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Interplay between Intolerance of Uncertainty and Anxiety Sensitivity in University Students: A Systematic Review

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Abstract

Intolerance of uncertainty (IU) and anxiety sensitivity (AS) are recognized as interconnected vulnerability factors affecting university students' mental health. This systematic review (2014–2024) followed PRISMA 2020 guidelines and was registered in PROSPERO (CRD420251036590). Seven databases across psychology, education and health were searched, yielding 664 records; 11 studies met inclusion criteria after screening. The evidence consistently shows a strong positive relationship between IU and AS. Students who struggle with uncertainty tend to also fear anxiety sensations, compounding their risk for psychological distress. In most studies, high IU exacerbated the effects of AS on anxiety-related outcomes (e.g. health anxiety), and conversely AS often mediated the impact of IU on overall anxiety levels. The included research—primarily cross-sectional studies from North America with student/young adult samples—indicates that IU and AS together fuel avoidance behaviors, help-seeking barriers, and academic difficulties, undermining inclusive participation in campus life. However, longitudinal data are scarce, and cultural diversity is limited, leaving causality and generalizability uncertain. This review synthesizes a decade of findings to highlight the intertwined roles of IU and AS in student anxiety, and it discusses implications for targeted interventions in higher education. Reducing IU and AS via cognitive-behavioral strategies and supportive educational practices is recommended to improve student resilience and inclusion.

Keywords: Intolerance of Uncertainty, Anxiety Sensitivity, Student Mental Health, Higher Education, Social Inclusion, Systematic Review

Introduction

Mental health problems are prevalent among university students and can significantly impact their daily life, community engagement, and academic success. Recent peer-reviewed evidence further suggests that student psychological distress is not only a clinical concern but is also associated with educational outcomes such as academic engagement, academic performance, and dropout intentions (Sinval et al., 2025; Chu et al., 2023). Many students report high levels of anxiety and depression when facing demanding coursework and

uncertain career paths (Evans et al., 2018; Levecque et al., 2017). In this context, two cognitive vulnerability factors are often highlighted: intolerance of uncertainty (IU) and anxiety sensitivity (AS). IU is defined as a tendency to struggle with unfamiliar or unclear situations, essentially a "fear of the unknown" (Carleton et al., 2007). AS refers to the fear of anxiety-related sensations, or "fear of fear" – a heightened sensitivity to one's own feelings of anxiety and their perceived consequences (Taylor et al., 2007). Recent student-focused research continues to position IU and AS as vulnerability processes that may shape how stress is appraised and managed in academic life. These traits frequently co-occur in students and are linked to greater anxiety and poorer functioning (Gellisch et al., 2024).

Beyond their influence on internal symptoms, IU and AS have important impacts on student behavior in social and educational contexts. A student with high IU may feel paralyzed by ambiguous class expectations or unpredictable social situations ("What will happen if I speak up?"), while a student with high AS may fear visible signs of anxiety like blushing or a racing heartbeat in public. Together, these fears can lead to avoidance behaviors: withdrawing from group discussions, avoiding class presentations, skipping networking events, and hesitating to join campus organizations. Over time, such avoidance can result in self-exclusion from the university community and missed opportunities for learning and growth. This is educationally important because university belonging and engagement show reliable associations with student well-being and academic outcomes in recent meta-analytic evidence (van Kessel et al., 2025). Students with both IU and AS often delay seeking help from peers, professors, or counseling services due to a combined fear of uncertain outcomes and fear of being negatively evaluated (Rickwood et al., 2005; Gulliver et al., 2010). Recent meta-analytic evidence also indicates that formal help-seeking remains limited among college students and identifies persistent barriers to service use, underscoring the practical relevance of understanding vulnerability processes linked to avoidance and delay (Zhao et al., 2025). Recent research during the COVID-19 pandemic further linked IU and AS to unique safety behaviors like excessive cleaning and hoarding, which, while intended to reduce anxiety, can disrupt daily routines and social interactions, such as, repeatedly sanitizing shared spaces or stockpiling supplies in response to uncertainty (Bredemeier et al., 2023; Saulnier et al., 2022).

To conceptualize these patterns, the present review proposes IU and AS as a linked loop in what can be termed a "Double Educational Vulnerability (DEV) model." In this framework (Figure 1), IU and AS reinforce one another: IU heightens anxiety and "what-if" worries in uncertain academic or social situations, while AS intensifies concern over the physical and cognitive sensations that accompany this anxiety (Deci & Ryan, 2000; Ryan & Deci, 2000). This reciprocal loop may increase avoidance behaviors. Drawing on self-determination theory, such a cycle can thwart students' basic psychological need for belonging or relatedness on campus. Externally, this manifests as weaker engagement with support services, reduced participation in learning communities, and social withdrawal. In other words, the same cognitive risk factors that drive internal anxiety may also create practical barriers to social inclusion in higher education. Students remain on the sidelines and postpone seeking help even when resources are available (Gulliver et al., 2010). In this review, the DEV model is used as an organizing lens to synthesize evidence on IU–AS processes in relation to education-relevant outcomes (e.g., belonging, engagement, and help-seeking) (van Kessel et al., 2025; Zhao et al., 2025). Figure 1 illustrates this DEV model and how IU and AS together can erode a student's sense of connection and safety in the campus environment.

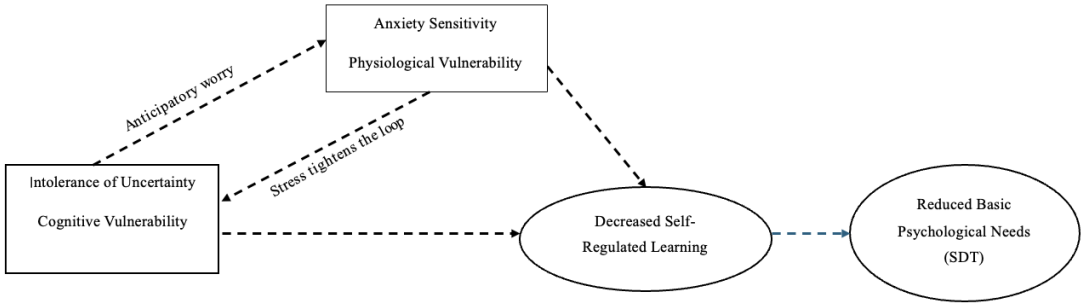

Figure 1 The Double Educational Vulnerability (DEV) Model

Against this backdrop, it is crucial to understand how IU and AS specifically interact in student populations. Research to date suggests a complex interplay: for instance, IU can trigger a cascade of anxiety through elevated AS, but under chronic stress the reverse might also occur (Partovi Pirooz et al., 2022). Yet, many foundational studies of IU and AS were conducted in general adult or clinical samples, leaving gaps in knowledge about university students' unique experiences (McEvoy & Mahoney, 2012; Shihata et al., 2016). University life entails academic pressures, social challenges, and uncertainty about future careers, all during a pivotal developmental stage. It remains under-explored how IU and AS jointly affect outcomes like academic performance, campus engagement, and help-seeking in this context. Recent student studies have linked IU to education-relevant strain (e.g., academic burnout), but the evidence remains dispersed across different outcomes and analytic approaches, making it difficult to compare effect sizes, directionality, and mechanisms across studies (Qiang et al., 2024). At the same time, recent meta-analytic syntheses show that belonging and help-seeking are central to student outcomes, yet these education-relevant domains are rarely integrated into a single synthesis focused on IU–AS interplay (van Kessel et al., 2025; Zhao et al., 2025). Therefore, a focused systematic review is needed to consolidate the last decade of findings and clarify whether the IU–AS link shows consistent patterns across student outcomes and contexts. Clarifying this could inform targeted strategies – for example, campus workshops on coping with uncertainty or managing panic symptoms – to support student well-being. This synthesis is timely given the growing recent literature on student uncertainty-related vulnerability and the persistent gap between mental health needs and service use in higher education (Qiang et al., 2024; Zhao et al., 2025).

This systematic review aims to synthesize empirical findings from 2014 to 2024 on the relationship between intolerance of uncertainty and anxiety sensitivity among students in higher education. By consolidating a fragmented evidence base, the review aims to clarify whether IU and AS show stable associations in student samples and how this nexus maps onto education-relevant outcomes such as engagement, belonging, and help-seeking (van Kessel et al., 2025; Zhao et al., 2025). The goals are: (1) to characterize the association between IU and AS in student and young adult samples (e.g., strength of correlation, whether one tends to influence the other, and documented mediation or moderation effects); (2) to examine how this IU–AS interplay relates to key student outcomes such as anxiety levels, mental health symptoms (e.g. health anxiety, depression), academic stress, help-seeking behavior, and social functioning (including academic engagement/functioning and sense of belonging); and (3) to draw out practical implications for educational settings, including early identification of at-risk students and interventions to foster resilience and inclusive participation. By consolidating a decade of research, we seek to identify consistent patterns and knowledge

gaps, advancing theoretical understanding of the IU–AS nexus in students while offering guidance for campus mental health practices and policies that promote inclusion.

Methods

We conducted this review in accordance with the PRISMA 2020 guidelines (Page et al., 2021) and a pre-registered protocol (PROSPERO ID: CRD420251036590). To ensure a comprehensive literature scope, we systematically searched multiple databases spanning psychology, education, medicine, and allied health. Specifically, seven electronic databases were searched: Scopus, Web of Science, PsycINFO, PubMed/MEDLINE, Embase, ERIC, and CINAHL. In addition, we performed targeted hand-searches of major publisher platforms (e.g. ScienceDirect, SpringerLink, Taylor & Francis Online, SAGE Journals) for any in-press or early-access articles from relevant education and psychology journals. The search covered publications from January 2014 up to December 2024. We used Boolean combinations of keywords related to “intolerance of uncertainty” (including alternative terms like uncertainty intolerance or IUS, referring to the Intolerance of Uncertainty Scale) and “anxiety sensitivity” (including ASI or phrases like fear of anxiety). These were paired with filters for English language and the publication year range. Table 1 outlines the core search strategies and results in each database.

Table 1
Databases, time window (2014–2024) and core search strings for IU and AS in higher-education samples

Database	Search Strategy	Number of Results
Web of Science	TS=("intolerance of uncertainty" OR "uncertainty intolerance") AND TS=("anxiety sensitivity") AND PY=(2014-2024) AND LA=(English)	125
ScienceDirect	Title, abstract or author-specified keywords: ("intolerance of uncertainty" OR "uncertainty intolerance") AND ("anxiety sensitivity") Year：2014-2024	40
Scopus	TITLE-ABS-KEY("intolerance of uncertainty" OR "uncertainty intolerance") AND TITLE-ABS-KEY("anxiety sensitivity") AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO(LANGUAGE, "English"))	116
Springer link	("intolerance of uncertainty" OR "uncertainty intolerance") AND ("anxiety sensitivity")' within English and 2014-2024	235
PubMed	("Intolerance of Uncertainty"[MeSH Terms] OR "intolerance of uncertainty" OR "uncertainty intolerance") AND ("Anxiety Sensitivity"[MeSH Terms] OR "anxiety sensitivity") AND ("2014/01/01"[Date - Publication] : "2024/12/31"[Date - Publication]) AND (english[Language])	90

Database	Search Strategy	Number of Results
Taylor & Francis Online	("intolerance of uncertainty" OR "uncertainty intolerance") AND ("anxiety sensitivity") AND [2014 TO 2024] AND language: English	21
SAGE Journals	("intolerance of uncertainty" OR "uncertainty intolerance") AND ("anxiety sensitivity") AND publication_date:[2014 TO 2024] AND language: English	37
Total		664

The initial search across databases yielded a total of 664 records. After removing 161 duplicates, 503 unique articles remained for screening. Titles and abstracts of these were screened against predetermined inclusion criteria. To be eligible, studies had to: (1) use a **quantitative empirical** design (including cross-sectional, longitudinal, or experimental studies) and appear in a peer-reviewed journal; (2) explicitly measure both intolerance of uncertainty and anxiety sensitivity (typically via validated scales such as the IUS-12 for IU and the ASI-3 for AS) and examine the relationship between them; (3) involve **student, adolescent, or young adult samples**, or samples closely relevant to educational settings; and (4) report outcomes related to mental health, psychosocial functioning, or behavior (especially those relevant to anxiety or participation). We excluded articles that were not peer-reviewed (e.g. dissertations, conference abstracts), not in English, or did not provide empirical data on the IU–AS relationship (for instance, studies measuring IU or AS in isolation without analyzing their association). Reviews or theoretical papers were excluded unless they contained original data relevant to IU and AS. **Table 2** summarizes the key inclusion and exclusion criteria applied. Two independent reviewers conducted the screening process; any disagreements were resolved through discussion, with a third reviewer consulted when necessary.

Table 2
Operational eligibility criteria and data-charting fields

Criterion	Inclusion Criteria	Exclusion Criteria	Note
Time Range	Publications from 2014 to 2024	Publications outside this time frame	The time frame was set to capture contemporary research on IU and AS in relation to student and youth mental health.
Language	English-language publications	Non-English publications	English was selected to ensure consistency and accessibility of empirical evidence.
Article Type	Peer-reviewed empirical studies (quantitative or mixed-methods)	Non-research items (editorials, letters, commentaries, news, conference abstracts); books or	The review focuses on studies providing analysable data or

Criterion	Inclusion Criteria	Exclusion Criteria	Note
	Systematic reviews or meta-analyses that report empirical findings on IU and AS	book chapters without primary data	robust empirical synthesis.
Content Relevance	Studies that examine the relationship between intolerance of uncertainty (IU) and anxiety sensitivity (AS), or analyse both constructs within the same model; Studies that discuss mechanisms, interactions, or joint impacts of IU and AS on mental health, functioning, or adjustment	Studies focusing exclusively on IU or exclusively on AS without considering the other construct; Studies unrelated to the IU–AS relationship (e.g. purely biological markers, unrelated medical outcomes)	Priority is given to robust quantitative evidence; qualitative components may be used for contextual insight only.
Study Design	Quantitative designs (e.g. cross-sectional surveys, longitudinal studies, experimental designs); Mixed-methods studies with a clearly reported quantitative component on IU and AS	Studies with incomplete, unclear or unverifiable data; Purely qualitative studies without quantitative analysis of IU and AS	Priority is given to robust quantitative evidence; qualitative components may be used for contextual insight only.
Target Population	SStudies conducted with students in secondary, college or university settings, or youth and young adults in educational, training or closely related transition contexts; Studies with closely related non-student samples are included only if the findings are directly interpretable for student mental health and social inclusion	Studies focusing exclusively on populations with severe physical illnesses unrelated to education (e.g. Alzheimer's disease, advanced cardiovascular disease); Non-human/animal studies; Samples where implications for student/youth inclusion cannot reasonably be inferred	The focus is on student and youth populations and contexts relevant to educational participation, adjustment and inclusion.
Journal Quality	Articles published in peer-reviewed journals indexed in recognised databases (e.g. Scopus, Web of Science)	Non-peer-reviewed sources; non-indexed outlets; technical reports without peer review	Emphasis is placed on credible, peer-reviewed evidence in psychology, psychiatry and behavioural sciences.

After title/abstract screening, we retrieved and examined the full texts of remaining candidates to confirm eligibility. Ultimately, **11 studies** met all criteria and were included in the systematic review. Figure 2 presents the PRISMA flow diagram detailing the study identification, screening, eligibility, and inclusion process. We extracted key data from each included study, including author/year, location, sample characteristics (sample size, age, population type), study design, measures of IU and AS (instruments and their versions), and main findings on the IU–AS relationship (e.g., correlation coefficients, regression results, mediation/moderation effects). Data extraction was performed independently by two reviewers to minimize errors, with any discrepancies resolved by consensus. We also appraised the general quality and potential risk of bias of the studies, focusing on common

considerations for observational designs (e.g., clarity of measures, control of confounding variables, completeness of reporting). Notably, since most included studies were cross-sectional surveys and nearly all reported significant associations between IU and AS, we remained cautious about possible publication bias (i.e. the tendency for null results not to be published). No formal meta-analysis was conducted due to the heterogeneity of study designs and outcomes; instead, we provide a narrative synthesis supported by summary tables. The findings are organized to first describe publication trends and study characteristics, then to synthesize the evidence on how IU and AS relate (including directionality and mechanisms), and finally to interpret these results in light of student mental health and inclusive educational practice.

At the end of the review process, 11 studies were included for analysis (see Figure 2). **Figure 2** illustrates how we arrived at this final set, from the initial pool of 664 records through screening and eligibility checks.

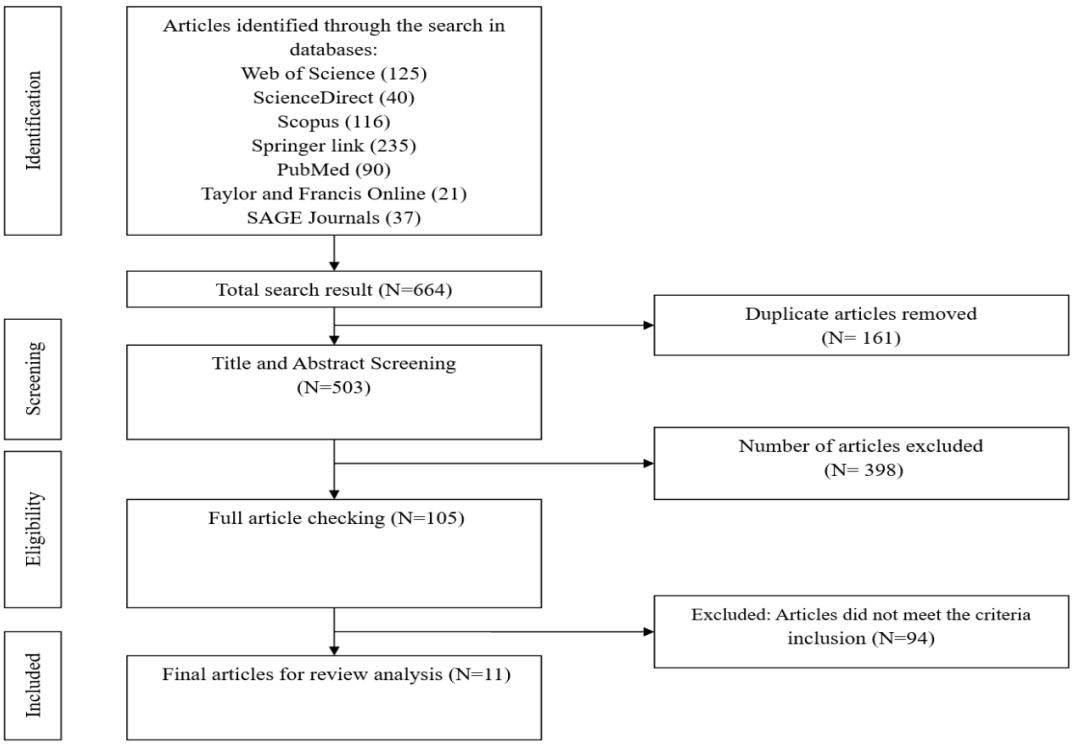

Figure 2 PRISMA 2020 flow diagram for identification, screening, eligibility and inclusion

Results

Publication Trends and Study Characteristics: The 11 included studies were published between 2014 and 2024. Research activity on the IU–AS link was relatively sparse prior to 2019, but then increased markedly during the COVID-19 pandemic period. Several studies were published in 2020–2022, coinciding with heightened interest in uncertainty and anxiety under pandemic conditions. Annual publication counts peaked around 2022 and slightly leveled off thereafter. Figure 3 displays the yearly publication trend, illustrating the surge in IU–AS studies during the pandemic. Geographically, the evidence base is dominated by North America: the United States contributed the most studies (six of the 11), followed by Canada (two studies). The remaining research came from Italy, Türkiye, and Colombia. Figure 4 maps the regional distribution of the reviewed studies. In terms of target populations, most studies focused on university students or non-clinical adults in community settings, reflecting an

emphasis on young adult samples. Eight of the 11 studies used college student or general young adult participants. Only one study specifically examined adolescents (high school-aged youth), and one explicitly targeted a clinical population (adults with a diagnosed anxiety-related condition, namely alcohol use disorder). This skew toward college-aged, non-clinical samples suggests that current findings are most directly applicable to typical student populations; we revisit the implications of this sample profile in the Discussion. Figure 5 summarizes the distribution of target participant groups across the studies.

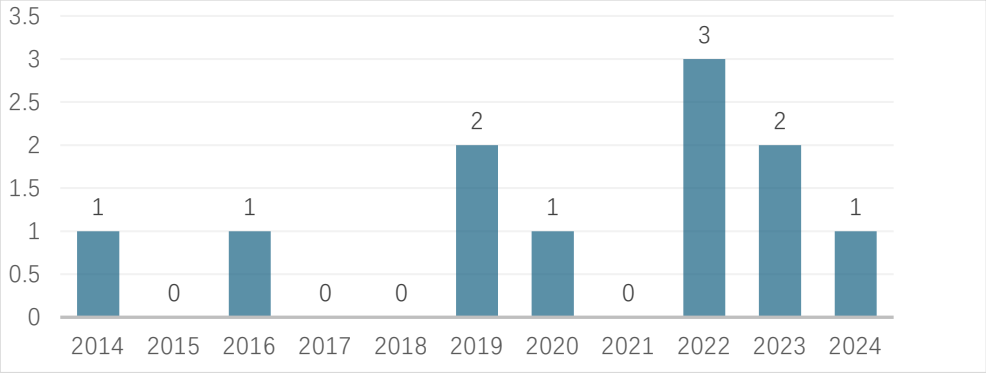

Figure 3 Annual Publication Trends

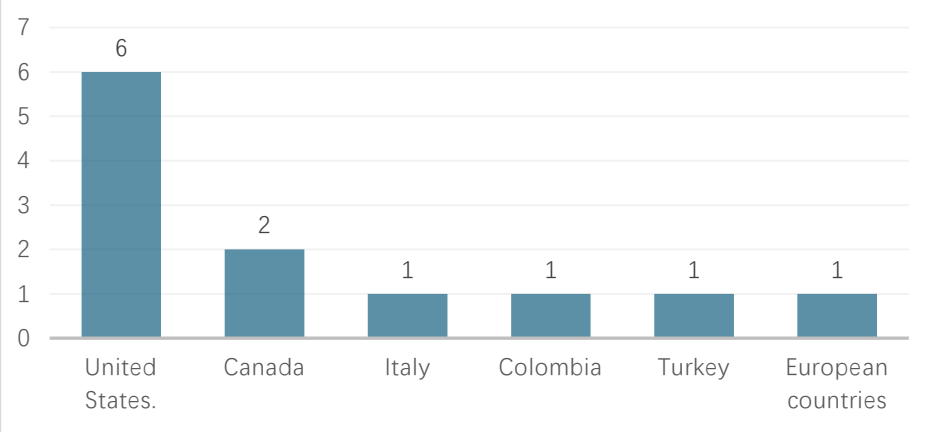

Figure 4 Regional Distribution of Studies

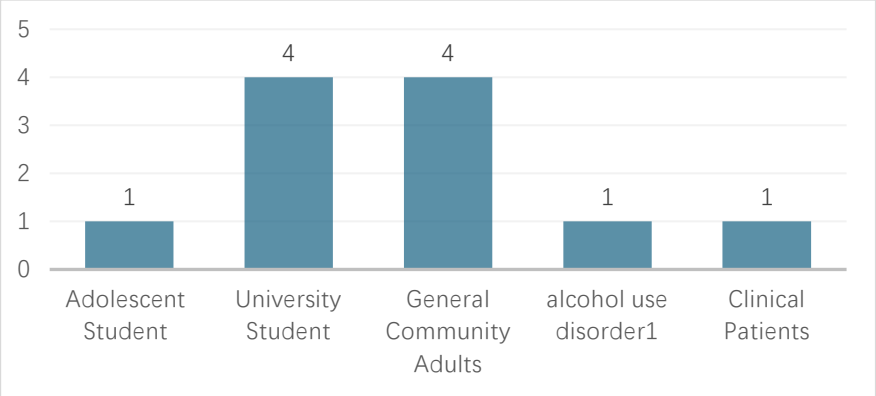

Figure 5 Target Population Distribution

All of the included studies employed quantitative methodologies, and a majority were cross-sectional surveys that assessed IU and AS at a single time point. Notably, two studies deviated

from this norm: one was an experimental study and one was longitudinal. In the experiment (Norr et al., 2014), undergraduate participants were exposed to a health-related uncertainty stressor (browsing potentially alarming medical information) to test if IU levels would moderate changes in AS following the task. In the longitudinal study (Bredemeier et al., 2023), participants (adults including students) were assessed twice, about six months apart, allowing the researchers to examine temporal directionality between IU and AS. The absence of any randomized intervention studies suggests that research on IU and AS in student samples remains in an exploratory phase, primarily mapping out relationships rather than testing ways to change these traits. In terms of measurement instruments, there was considerable consistency across studies.

Most used the validated self-report scales: versions of the Intolerance of Uncertainty Scale (IUS), either the full 27-item form or the brief 12-item IUS-12, to measure IU; and the Anxiety Sensitivity Index (ASI), usually the 18-item ASI-3 (or in older studies the 16-item ASI) for measuring AS. This commonality in measurement enhances the comparability of findings. Some studies also examined sub-dimensions: for example, several distinguished between Prospective IU (worrying about future uncertainties) and Inhibitory IU (being paralyzed by uncertainty) using IUS subscales (e.g., Wright et al., 2016; O'Bryan et al., 2022). Likewise, AS was sometimes broken into its facets – Physical, Cognitive, and Social concerns – as measured by the ASI-3 subscales. One study (de Lafontaine et al., 2023) specifically tested which facets of AS were most implicated in the IU–anxiety link, finding that Cognitive AS (fear of "going crazy" or losing cognitive control) and Social AS (fear of observable anxiety symptoms) mediated the effect of IU on anxiety outcomes, whereas Physical AS (fear of physical anxiety sensations like a rapid heartbeat) did not. Overall, the use of consistent instruments and the attention to subcomponents suggest that differences in results across studies are more likely due to true contextual or sample differences rather than inconsistent definitions of IU or AS. Table 3 provides an overview of the designs and instruments of the included studies.

Table 3
Overview of Research Methods and Measurement Instruments in Selected Studies

Study Design	Year	Author(s)	Measurement Instruments
Cross-sectional Experiment	2014	Norr et al.	ASI (16 items); IUS (27 items)
Explanatory Cross-sectional	2020	Toro Tobar et al.	ASI-3 (18 items); IUS (27 items)
Cross-sectional Study	2016	Wright et al.	IUS-R (12 items); CASI (18 items)
	2019	Horenstein et al.	ASI-3 (18 items); IUS-12 (12 items)
	2019	Lauriola et al.	ASI-3 (18 items); IUS-12 (12 items)
	2022	Çelik et al.	ASI-3 (18 items); IUS-12 (12 items)
	2022	O'Bryan et al.	ASI-3 (18 items); IUS-12 (12 items)
	2022	Saulnier et al.	ASI-3 (18 items); IUS-12 (12 items)

Study Design	Year	Author(s)	Measurement Instruments
	2023	Bredemeier et al.	ASI-3 (18 items); IUS-12 (12 items)
	2023	de Lafontaine et al.	ASI-3 (18 items); IUS (27 items)
	2024	Byrne et al.	ASI-3 (18 items); IUS-12 (12 items)

Across all studies, there was a clear positive association between intolerance of uncertainty and anxiety sensitivity. Every study reported a **significant correlation** between IU and AS, typically of moderate to high magnitude. In simple terms, individuals – especially students – who struggled more with uncertainty also tended to be more fearful of anxiety symptoms. For example, Lauriola et al. (2019) found a robust correlation (around $r = 0.5$) between IU and AS in a sample of 300 Italian undergraduates. Notably, this relationship remained significant even after controlling for overall anxiety and depressive symptoms, suggesting that IU and AS share a unique linkage independent of general distress. Another study by Gu et al. (2020) in a community adult sample demonstrated that IU partly mediated the effect of uncertainty on anxiety – in other words, people who found uncertainty intolerable experienced higher anxiety partly *because* they had high AS to amplify their worry (an example of IU → AS → anxiety). These convergent findings reinforce the idea that IU and AS are closely related constructs, each tapping into a general vulnerability to anxiety: IU reflects fear of the unknown, and AS reflects fear of the feelings of anxiety. A person high in both is likely to experience compounding anxiety. Importantly, no study in this review found a negative or null relationship between IU and AS; the link was consistently positive, although the strength did vary somewhat by sample and context.

Beyond correlation, researchers probed the directionality and mechanisms linking IU and AS. One recurring theme is IU serving as a moderator of AS effects. Intolerance of uncertainty can magnify the impact that anxiety sensitivity has on outcomes. For instance, in Norr et al.'s (2014) experiment, students with high IU showed a pronounced increase in AS after the uncertainty stressor, whereas those with low IU showed little change. This implies that when a student is already very intolerant of uncertainty, encountering an ambiguous threat "turns up the volume" on their anxiety sensitivity – they become much more reactive to anxious feelings under uncertainty. Similarly, Saulnier et al. (2022) found that IU and AS interacted to predict COVID-19-related behaviors and worries. In their adult sample, individuals with both high IU and high AS engaged in the most excessive safety behaviors (such as hoarding supplies and over-cleaning) and had elevated pandemic-related worry. Interestingly, Saulnier et al. noted this interaction was significant in one of their samples (a general adult group) but not as strong in a student subsample, hinting that factors like age or life situation might modulate the strength of IU's moderating role. Taken together, these findings suggest that intolerance of uncertainty often acts as a risk enhancer, making the effects of anxiety sensitivity on stress and coping more severe. A student high in AS might not always exhibit serious anxiety-driven behaviors – unless they also have high IU, which "unlocks" the full impact of AS on their behavior (for example, repeatedly seeking reassurance for minor health concerns, or avoiding any situation with unpredictable elements).

Conversely, many studies showed AS functioning as a mediator of IU effects. In these cases, anxiety sensitivity explains how or why intolerance of uncertainty leads to certain negative outcomes. Wright et al. (2016) provided an early example in an adolescent sample: higher IU predicted greater health anxiety in teenagers, and a significant portion of this effect was statistically explained by their levels of AS. In practical terms, teens who could not tolerate uncertainty about their health tended to worry more about health issues because they also greatly feared anxiety sensations (e.g., a fast heartbeat), which amplified their health-related fears. Both facets of IU – prospective and inhibitory – contributed to health anxiety directly and indirectly via AS in that study. Another example comes from Çelik et al. (2022): in a sample of 302 adults during the pandemic, AS fully mediated the relationship between IU and fear of COVID-19. Those with high intolerance of uncertainty about the pandemic tended to experience much greater fear of COVID, largely because they had high anxiety sensitivity (for instance, if they felt their heart race when reading COVID news, their high AS would lead them to catastrophize that sensation, thereby increasing their fear). In a clinical context, O'Bryan et al. (2022) found among adults with anxiety disorders that IU's effect on general anxiety symptoms was indirect through AS – specifically, prospective IU (excessive future-oriented worry) led to higher AS, which in turn was associated with heightened anxiety symptoms. The inhibitory IU component (being frozen by uncertainty) did not show a mediation via AS in that study, suggesting that the active worry aspect of IU is what feeds into anxiety sensitivity and subsequent symptoms. Even in non-clinical student samples, hints of AS's mediating role appear; for example, Lauriola et al. (2019) observed that IU's link with emotional distress (anxiety/depression symptoms) was stronger when AS was high, consistent with AS serving as the conduit that translates uncertainty intolerance into actual emotional symptoms. In summary, these findings paint AS as a bridge: intolerance of uncertainty contributes to anxiety and related problems in part by elevating the fear of anxiety sensations, which then exacerbates overall anxiety. From an intervention standpoint, this implies that reducing a student's AS (through education or exposure to benign anxiety symptoms) could buffer the negative impact of high IU on their mental health. Indeed, prior work suggests AS is malleable through brief interventions (Fitzgerald et al., 2021), raising the possibility that lowering AS might protect high-IU individuals from spiralling into anxiety.

A third insight from the results is the potential for bidirectional influence and the importance of context. While the majority of studies support a model where IU increases or intensifies AS (and together they worsen outcomes), there is some evidence that high AS can, at least under certain conditions, contribute to higher IU over time. Toro Tobar et al. (2020) used structural equation modeling in a Colombian sample and found an unexpected direction: they reported that AS predicted subsequent IU. In their model, people with higher anxiety sensitivity later reported greater intolerance of uncertainty – essentially, frequent intense "fear of anxiety" experiences might erode one's tolerance for uncertainty. One way to interpret this is that if someone is repeatedly distressed by the sensations of anxiety, they might come to fear not just the sensations but also any unpredictable situations that could trigger those sensations, thereby becoming more uncertainty-intolerant. However, it's important to note that Toro Tobar et al.'s study was cross-sectional (assessing correlations at one time point) and not primarily designed to establish causality between IU and AS, so this finding, while intriguing, is correlational. In contrast, Bredemeier et al. (2023) provided a more robust test of directionality with their longitudinal design. Over a six-month period during the pandemic, they found that baseline IU predicted increases in AS at follow-up, whereas

baseline AS did not predict changes in IU. This suggests that, at least in that context, intolerance of uncertainty was a one-way driver: it led to heightened anxiety sensitivity over time, rather than the other way around. Bredemeier et al. interpreted this in light of the pandemic's pervasive uncertainty – an environment of chronic uncertainty may elevate IU, which then makes people more sensitized to anxious feelings; simply being high in AS from the start didn't end up making someone more intolerant of uncertainty later on. They also found that IU accounted for the shared variance between AS and health anxiety, underscoring IU's central role in the mix. Reconciling Toro Tobar and Bredemeier's findings, it seems context is key. The former was pre-pandemic and in a different cultural setting (Latin America), whereas the latter was mid-pandemic in the U.S.; differences in culture or the ambient level of uncertainty might explain the differing directions. Overall, the evidence from this decade of studies leans toward a model where IU is the antecedent and amplifier of AS, yet we cannot rule out that under certain high-stress conditions or in certain groups, high AS could in turn fuel greater IU. This implies a self-reinforcing cycle may exist: being intolerant of uncertainty can heighten one's sensitivity to anxiety, and (to a lesser extent) being highly sensitive to anxiety might further reduce one's tolerance for uncertainty. Recognizing this cyclical possibility is important for theory and suggests that breaking either link (through intervention on IU or AS) could potentially weaken the other.

To illustrate how IU and AS together affect student experiences, consider a finding by Horenstein et al. (2019). In a survey of 566 U.S. college students, those with both high IU and high AS reported the highest levels of health anxiety and were most prone to excessive medical service use (e.g. frequent doctor visits for benign symptoms). They observed an interaction such that AS was associated with more health-related doctor visits primarily when IU was also high. In simpler terms, a student who is very sensitive to bodily sensations and cannot tolerate uncertainty about health is likely to seek medical reassurance even for minor issues. In contrast, a student who greatly fears physical anxiety sensations (high AS) but is relatively comfortable with uncertainty (low IU) might worry internally yet not visit the doctor as often, since they can live with the ambiguity of those symptoms. This example shows how IU and AS together create a "perfect storm" for anxiety-driven behaviors in students. Another example is from Byrne et al. (2024), who studied university students with alcohol use disorder (AUD) compared to healthy controls. They found that IU and AS were positively correlated in the AUD group (the clinical, high-stress group) but not correlated in the healthy student group. In other words, among students under chronic stress (managing an addiction), those who were more uncertainty-intolerant also had higher anxiety sensitivity, whereas in low-stress typical students this coupling did not appear. This suggests that extreme stress or psychopathology can tighten the IU–AS link. These student-focused findings reinforce our central theme: IU and AS together heighten risk, leading to outcomes like excessive worry, avoidance, help-seeking delays, and even poorer sleep or academic performance as indicated in some studies (Lauriola et al., 2019; Qiang et al., 2024). And in certain high-risk student subgroups (those with concurrent disorders or high life stress), the interplay of IU and AS becomes even more pronounced.

Finally, to provide a concise view of the reviewed evidence, Table 4 presents a summary of key findings from each included study, including the nature of the IU–AS relationship and any notable outcomes (e.g., sleep disturbances, academic issues) examined.

Table 4
Summary of Key Findings on IU–AS Relationships Across Reviewed Studies

No.	Author	Publication Year	Country	Finding
1	Norr et al.	2014	United States	-IU moderates the impact of browsing medical information on AS. -For individuals with high IU, browsing medical websites increases AS levels, while it has no effect on low-IU individuals, suggesting IU heightens sensitivity to anxiety-related feelings from medical information.
2	Wright et al.	2016	Canada	AS mediates the relationship between IU and health anxiety. Both IU dimensions (prospective and inhibitory) directly and indirectly (via AS) influence health anxiety, showing IU's role in increasing AS, which then impacts health anxiety.
3	Horenstein et al.	2019	United States	IU and AS are significantly related to health anxiety. High levels of IU and AS strengthen the relationship between health anxiety and healthcare utilization.
4	Lauriola et al.	2019	Italy	IU and AS are positively correlated but not overlapping concepts. IU influences insomnia severity more strongly through anxiety pathways.
5	Toro Tobar et al.	2020	Colombia	AS predicts IU, with higher AS associated with lower IU. AS and IU are closely linked but retain unique mechanisms, both relating to anxiety and depression symptoms.
6	Çelik et al.	2022	Türkiye	IU correlates positively with COVID-19 fear, and AS mediates this relationship. High AS enhances IU's predictive impact on COVID-19 fear.
7	O'Bryan et al.	2022	United States	In anxiety-related disorders, IU indirectly impacts anxiety symptoms via AS. Prospective IU shows significant indirect effects with AS dimensions, while inhibitory IU does not.
8	Saulnier et al.	2022	United States	IU and AS are independent but related risk factors linked to anxiety and behaviors during the COVID-19 pandemic. Their interaction influences pandemic-related behaviors such as hoarding, cleaning, and catastrophic thinking.
9	Bredemeier et al.	2023	European Countries And United States	Initial After six months, IU predicts levels of AS and health anxiety, but AS and health anxiety do not predict changes in IU.

No.	Author	Publication Year	Country	Finding
10	de Lafontaine et al.	2023	Canada	IU and negative emotion tolerance influence anxiety via AS. Cognitive and social AS dimensions mediate these relationships, while the physical AS dimension does not. Cognitive concerns and social worries about anxiety symptoms play significant roles.
11	Byrne et al.	2024	United States	In patients with AUD, the higher the level of Anxiety Sensitivity, the higher the Intolerance of Uncertainty In the healthy control group, this relationship did not exist

Discussion

Summary of Key Findings: Over the past decade, research on university students and young adults has converged on the conclusion that intolerance of uncertainty and anxiety sensitivity are tightly intertwined. All 11 studies in this review found a positive link between IU and AS, indicating that students who struggle with uncertainty tend to also fear the symptoms of anxiety. Beyond mere correlation, the evidence suggests a dynamic interplay: IU often acts as an antecedent and amplifier of AS, meaning that high IU leads to increases in AS or makes individuals more reactive to stressors (as shown in longitudinal and experimental findings by Bredemeier et al., 2023; Norr et al., 2014). At the same time, AS frequently serves as a mediator through which IU exerts its effects on anxiety outcomes – students high in IU experience more anxiety partly because they intensely fear anxious sensations (Wright et al., 2016; Çelik et al., 2022). Under certain high-stress conditions, the relationship may become reciprocal: for example, among clinical students with substance use issues, AS and IU rose and fell together (Byrne et al., 2024), implying a feedback loop. In sum, IU and AS form a potent combination that elevates students' risk for anxiety problems. Together they are associated with heightened health anxiety and healthcare use (Horenstein et al., 2019), greater avoidance of challenging academic or social situations, sleep disturbances (Lauriola et al., 2019), and even indicators of academic burnout (Qiang et al., 2024). While an outlier study (Toro Tobar et al., 2020) found AS could predict IU, the preponderance of evidence suggests IU more commonly precedes or intensifies AS, and any reverse effect likely depends on context (e.g., extreme stress or different cultural settings).

Comparison with Theory and Prior Research: These findings align with fundamental theories of anxiety and extend them in the educational context. Decades ago, Reiss et al. (1986) introduced anxiety sensitivity as the "fear of fear," and more recently Carleton (2016) posited that fear of the unknown (IU) is a central driver of anxiety disorders. Our review supports these foundational ideas by demonstrating empirically that fear of the unknown and fear of anxiety sensations jointly contribute to students' anxiety. In fact, the results resonate strongly with Barlow's (2002) triple-vulnerability theory, which proposes that a general psychological vulnerability (like low tolerance for uncertainty) combined with a specific vulnerability (like sensitivity to anxious arousal) can produce elevated anxiety. The robust correlations we observed (often $r \approx .5$) also echo transdiagnostic frameworks of emotional disorders (e.g., McEvoy & Mahoney, 2012; Shihata et al., 2016), wherein IU and AS are seen

as broad risk factors across various anxiety-related conditions. By confirming that IU and AS are each significant—and mutually reinforcing—components of anxiety vulnerability, our findings bolster the case for including both in comprehensive models of anxiety.

At the same time, this review adds nuance by highlighting possible bidirectional influences and contextual moderators. The fact that one study found AS → IU and that some effects (like the IU×AS interaction) differed between student and non-student samples suggests we should not oversimplify the relationship as one-directional in all cases. Factors such as age, culture, and stress exposure can modulate the IU–AS dynamic. For instance, our review noted that in a student sample during COVID-19, the IU×AS synergy was weaker (Saulnier et al., 2022) – perhaps younger individuals or those in structured environments had different coping resources. Additionally, the stronger IU–AS coupling in high-stress subgroups (e.g., students with AUD; Byrne et al., 2024) indicates that life stress or clinical conditions can intensify these vulnerabilities. These nuances underscore a vulnerability-stress framework: IU and AS can be seen as latent vulnerabilities that, when activated by external stressors (academic pressure, global crises), lead to especially poor outcomes. Two students under the same stress might fare differently – those high in IU/AS spiral into anxiety more easily, as our findings illustrate.

Importantly, our results bridge clinical psychology and educational research by linking IU and AS with outcomes relevant to student life. Emotional factors like fear of uncertainty and fear of anxiety symptoms emerge as contributors to academic functioning. This dovetails with educational theories that acknowledge the role of affect in learning. For example, in self-determination theory, excessive uncertainty can undermine a student's sense of competence or control (Ryan & Deci, 2000). In self-regulated learning models, unmanaged anxiety consumes cognitive resources needed for academic tasks (Pintrich & De Groot, 1990; Zimmerman, 2002). Our review's insights suggest that if a student is chronically worried about the unknown and hyper-aware of their anxiety, they may struggle to concentrate, participate, and perform academically. Thus, beyond the clinical realm, addressing IU and AS could become integral to theories of student resilience and academic success. It reinforces the notion that supporting students' emotional regulation (specifically their tolerance for uncertainty and reactions to anxiety) is key to helping them thrive in higher education.

Implications for Higher Education Practice: From a practical standpoint, identifying IU and AS as dual risk factors points to valuable opportunities for intervention. The encouraging message is that both IU and AS are modifiable traits. A growing body of evidence shows that targeted interventions can reduce AS, and preliminary work suggests IU can be improved as well. For instance, a meta-analysis by Fitzgerald et al. (2021) found that even brief (single-digit session) interventions can produce moderate-to-large reductions in anxiety sensitivity that persist at least in the short term. Similarly, emerging therapies specifically address IU through systematic exposure to uncertainty and cognitive techniques to challenge "what if?" thoughts (Knowles & Olatunji, 2023). Some recent studies on student samples explicitly recommend targeting IU to alleviate not only anxiety but also related issues like depression and eating disorder symptoms (Charbonnier et al., 2023). Our review strongly supports such recommendations. Below, we outline several practical strategies that universities and colleges can implement to mitigate IU and AS among students, thereby improving mental health and fostering a more inclusive, supportive campus environment:

- Psychoeducation and Awareness Programs: Universities should offer workshops or seminars that educate students about uncertainty and anxiety. These programs can normalize the experience of uncertainty and anxious feelings, reducing stigma and misconceptions. For example, sessions might explain common cognitive distortions of high-IU individuals (like overestimating the likelihood of worst-case outcomes) and highlight the benign nature of most anxiety symptoms (so that a racing heart or shortness of breath is not seen as catastrophic). Emphasizing that "it's okay to feel unsure or anxious" can encourage at-risk students to seek help sooner rather than later. Psychoeducational materials can also include testimonials or peer discussions to show students they are not alone in these feelings.
- Targeted Cognitive-Behavioral Interventions: Campus counseling centers are advised to integrate brief, evidence-based interventions that address IU and AS simultaneously. Cognitive-behavioral therapy (CBT) techniques have proven effective: for example, interoceptive exposure exercises can help students with high AS learn that bodily anxiety sensations (like dizziness or a pounding heart) are tolerable and not dangerous, thereby reducing the "fear of fear." Likewise, uncertainty tolerance training (gradually confronting uncertain situations or deliberately delaying immediate answers) can build resilience to ambiguity. These might be delivered in group formats – akin to test-anxiety workshops – focusing specifically on coping with uncertainty in academic life and managing panic-like symptoms. Even short interventions (e.g. 4–8 sessions) during a semester could yield improvements in IU and AS that help students feel more in control.
- Embedding Resilience in the Curriculum: Academic affairs and faculty can also play a role by incorporating resilience and uncertainty-management skills into the curriculum. For instance, first-year seminars or orientation courses could include modules on flexible thinking, stress management, and adapting to unexpected challenges. Professors might introduce manageable uncertainty in class assignments – such as open-ended problems or ambiguously defined projects – paired with guided reflection to help students learn from the discomfort. By practicing in a low-stakes setting and discussing coping strategies, students can improve their tolerance for uncertainty. This approach aligns with findings that resilience training enhances students' capacity to handle academic unpredictability (Zhuo et al., 2021).
- Early Screening and Support: Colleges should consider routine screening for IU and AS, especially at intake or during wellness checks. Brief questionnaires (like the IUS-12 and ASI-3) could be included in mental health screenings or student orientation surveys to flag individuals with elevated IU/AS. Those identified can be proactively offered resources – for example, a specialized group or workshop on "uncertainty and anxiety skills." Additionally, training student services staff (advisors, resident assistants, etc.) to recognize signs of IU/AS (such as extreme worry over ambiguous situations or disproportionate reactions to mild stressors) can lead to timely referrals. Early identification and intervention might prevent more severe anxiety or academic crises down the line.

These multi-level initiatives – from psychoeducational outreach and counseling interventions to curricular changes and screening protocols – collectively form a comprehensive strategy. By simultaneously tackling the cognitive (IU) and interoceptive (AS) aspects of anxiety, universities can better support students who might otherwise quietly struggle. The ultimate goal is to create an academic environment where uncertainty is not

seen as an insurmountable threat and where the physical sensations of anxiety are understood as manageable, normal experiences. In such an environment, students are more likely to engage, seek help when needed, and persist through challenges, thereby enhancing both mental well-being and academic performance.

Limitations: Despite adhering to rigorous review methods, this study has several limitations. First, the reliance on mostly cross-sectional research limits our ability to draw causal conclusions. Only one longitudinal and one experimental study were available, so in most cases we cannot definitively say whether IU causes changes in AS or vice versa – we must infer directionality cautiously. Second, the focus on university student and young adult samples, while intentional, means the findings may not generalize to older adults or clinical populations. IU–AS dynamics might differ in middle-aged or older individuals, or in those with severe psychiatric disorders, and our review does not capture those groups. Third, the geographical concentration on North America (and to a lesser extent Europe) raises questions about cross-cultural applicability. Cultural attitudes toward uncertainty and emotional expression vary; for example, how an East Asian student versus a Western student perceives and reacts to uncertainty could differ (this was not addressed in the studies we reviewed). Thus, more research in diverse cultural contexts is needed. Fourth, a significant portion of the data were collected during the unique period of the COVID-19 pandemic. That period was characterized by exceptionally high and prolonged uncertainty, which may have amplified IU–AS effects. It is unclear if the observed relationships would be as strong under more typical circumstances – future research in post-pandemic settings should verify this. Fifth, nearly all studies relied on self-report questionnaires for IU, AS, and outcomes like anxiety or behavior. Self-reports are subject to response biases and shared method variance, which could inflate associations. Objective measures (behavioral tasks, physiological recordings) were rarely used, so incorporating those would strengthen future evidence. Sixth, we must consider potential publication bias: it's possible that studies which found no link between IU and AS were less likely to be published, skewing the literature toward positive findings. Although we did not formally test for this, the fact that every included study found a significant result suggests a need for caution – the true average relationship might be smaller if unpublished null studies exist. These limitations highlight the need to interpret our conclusions carefully.

Future Directions: Building on the gaps identified, we recommend several avenues for future research. One priority is more longitudinal studies tracking students over multiple years of university to map how IU and AS co-evolve – for instance, does a student's IU in freshman year predict changes in AS by senior year (or vice versa)? Such data would help clarify developmental trajectories and causal ordering. A second need is for randomized controlled trials (RCTs) that target IU or AS (or both) to directly test causality and intervention efficacy. For example, an RCT could provide an uncertainty tolerance program to one group of students and compare their changes in AS and anxiety to a control group. If reducing IU also lowers AS and anxiety, that would strongly support a causal role. Third, research should expand to more diverse cultural contexts. Cross-cultural comparisons (e.g., comparing IU–AS links in East Asian students vs. Western students) could reveal whether these constructs operate similarly worldwide or if cultural factors moderate their relationship. Relatedly, examining under-studied regions (Africa, South Asia, etc.) would enhance generalizability. Fourth, focusing on high-risk subpopulations is important. Studies specifically examining students with known high stress (e.g., international students far from home, students with

chronic health conditions, or those in high-pressure majors) could shed light on whether IU and AS have amplified effects under those conditions. The Byrne et al. (2024) finding about AUD patients implies that other clinical student groups (like those with generalized anxiety disorder or PTSD) might also show unique IU–AS patterns worth investigating. Fifth, incorporating multi-method assessments and exploring other psychological variables will deepen understanding. For instance, measuring physiological responses (heart rate, cortisol) during uncertainty tasks could validate self-report findings. Investigating mediators and moderators such as emotion regulation strategies, perfectionism, or social support (as suggested by Zhuo et al., 2021 for social support's moderating role) would help explain when and for whom IU and AS are most problematic. Finally, linking IU and AS to concrete academic outcomes should be a focus. Few studies directly measured things like GPA, class attendance, or dropout rates in relation to IU/AS. If future research shows that IU and AS predict lower GPA or higher attrition (controlling for prior achievement), that would strongly argue for institutional interventions. By pursuing these directions, the field can move from establishing that IU and AS are linked to understanding the full context and impact of that link, and most importantly, how to break the cycle to improve student outcomes.

Conclusion

This systematic review confirms that intolerance of uncertainty and anxiety sensitivity have a significant, intertwined influence on university students' mental health. The evidence from 2014–2024 indicates that IU frequently precedes and amplifies AS – students who cannot tolerate uncertainty often develop a heightened "fear of fear," which in turn mediates and magnifies IU's impact on anxiety (Wright et al., 2016; de Lafontaine et al., 2023). These processes manifest in various difficulties: elevated health anxiety and excessive reassurance-seeking (Horenstein et al., 2019), pandemic-related worries and safety behaviors (Saulnier et al., 2022), poor sleep quality (Lauriola et al., 2019), and even academic burnout in those with low resilience (Qiang et al., 2024). In high-stress subgroups (such as students with alcohol dependence), AS can also feed back to increase IU, suggesting a reciprocal loop under extreme conditions (Byrne et al., 2024). Overall, our findings reinforce theoretical frameworks that position "fear of the unknown" as a core element of anxiety (Carleton, 2016) and echo transdiagnostic models seeing IU and AS as universal vulnerability factors (McEvoy & Mahoney, 2012).

From a practical perspective, IU and AS represent actionable targets for fostering a more inclusive and supportive campus climate. Both can be mitigated through interventions: uncertainty-tolerance training and interoceptive exposure have shown efficacy in reducing IU and AS respectively (Fitzgerald et al., 2021; Knowles & Olatunji, 2023). We encourage universities and colleges to incorporate IU/AS-focused modules into student orientation, counseling services, and wellness programs. For example, brief group workshops can teach students skills to handle uncertainty (rather than avoid it) and to reinterpret anxiety sensations as normal and manageable. Additionally, routine screening for IU and AS can help identify at-risk students early – much like how some schools screen for depression – enabling timely preventive support. Importantly, addressing IU and AS is not just a matter of treating individual distress but also one of educational equity and inclusion: students who remain on the sidelines due to these anxieties miss out on learning and social opportunities. By proactively helping students become more comfortable with uncertainty and less fearful of their own anxiety responses, institutions can promote greater engagement, well-being, and

success across the student body. In conclusion, tackling the dual vulnerabilities of IU and AS in tandem offers a promising avenue for higher education to cultivate resilient learners who can thrive amid the inherent uncertainties of university life.

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