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Postprint: Current Status and Influencing Factors of Intolerance of Uncertainty in Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease from a Health Ecology Perspective

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Abstract

Background Patients with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) chronically face disease uncertainty and high stress states. Their psychological trait of intolerance of uncertainty is closely associated with adverse health outcomes; however, existing research lacks comprehensive analysis based on multi-level ecological systems.

Objective To analyze the current status and influencing factors of intolerance of uncertainty in AECOPD patients from the perspective of health ecology, thereby providing a reference basis for developing targeted intervention strategies.

Methods AECOPD patients from the Respiratory and Critical Care Medicine Center of Xinjiang Uygur Autonomous Region People' s Hospital between November 2024 and June 2025 were conveniently selected as survey subjects. General patient data were collected, and a cross-sectional survey was conducted using the Short Intolerance of Uncertainty Scale, Acceptance and Action Questionnaire-II, Chronic Obstructive Pulmonary Disease Health Literacy Scale, Perceived Social Support Scale, etc., to measure patients' intolerance of uncertainty, psychological flexibility, health literacy, and social support levels.

Results A total of 360 questionnaires were distributed, with 342 valid questionnaires recovered, yielding an effective recovery rate of 95%. The total intolerance of uncertainty score for the 342 AECOPD patients was (32.2$±7.1)$points, whilethescoresforpsychologicalflexibility, healthliteracy, andsocialsupportwere(24.7±8.6
0.155, 95 = 0.097, 95 = 0.114, 95 = 0.179, 95 = 0.183, 95 = −0.249, 95 $=-0.212,

95%CI=-0.188~-0.068) were the main influencing factors of intolerance of uncertainty in AECOPD patients (P<0.05).

Conclusion AECOPD patients exhibit moderately high levels of intolerance of uncertainty, which is influenced by the interaction of multi-level factors. Comprehensive interventions for AECOPD patients should be implemented based on their disease condition and from multiple perspectives including psychological, family, and social dimensions.

Full Text

Abstract

Background: Patients with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) are chronically exposed to disease uncertainty and high stress, and their psychological trait of intolerance of uncertainty is strongly associated with poor health outcomes. However, existing research lacks comprehensive analyses based on multilevel ecosystems.

Objective: To analyze the current situation and influencing factors of intolerance of uncertainty in patients with AECOPD from the perspective of health ecology, and to provide reference for formulating targeted intervention strategies.

Methods: From November 2024 to June 2025, 342 patients with AECOPD in the Respiratory and Critical Care Medicine Center of Xinjiang Uygur Autonomous Region People' s Hospital were conveniently selected as survey subjects. The Intolerance of Uncertainty Scale-12, the Acceptance and Action Questionnaire-II, the COPD Knowledge Questionnaire, and the Perceived Social Support Scale were used to conduct a cross-sectional survey.

Results: The 342 patients with AECOPD had a total intolerance of uncertainty score of (32.2$±7.1).*Thescoresofpsychologicalflexibility*, *healthliteracy*, *andsocialsupportwere*(24.7±8.6), (6
0.155, 95 = 0.097, 95 = 0.114, 95 = 0.179, 95 = 0.183, 95 = −0.249, 95 $=-0.212, 95%CI=-0.188~-0.068) were the main influencing factors of intolerance of uncertainty in patients with AECOPD (P<0.05).

Conclusion: The intolerance of uncertainty of AECOPD patients is at a moderately high level, and their intolerance of uncertainty is influenced by the interaction of multilevel factors. Comprehensive interventions should be carried out for AECOPD patients according to the patient' s condition and from multiple perspectives, such as psychological, family, and social.

Keywords: Acute exacerbation of chronic obstructive pulmonary disease; Intolerance of uncertainty; Root cause analysis; Health ecology model

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Chronic obstructive pulmonary disease (COPD) is a common respiratory disease, and acute exacerbation of COPD (AECOPD) represents a critical stage in the

disease course. These patients, predominantly middle-aged and elderly ($ $40 years), frequently face numerous disease uncertainties: symptomatically, they experience recurrent and unpredictable dyspnea, cough, and sputum production, leading to constant worry about sudden severe respiratory distress; therapeutically, different triggers require different treatment protocols with substantial individual variation in efficacy, leaving patients uncertain whether current treatments can effectively control their condition; prognostically, each acute exacerbation may damage lung function, creating anxiety about disease progression to respiratory failure and uncertainty about future functional capacity and health status. Compared with stable-phase patients, AECOPD patients not only endure more significant physiological symptom impacts but also experience heightened psychological vulnerability to uncertainty due to sudden disease changes, resulting in significantly reduced tolerance for disease progression uncertainty.

Intolerance of uncertainty (IU) refers to an individual' s cognitive-emotional tendency to have difficulty accepting uncertain events and their potential negative outcomes, existing on a continuum from low to high levels in the population. High IU individuals exhibit marked intolerance, worry, and avoidance in uncertain situations, while low IU individuals demonstrate relatively greater tolerance and adaptability. Previous research indicates that high IU levels are particularly prominent in AECOPD patients. Persistent concerns about sudden symptom deterioration, unpredictable treatment efficacy, or loss of future functional capacity generate excessive anxiety and avoidance behaviors that severely constrain disease management effectiveness and quality of life, leading to decreased treatment adherence, amplified symptom perception, deteriorating mental health (such as anxiety/depression), and even increased readmission risk, creating a vicious cycle. However, current research on IU levels in AECOPD patients has primarily focused on single psychological factors, lacking systematic analysis of the interactive effects of multilevel factors.

The health ecology model (HEM) emphasizes that individual health is comprehensively influenced by personal traits, behavioral psychology, interpersonal networks, living environments, and policy contexts. Its multilevel framework provides an ideal theoretical perspective for systematically interpreting the complex causes of high IU levels in AECOPD patients. Therefore, based on the five-level perspective of HEM, this study aims to: (1) describe the current status of IU in AECOPD patients; (2) analyze influencing factors and their interactions across multiple levels, including personal characteristics (e.g., comorbidities, disease course), behavioral psychology (psychological flexibility, health literacy), interpersonal networks (social support), living conditions (economic burden), and policy environments (medical payment); and (3) provide evidence for developing targeted psychological intervention and social support strategies.

1.1 Study Subjects

Using convenience sampling, AECOPD patients admitted to the Respiratory and Critical Care Medicine Center of Xinjiang Uygur Autonomous Region Peo-

ple' s Hospital from November 2024 to June 2025 were selected as survey subjects. Inclusion criteria were: (1) meeting clinical diagnostic criteria for COPD; (2) being in the acute exacerbation phase, with clinical manifestations of worsening dyspnea and/or cough and sputum symptoms within 14 days; (3) age $ $40 years; (4) clear consciousness with basic reading comprehension or verbal communication ability; and (5) voluntary participation with signed informed consent. Exclusion criteria were: (1) presence of other terminal diseases such as cancer or severe heart failure; (2) coexisting cognitive or mental disorders preventing study completion; and (3) participation in other related clinical studies.

Sample size was estimated using the formula n=($\alpha/2\sigma/\delta)^2$. With bilateral α=0.05, $\alpha/2$=1.96, and based on pilot survey results showing a standard deviation of 4.16 for total IU scores, the allowable error δ was set at 0.5, yielding n=266. Considering a 20% attrition/invalid questionnaire rate, the minimum required sample size was determined to be 320 cases. This study ultimately included 342 eligible AECOPD patients. The study was approved by the Ethics Committee of Xinjiang Uygur Autonomous Region People' s Hospital (KY2025030408).

1.2 Variable Selection

The HEM comprises five key levels from inner to outer layers: personal characteristics, behavior and psychology, interpersonal networks, living and working conditions, and policy environment. The research team initially reviewed literature to identify representative factors across these five levels, then organized focus group discussions to validate the preliminary factors, ultimately determining the included potential influencing factors: (1) Personal characteristics level: age, gender, number of comorbidities, disease course, number of hospital admissions; (2) Behavior and psychology level: regular exercise, average nighttime sleep duration, psychological flexibility, health literacy; (3) Interpersonal network level: marital status, social support; (4) Living and working conditions level: education level, per capita monthly family income, average monthly medication cost, residence location; and (5) Policy environment level: medical insurance type [Figure 1: see original paper].

1.3 Survey Instruments

1.3.1 General Information Questionnaire: The research team designed this questionnaire based on literature review to collect demographic data including gender, age, education level, residence location, marital status, and per capita monthly family income, as well as disease-related data such as number of comorbidities, disease course, and number of hospital admissions.

1.3.2 Intolerance of Uncertainty Scale-12 (IUS-12): This study used the Chinese version translated by Zhang Yajuan et al. to measure individuals' tolerance for uncertainty. The scale includes two dimensions: prospective anxiety (7 items) and inhibitory anxiety (5 items), totaling 12 items. Using a 5-point

scoring system where 1 represents "very uncharacteristic of me" and 5 represents "very characteristic of me," total scores range from 12 to 60, with higher scores indicating higher levels of intolerance of uncertainty. The scale' s Cronbach' s α coefficient was 0.897, and in this study it was 0.865.

1.3.3 Acceptance and Action Questionnaire-II (AAQ-II): This study used the Chinese version translated by Cao Jing et al. to assess psychological flexibility. The AAQ-II is a 7-item unidimensional scale using a 7-point scoring system where 1 represents "never" and 7 represents "always." Total scores range from 7 to 49, with higher scores indicating lower psychological flexibility. The scale' s Cronbach' s α coefficient was 0.917, and in this study it was 0.922.

1.3.4 COPD Knowledge Questionnaire (COPD-Q): Developed by White et al. to assess COPD patients' disease knowledge mastery. The questionnaire covers clinical manifestations, treatment principles, and prevention, including 8 forward-scored and 5 reverse-scored items. Forward items score 1 point for "yes" and 0 for "no" or "don' t know," with reverse items scored oppositely. Total scores range from 0 to 13, with higher scores indicating better disease cognition. The scale' s Cronbach' s α coefficient was 0.720, and in this study it was 0.789.

1.3.5 Perceived Social Support Scale (PSSS): This study used the Chinese version translated by Jiang Qianjin to evaluate social support levels. The scale includes three dimensions: family support (4 items), friend support (4 items), and other support (4 items), totaling 12 items. Using a 7-point scoring system where 1 represents "very strongly disagree" and 7 represents "very strongly agree," total scores range from 12 to 84, with higher scores indicating higher social support levels. Scores of 12-36 indicate low level, 37-60 moderate level, and 61-84 high level. The scale' s Cronbach' s α coefficient was 0.869, and in this study it was 0.938.

1.4 Data Collection Method

After obtaining ethics committee approval and informed consent from the head nurse of the department, paper questionnaires were used to survey AECOPD patients meeting inclusion and exclusion criteria. The survey was conducted after patients' conditions initially stabilized following admission treatment and after the attending physician confirmed stable vital signs, clear consciousness, and adequate cooperation ability. The survey team consisted of 2 nursing graduate students and 2 respiratory nurses trained in survey methodology. Investigators used standardized instructions to explain the study purpose, content, and significance to participants, obtained informed consent, and conducted one-on-one, face-to-face surveys in quiet rooms. When participants could not complete the questionnaire themselves, investigators asked questions item-by-item and recorded responses. After completion, questionnaires were immediately checked for accuracy and completeness. Questionnaires with incorrect identity information, substantial missing key content, or multiple logical contradictions were deemed invalid and excluded. A total of 360 questionnaires were distributed,

with 342 valid questionnaires recovered.

1.5 Statistical Methods

Data were independently entered by two researchers using EpiData 3.0 software and cross-checked for accuracy. SPSS 26.0 software was used for data analysis. Count data were expressed as frequency and percentage. Normally distributed measurement data were expressed as ($\bar{x}\pm s$) and compared between AECOPD patients with different characteristics using independent samples t-test or one-way ANOVA. Pearson correlation analysis was used to explore correlations between psychological flexibility, health literacy, social support, and IU. Multiple linear regression analysis was used to investigate influencing factors of IU in AECOPD patients. The significance level was set at α=0.05.

2.1 Current Status of IU and Related Factors in AECOPD Patients

The 342 AECOPD patients had a total IUS-12 score of (32.2$±7.1), *withprospectiveanxietyandinhibitoryanxie*
respectively.

2.2 Single-Factor Analysis of IU in AECOPD Patients

Significant differences in IUS-12 total scores were found among AECOPD patients with different numbers of comorbidities, hospital admission frequencies, regular exercise status, average nighttime sleep duration, marital status, and average monthly medication costs (P<0.05). No statistically significant differences were observed in IUS-12 total scores among patients of different ages, genders, disease courses, education levels, per capita monthly family incomes, residence locations, or medical insurance types (P>0.05) .

2.3 Correlation Analysis Between IU and Variables in AECOPD Patients

Pearson correlation analysis showed that IUS-12 scores were positively correlated with psychological flexibility scores (r=0.648, P<0.001) and negatively correlated with health literacy and social support scores (r=-0.548 and -0.643, respectively, P<0.001).

2.4 Multiple Linear Regression Analysis of IU in AECOPD Patients

Using IUS-12 total score as the dependent variable (assigned as actual value) and statistically significant factors from single-factor and correlation analyses as independent variables—including number of comorbidities (assigned: 0=1, 1=2, 2=3, $ $3=4), admission frequency (assigned: <2 times=1, $ $2 times=2), regular exercise (assigned: yes=1, no=2), average nighttime sleep duration (assigned: <6h=1, $ $6h=2), marital status (assigned: married=1, unmarried/divorced/widowed=2), average monthly medication cost (assigned: <500 yuan=1, $ $500 yuan=2), psychological flexibility (assigned as actual value),

health literacy (assigned as actual value), and social support (assigned as actual value)—a multiple linear regression model was constructed. Results showed that number of comorbidities, admission frequency, regular exercise, average monthly medication cost, psychological flexibility, health literacy, and social support were main influencing factors of IU in AECOPD patients (P<0.05). These variables jointly explained 62.4% of the total variance in IU among AECOPD patients .

3.1 Current Status of IU in AECOPD Patients: Moderately High Level Dominated by Prospective Anxiety

This study showed that AECOPD patients had a total IUS-12 score of (32.2$±7.1), *indicatingamoderatelyhighlevelsignificantlyhigherthanthatreportedbyYiRuonanetal.*(31.81±7.
threateningsymptomexperiencecontinuouslyreinforcespatients′concernsabout"uncontrollablefutureattacks
confirming the disease characteristics of AECOPD—patients develop persistent vigilance toward future deterioration risks due to repeated experiences of sudden dyspnea and unpredictable acute exacerbations. This disease cognition pattern of "possible attack at any time" immerses patients in excessive worry about negative prognoses (such as respiratory failure or death), constituting the core manifestation of IU. This suggests that clinical interventions should prioritize addressing patients' catastrophic cognitions about disease uncertainty and promote the integration of cognitive behavioral therapy (CBT) into COPD management guidelines, establishing a multi-departmental collaboration network among "respiratory medicine-psychology-community" to reduce patients' IU levels.

3.2.1 Personal Characteristics Level: The Core of the HEM Model

This study found that the number of comorbidities and hospital admissions influenced IU levels in AECOPD patients. Each additional comorbidity increased the IUS-12 score by 1.057 points (β=0.155, P<0.001), consistent with previous research findings. The reason may be that multiple chronic conditions coexisting exacerbate symptom burden and functional limitations, amplifying patients' fear of "multiple disease interactions worsening" and magnifying uncertainty perception. Additionally, patients with \$ \$2 admissions had IUS-12 scores 5.4 points higher than those with <2 admissions (P<0.001). Frequent hospitalizations reinforce patients' perception of "uncontrolled disease," leading to heightened anxiety about unpredictable disease progression. Repeated acute exacerbations requiring hospitalization may worsen lung function impairment and daily activity limitations, and the resulting treatment dependence and financial pressure create greater conflict and stress when patients face disease management decisions, manifesting as higher IU levels. This suggests that clinical attention should focus on AECOPD patients with multiple comorbidities and frequent admissions, with individualized treatment plans developed based on patient conditions. When formulating plans, priority should be given to simplifying medication regimens, strengthening self-management education, and

integrating psychosocial support resources (such as CBT) to reduce patients' disease uncertainty and enhance their sense of control and confidence in disease management.

3.2.2 Behavioral and Psychological Level: The Intermediate Regulatory Layer of the HEM Model

This study found that regular exercise, health literacy, and psychological flexibility affected patients' IU levels. First, patients lacking exercise had IU scores 6.8 points higher than those exercising regularly (P<0.001), consistent with Liu et al.' s findings. The reason may be that AECOPD patients often reduce physical activity due to dyspnea and fatigue, leading to further lung function decline and symptom deterioration, which in turn intensifies anxiety, creating a physiological-psychological bidirectional negative feedback loop. Second, each 1-point increase in COPD-Q score reduced IUS-12 by 0.754 points (β=-0.249, P<0.001), a finding similar to Uyanik et al.' s research. The reason may be that patients lacking correct disease knowledge easily misinterpret symptoms (such as viewing emphysema as "lung cancer"), triggering unnecessary treatment panic. Additionally, each 1-point increase in AAQ-II increased IUS-12 by 0.151 points (β=0.183, P<0.001). Patients with poor psychological flexibility have lower acceptance capacity and are more prone to rumination, repeatedly falling into the dilemma of "what if the condition worsens" and amplifying uncertainty threats. This suggests that clinical practice should implement COPD health literacy education focusing on acute exacerbation warning signs, develop individualized exercise prescriptions (such as daily breathing exercises plus 30-minute walking) to break the anxiety cycle, and particularly focus on cultivating patients' psychological flexibility through interventions like acceptance and commitment therapy (ACT) to help patients learn to accept disease-related uncertainty with an open, non-judgmental attitude, reduce rumination, and redirect energy toward value-oriented actions. Additionally, providing easily understandable visual tools (such as symptom warning cards and self-management manuals) for patients with low health literacy can reduce panic caused by information misunderstanding.

3.2.3 Interpersonal Network Level: The Peripheral Buffering Layer of the HEM Model

This study found that each 1-point increase in PSSS reduced IUS-12 by 0.128 points (β=-0.212, P<0.001). Previous research indicates that social support, as an important external resource, helps buffer disease-related emotional and psychological stress and improves the ability to cope with uncertainty. Family support (especially spousal support) is a core buffering source, but AECOPD patients often avoid confiding due to illness-related stigma, cutting off critical support channels. Unmarried/divorced/widowed patients had higher IU in single-factor analysis, but this factor was not retained in multivariate analysis, consistent with Ji et al.' s findings in primiparas, possibly because its effect

is mediated through social support. This suggests that clinical practice should conduct "family support workshops" to train family members in symptom recognition and psychological support skills, establish patient mutual aid groups to reduce stigma, and more importantly, healthcare providers should proactively assess patients' perceived social support levels (using the PSSS scale) to identify individuals at risk for low support (such as unmarried/divorced/widowed patients or those self-reporting insufficient support) and actively guide them to establish or expand support networks (such as encouraging community participation or contacting relatives and friends). For patients who avoid communication due to strong stigma, providing a safe, non-judgmental communication environment is essential to gradually guide them to express needs and accept support.

3.2.4 Living Conditions Level: The Environmental Stress Layer of the HEM Model

This study found that patients with average monthly medication costs >500 yuan had IUS-12 scores 8.8 points higher than those with costs $ $500 yuan (P<0.001), consistent with previous research findings. The reason may be that financial pressure directly triggers "fear of treatment interruption," with patients worrying "if I stop medication, will I suddenly deteriorate," reinforcing sensitivity to uncertainty. Notably, per capita monthly family income did not enter the model, consistent with Bai Lu et al.' s findings, possibly because medical insurance coverage (97.1%) weakened the impact of income differences. This suggests that clinical practice should optimize the essential drug list to include high-cost inhalers in medical insurance reimbursement and establish green channels for medication cost reduction. Simultaneously, healthcare providers must actively assess patients' financial burden, provide individualized medication consultation for those with high costs (such as exploring equivalent but more economical alternative medications), and assist them in connecting with social support resources (such as charitable drug donation programs or chronic disease subsidy applications) to effectively reduce financial pressure and concerns about treatment interruption, thereby lowering disease uncertainty.

3.2.5 Policy Environment Level: The Macro-Guarantee Layer of the HEM Model

This study found no difference in IUS-12 scores among patients with different medical insurance types (P=0.834). The reason may be that medical insurance coverage reached 97.1% in the sample, essentially providing a safety net for medical expenses and weakening policy-level differences. However, self-paid patients (2.9%) still showed an elevated IUS-12 score trend [(31.6$±$6.3)]. Therefore, in clinical practice, routine IU psychological screening is recommended for all AECOPD patients, with particular attention to identifying self-paid patients and assessing their financial pressure and psychological burden. For high-IU self-paid patients identified through screening, in addition to assisting with social

resource applications, priority should be given to treatment plans with lower economic burden (such as optimizing inhaler device selection to reduce costs or strengthening community follow-up to reduce unnecessary hospitalizations), and actively feeding back the protection gaps of such vulnerable groups to policymakers to promote further improvement of medical insurance coverage.

3.3 Limitations of This Study

First, the single-center cross-sectional design with samples from only one tertiary hospital in Urumqi may introduce regional bias and limit generalizability. Future research should expand sample sources and conduct multi-center studies across eastern and western regions. Second, potential variables such as stigma and self-management were not examined; future studies could introduce the COPD Self-Efficacy Scale. Third, policy-level analysis was limited by sample homogeneity and requires inclusion of more self-paid and out-of-region medical insurance patients.

Author Contributions: Yang Fangting and Xiao Jiangqin were responsible for conceptualization, design, and core ideas; Xu Junfeng and Yang Qin were responsible for participant screening, data collection, and verification; Yang Fangting was responsible for data analysis and manuscript writing; Ma Yingzhi was responsible for manuscript revision; Zhou Ling was responsible for literature organization; Xiao Jiangqin was responsible for overall manuscript quality control and accountability.

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