants (60.4%) reported living with both biological parents, 96 (24.1%) with a single parent, and 62 (15.5%) with other guardians.

Table 1

Descriptive statistics of study variables (N = 399)

Variable	Mean	SD
Physical Rehabilitation Adherence	22.84	5.13
Health Beliefs	138.42	18.57
Family Stress	41.76	9.64

The descriptive statistics (Table 1) show that the mean score for physical rehabilitation adherence was 22.84 (SD = 5.13), indicating a moderate level of adherence across participants. Health beliefs yielded a higher mean of 138.42 (SD = 18.57), suggesting that adolescents generally reported positive health-related cognitions. Family stress demonstrated a mean of 41.76 (SD = 9.64), reflecting a moderate degree of reported stressors in family environments.

Before conducting correlational and structural analyses, statistical assumptions were evaluated and confirmed. Examination of normality using skewness and kurtosis statistics showed values within the acceptable range of ±1.5, with skewness ranging from –0.84 to 0.92 and kurtosis ranging from –1.12 to 1.27, indicating approximate normal distribution of the variables. Linearity was assessed through scatterplots, which showed consistent linear relationships between predictor and outcome variables. Multicollinearity diagnostics indicated variance inflation factor (VIF) values between 1.18 and 2.04, all well below the cutoff of 10, confirming the absence of multicollinearity. Finally, homoscedasticity was confirmed through visual inspection of residual plots, with no evidence of systematic variance patterns.

Table 2

Pearson correlations among study variables (N = 399)

Variable	1	2	3
1. Physical Rehabilitation Adherence	—		
2. Health Beliefs	.47** (p < .001)	—	
3. Family Stress	–.39** (p < .001)	–.29** (p < .001)	—

As presented in Table 2, physical rehabilitation adherence was significantly and positively correlated with health beliefs (r = .47, p < .001), indicating that adolescents with stronger health beliefs were more likely to adhere to rehabilitation programs. Conversely, family stress was significantly and negatively correlated with adherence (r = –.39, p < .001) and also negatively associated with health beliefs (r = –.29, p < .001). These findings support the hypothesized associations among variables.

Table 3

Fit indices for the structural equation model

Fit Index	Value	Criterion
χ^2	112.68	—
df	64	—
χ^2/df	1.76	< 3.00
GFI	0.95	≥ 0.90
AGFI	0.92	≥ 0.90
CFI	0.97	≥ 0.95
TLI	0.96	≥ 0.95
RMSEA	0.044	≤ 0.08

JARAC Assessment and Research in Applied Counseling
E-ISSN: 3041-8518

Model fit indices (Table 3) demonstrated that the structural model achieved satisfactory goodness-of-fit. The chi-square statistic was χ^2 (64) = 112.68, with a ratio of χ^2/df = 1.76, well below the acceptable threshold of 3. Fit indices indicated strong model adequacy (GFI = 0.95, AGFI = 0.92, CFI = 0.97, TLI = 0.96). Additionally, the RMSEA value of 0.044 confirmed an excellent fit, indicating the model provided a good representation of the observed data.

Table 4

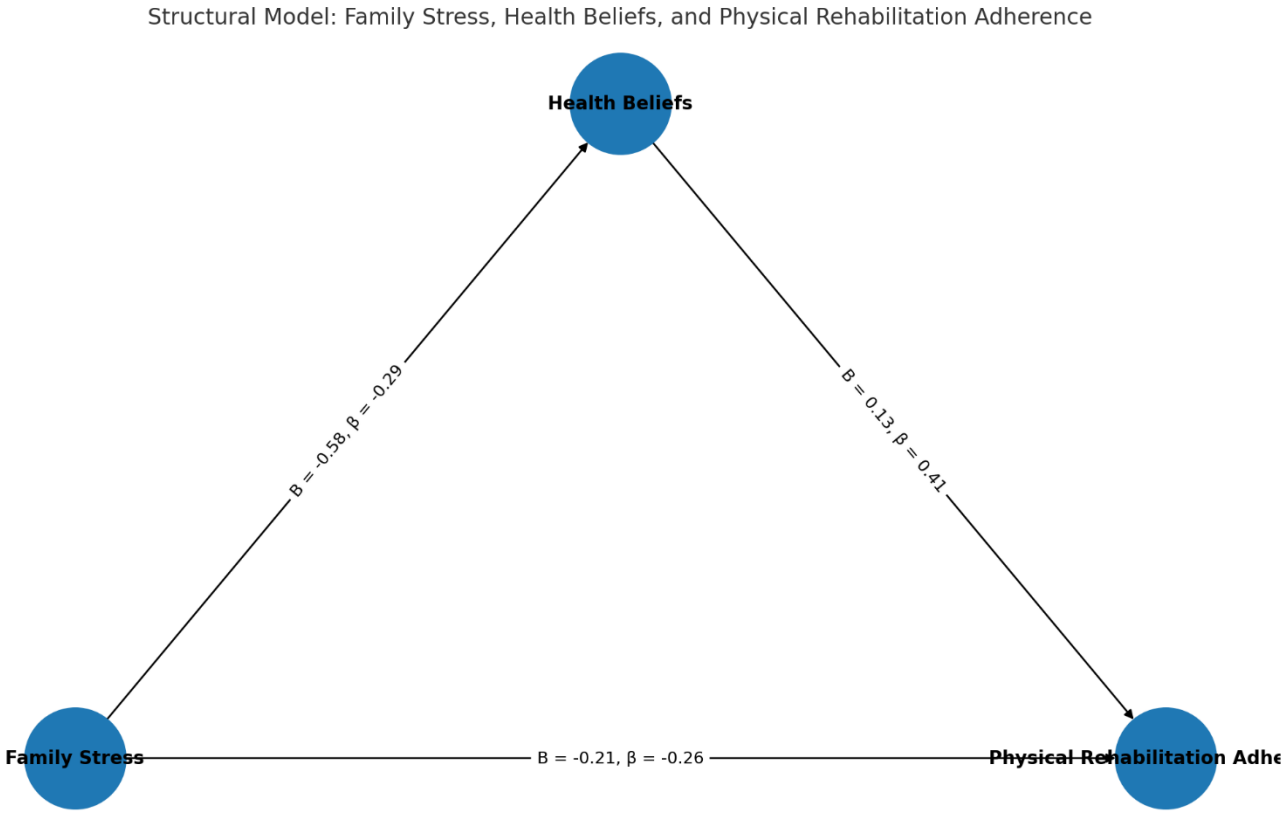
Direct, indirect, and total effects between study variables

Path	b	SE	β	p
Family Stress → Health Beliefs	–0.58	0.09	–0.29	< .001
Health Beliefs → Adherence	0.13	0.02	0.41	< .001
Family Stress → Adherence (direct)	–0.21	0.05	–0.26	< .001
Family Stress → Adherence (indirect)	–0.08	0.02	–0.12	.002
Family Stress → Adherence (total)	–0.29	0.06	–0.38	< .001

Path coefficients (Table 4) revealed that family stress had a significant negative direct effect on health beliefs (b = –0.58, β = –0.29, p < .001). Health beliefs significantly predicted adherence (b = 0.13, β = 0.41, p < .001). The direct effect of family stress on adherence remained significant (b = –0.21, β = –0.26, p < .001), while the indirect effect through health beliefs was also significant (b = –0.08, β = –0.12, p = .002). The total effect of family stress on adherence was stronger (b = –0.29, β = –0.38, p < .001), confirming partial mediation by health beliefs.

Figure 1

Model with Beta Coefficients



JARAC Assessment and Research in Applied Counseling
E-ISSN: 3041-8518

4. Discussion and Conclusion

The present study investigated the relationship between family stress and physical rehabilitation adherence in adolescents, with a particular focus on the mediating role of health beliefs. Using both correlational analysis and structural equation modeling, the findings revealed that family stress was significantly and negatively associated with physical rehabilitation adherence, suggesting that adolescents from families experiencing higher levels of stress were less likely to consistently follow prescribed rehabilitation protocols. Moreover, health beliefs were found to mediate this relationship, indicating that family stress does not only exert a direct negative impact on adherence but also indirectly influences it through shaping adolescents' perceptions of susceptibility, severity, benefits, and barriers. These results underscore the complex interplay between family dynamics, cognitive appraisal processes, and health behaviors during adolescence.

The direct relationship between family stress and lower adherence to rehabilitation aligns with prior evidence in related health domains. Research has consistently shown that families under strain—whether from financial hardship, conflict, or health-related burdens—tend to have adolescents who demonstrate poorer treatment adherence (Condeço, 2025). In type 1 diabetes management, similar findings have been reported, where family stress undermines the consistency of blood glucose monitoring and insulin administration (Azar et al., 2024; Bombaci et al., 2024). In contexts such as antiretroviral therapy for HIV-positive adolescents, family stress has been identified as a major barrier to adherence, not only because it disrupts routine but also because it diminishes adolescents' sense of stability and support (Damulira et al., 2019; Nabunya et al., 2020). The current study's findings extend this evidence into the domain of physical rehabilitation, suggesting that the mechanisms observed in chronic illness adherence also apply in rehabilitative care.

The mediating role of health beliefs highlights the importance of cognitive frameworks in shaping adolescent health behaviors. Adolescents who perceived rehabilitation as beneficial, believed themselves to be at risk if adherence was not maintained, and felt confident in their ability to overcome barriers demonstrated greater adherence, even when experiencing family stress. This finding aligns with the Health Belief Model, which posits that individuals' health behaviors are influenced by their beliefs about susceptibility, severity, benefits, and barriers (Amalia, 2021). Prior studies in chronic conditions, such as diabetes, confirm the central role of health beliefs in predicting adherence (Almeida et al., 2020; Almeida et al., 2023). For instance, adolescents with strong beliefs in treatment efficacy are more consistent in adhering to medical regimens, while those with weak or negative health beliefs are more prone to non-adherence (Bombaci et al., 2024). The current study adds to this literature by showing that health beliefs not only predict adherence but also explain how family stress translates into reduced engagement with rehabilitation.

The interplay of stress and beliefs in shaping adherence is consistent with prior research in diverse adolescent health contexts. In studies of HIV-positive adolescents in Uganda and Zambia, adherence was strongly influenced by psychosocial well-being, with family and peer support fostering more positive health beliefs and higher adherence (Okawa et al., 2018; Rencken et al., 2021). Similarly, adolescents with thalassemia facing barriers to iron chelation therapy often reported negative health beliefs about treatment efficacy, which were exacerbated by family and social stressors (Mohamed et al., 2022). The present study parallels these findings, indicating that stressful family environments likely distort adolescents' cognitive appraisals of rehabilitation, leading them to perceive barriers as more severe and benefits as less convincing.

Furthermore, the observed relationship between family stress and adherence resonates with the growing body of evidence linking socioeconomic and environmental stressors to adolescents' health outcomes. For example, adolescents from disadvantaged backgrounds with stronger beliefs in social mobility and intentional self-regulation tend to show more positive health behaviors, while those who lack such beliefs exhibit weaker adherence (Zuo et al., 2024). Similarly, lifestyle and behavioral studies confirm that adolescents' self-perceived health is shaped by both external stressors and internalized health beliefs (García et al., 2020). The current findings align with this dual perspective by highlighting the role of both family-level stress and individual health beliefs in explaining variation in adherence.

The findings also connect to the broader literature on psychosocial interventions aimed at enhancing adherence. Family-based interventions that target communication and stress reduction have been shown to improve adolescents' adherence outcomes (Alexander, 2025). Likewise, therapist adherence to family-oriented treatments has been linked with stronger therapeutic alliances and better adherence behaviors among adolescents at risk (Ibrahim et al., 2021).

JARAC Assessment and Research in Applied Counseling
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These findings reinforce the interpretation that family stress influences adherence not simply through practical barriers, but also through emotional and relational dynamics that shape adolescents' cognitive engagement with their rehabilitation.

Another important interpretation is that adherence in rehabilitation contexts shares commonalities with adherence to exercise, lifestyle, and health promotion programs. Interventions promoting physical activity, healthy diet, and weight management have consistently demonstrated the importance of both family and individual belief systems (Ahsan et al., 2020; Papadaki & Carayanni, 2022). For example, multidisciplinary family-centered interventions in obesity management have yielded better adherence outcomes, reflecting the combined influence of family support and positive health beliefs (Ahsan et al., 2020). The parallels with physical rehabilitation adherence are evident: consistent engagement in exercises requires motivation, structure, and reinforcement, all of which are sensitive to stress and cognitive appraisals.

The current findings also resonate with the literature on rehabilitation-specific adherence. Adolescents with musculoskeletal disorders or orthopedic rehabilitation needs often show variable adherence depending on motivation, family encouragement, and perceived efficacy of the exercises (Amaricăi, 2018; Rathleff et al., 2018; Wright et al., 2021). Stressful environments can undermine motivation, while supportive families facilitate engagement. The mediating role of health beliefs helps explain why some adolescents persist in rehabilitation despite challenging circumstances: their cognitive frameworks allow them to reinterpret stress in ways that preserve motivation.

In synthesizing these results, the study contributes to a growing recognition that adherence is a multidimensional construct shaped by the dynamic interaction of family stress, adolescent cognition, and broader contextual factors. Consistent with findings in diabetes (Almeida et al., 2020; Azar et al., 2024), HIV (Foster et al., 2020; Rencken et al., 2021), and lifestyle interventions (García et al., 2020; Papadaki & Carayanni, 2022), this study supports the interpretation that interventions should address both family stressors and health beliefs to optimize rehabilitation adherence. Importantly, the mediating role of health beliefs provides a target for clinical practice: strengthening adolescents' positive health beliefs may buffer the negative effects of stressful family environments.

5. Limitations & Suggestions

This study has several limitations that must be acknowledged. First, its cross-sectional design limits the ability to make causal inferences about the directionality of the observed relationships. While the structural model supports the mediating role of health beliefs, longitudinal research is needed to confirm whether family stress leads to changes in beliefs and adherence over time. Second, the study relied on self-report measures, which are subject to recall bias and social desirability effects, potentially inflating adherence levels or underestimating stress. Third, the sample was drawn exclusively from Minnesota, which may limit generalizability to adolescents from different cultural, socioeconomic, or healthcare contexts. Fourth, although validated instruments were used, the complexity of family stress and adolescent belief systems may not be fully captured by standardized questionnaires. Finally, the study did not account for potential moderating variables such as peer support, school involvement, or healthcare provider relationships, which may influence the relationship between family stress and adherence.

Future studies should employ longitudinal designs to better capture the dynamic interactions between family stress, health beliefs, and adherence behaviors across time. It would be valuable to explore whether interventions that specifically target adolescents' health beliefs can buffer the effects of family stress on adherence outcomes. Expanding research to diverse populations and cultural contexts will also enhance generalizability and shed light on cultural differences in the family-adherence dynamic. Incorporating qualitative methods, such as interviews with adolescents and families, could provide deeper insights into the lived experiences of stress and adherence. Additionally, future research should examine potential moderators such as peer support, therapeutic alliance with providers, and socioeconomic factors to build a more comprehensive understanding of the adherence process. Finally, intervention-based studies testing the effectiveness of family stress reduction programs, combined with belief-focused psychoeducation, would offer important applied contributions.

From a clinical perspective, the findings highlight the importance of addressing both family stress and adolescent health beliefs in promoting rehabilitation adherence. Healthcare providers should consider integrating family-based counseling and stress management strategies into rehabilitation programs to reduce the negative impact of stressful environments. At the same time, interventions should incorporate health education and cognitive-

JARAC Assessment and Research in Applied Counseling
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behavioral strategies to strengthen adolescents' positive health beliefs, thereby enhancing motivation to adhere. Collaborative approaches involving families, schools, and rehabilitation professionals may provide the most effective support. By simultaneously targeting family stressors and belief systems, practitioners can improve adherence rates and ultimately optimize rehabilitation outcomes for adolescents.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

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

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed in this article.

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