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Review Article

Frequent Low-Stakes Formative Testing as a Mechanism to Reduce Academic Anxiety Among Second-Year Medical Students: A Narrative Review

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ABSTRACT

Academic anxiety is highly prevalent among medical students and is particularly pronounced during the second year of undergraduate medical education, when increasing curricular complexity and frequent high-stakes examinations may adversely affect learning, psychological well-being, and academic performance. Frequent low-stakes formative testing has emerged as a promising educational strategy that promotes continuous learning while potentially reducing assessment-related anxiety. This narrative review examines the current evidence regarding the effectiveness of frequent low-stakes formative assessment in alleviating academic anxiety among second-year medical students and explores the psychological and educational mechanisms underlying its benefits. Relevant peer-reviewed literature published between 2005 and 2024 was identified through searches of PubMed, Scopus, Web of Science, and Google Scholar, focusing on formative assessment, retrieval practice, educational psychology, test anxiety, and medical student well-being. The available evidence indicates that regular low-stakes assessments improve knowledge retention while reducing anxiety through multiple complementary mechanisms, including increased familiarity with examination conditions, enhanced retrieval practice, improved metacognitive awareness, strengthened self-efficacy, reduced fear of failure, normalization of assessment, and timely formative feedback. However, the current evidence is limited by methodological heterogeneity, reliance on self-reported anxiety measures, predominantly observational study designs, and limited data specifically involving second-year medical students. Excessive assessment frequency and poor-quality feedback may also diminish the psychological benefits of formative testing. Overall, frequent low-stakes formative assessment represents an evidence-informed approach that can enhance both learning and student well-being when thoughtfully integrated into medical curricula. Future multicenter longitudinal and randomized studies are needed to establish optimal implementation strategies and evaluate sustained effects on academic anxiety, resilience, and educational outcomes.

Key words: Medical students, academic anxiety, low-stakes testing, formative assessment, retrieval practice, well-being

INTRODUCTION

Medical education is widely recognized as one of the most psychologically demanding forms of professional training. Medical students consistently report elevated levels of stress, burnout, depression, and anxiety compared with age-matched peers in other academic disciplines. [1,2] Among the various contributors to psychological distress, academic assessment remains one of the most significant. [3]

The second year of medical school represents a particularly vulnerable period in undergraduate medical education. During this stage, students frequently encounter increasingly complex biomedical sciences, the integration of organ-system learning, cumulative examinations, and early preparation for major licensing or progression examinations. [4] Assessment anxiety may be defined as a combination of cognitive, emotional, and physiological distress arising in anticipation of academic evaluation. [5] When excessive, this anxiety impairs working memory function, reduces concentration, interferes with information retrieval, and negatively influences overall academic performance. [6]

Traditionally, medical education has relied heavily on summative assessment structures in which a limited number of high-stakes examinations determine progression decisions. While summative assessment remains necessary for credentialing, growing evidence suggests that exclusive dependence on high-stakes testing may amplify stress and undermine effective learning. [7] Consequently, frequent low-stakes formative testing has emerged as an alternative strategy designed to shift the paradigm of assessment from episodic judgment toward continuous learning enhancement. These assessments contribute minimally to final grades while providing repeated opportunities for retrieval practice, feedback, and self-assessment. [8] This narrative review explores whether frequent low-stakes testing reduces academic anxiety among second-year medical students and critically evaluates the psychological and educational mechanisms supporting this intervention.

REVIEW METHODOLOGY

A narrative review methodology was adopted to systematically synthesize educational and psychological evidence across heterogeneous study designs, facilitating a comprehensive evaluation of the current landscape. Peer-reviewed articles published between 2005 and 2025 were identified through electronic database searches of PubMed, Scopus, Web of Science, and Google Scholar. The search strategy employed targeted keyword combinations—including "medical student anxiety," "formative assessment medical education," "low-stakes testing anxiety reduction," "retrieval practice educational psychology," "second-year medical students stress," and "assessment and student well-being"—to ensure the retrieval of a broad, representative spectrum of pertinent academic literature.

SECOND-YEAR STUDENT ANXIETY AND ASSESSMENT PARADIGMS

Systematic literature reviews consistently highlight a disproportionate prevalence of anxiety and psychological distress among medical students compared to their non-medical peers. Dyrbye and colleagues reported significantly elevated psychological distress among medical trainees relative to the general population, identifying assessment-related fear as a critical driver. [9] The second year of medical school constitutes a precarious transitional phase characterized by a unique confluence of compounding stressors. This period is marked by an escalation in curricular complexity, frequent cumulative examinations, intense pressure to maintain academic standing, burgeoning anxiety regarding future clinical competence, and a destabilizing decline in self-confidence as students grapple with the integration of foundational and clinical knowledge. [4]

The structural design of traditional medical curricula profoundly shapes these anxiety patterns. Models that rely predominantly on periodic, high-stakes summative assessments—such as mid-term examinations, final comprehensive assessments, and high-consequence progression decisions—inadvertently concentrate performance pressure into isolated, high-risk events. The Yerkes–Dodson law illustrates that, while moderate arousal may facilitate performance, excessive anxiety invariably degrades cognitive processing efficiency. [10] Cognitive psychology research further demonstrates that this elevated anxiety depletes the working memory capacity essential for higher-order reasoning. [11] For second-year medical students, this cognitive burden acts as a systemic barrier, impairing diagnostic reasoning, factual recall, clinical simulation performance, and the long-term consolidation of complex knowledge. [12]

MECHANISMS OF ANXIETY REDUCTION THROUGH LOW-STAKES TESTING

Low-stakes testing appears to reduce anxiety through several interacting psychological and educational mechanisms (**Figure 1**).

Familiarity reduces threat perception: Repeated exposure to testing conditions reduces the uncertainty inherently associated with examinations. The exposure principle from behavioral psychology suggests that repeated, safe exposure reduces anticipatory anxiety responses. [13] Students who regularly complete short, low-stakes quizzes become desensitized to examination-related stressors, effectively lowering the perceived threat of the testing environment.

Retrieval practice strengthens cognitive confidence: The "testing effect" demonstrates that active retrieval improves long-term retention more effectively than passive review. Seminal work by Roediger and Karpicke demonstrated that repeated retrieval significantly improves memory retention. [14] As students experience successful recall, their subjective perception of mastery increases, which directly reduces uncertainty-driven anxiety. [15]

Improved metacognitive calibration: Students frequently exhibit inaccurate self-assessment, commonly overestimating their level of mastery—a phenomenon in cognitive psychology termed the "illusion of competence." Frequent, low-stakes quizzes provide objective, external benchmarks that illuminate specific knowledge gaps. By correcting these miscalibrations, students can engage in more targeted and effective self-regulated learning. [16] This systematic recalibration replaces vague anxiety about potential failure with concrete, actionable study targets, thereby mitigating the catastrophic thinking often triggered by discrepancies between perceived preparation and actual examination performance. [17]

Reduced fear of failure: High-stakes assessments often impose a binary, "all-or-nothing" mindset that elevates student anxiety. By distributing evaluation across frequent, lower-stakes touchpoints, the cumulative risk of any single assessment is significantly diffused. Educational psychologists characterize this as the reduction of "performance pressure

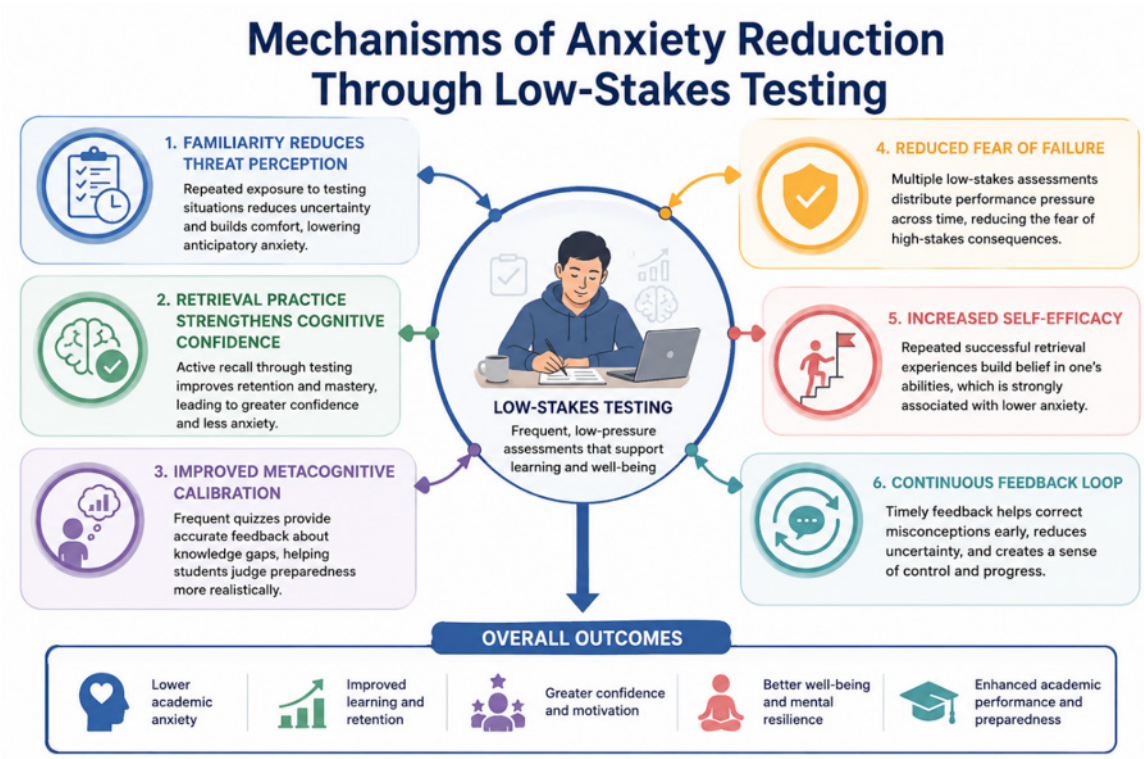

Figure 1: Mechanisms of anxiety reduction through low-stakes testing. Conceptual framework illustrating the pathways by which repeated low-stakes formative assessments reduce academic anxiety among second-year medical students. Key mechanisms include familiarity with examination conditions, retrieval practice strengthening cognitive confidence, improved metacognitive calibration, reduced fear of failure, increased self-efficacy, and continuous feedback loops. These mechanisms collectively contribute to improved academic performance, enhanced psychological resilience, and reduced assessment-related distress.

concentration," a shift that empowers students to interpret isolated, suboptimal results as constructive learning opportunities rather than evidence of catastrophic academic failure. [18]

Increased self-efficacy: According to Albert Bandura's social cognitive theory, repeated successful retrieval experiences act as mastery experiences, which are the strongest influencers of self-efficacy beliefs. [19] Higher self-efficacy correlates robustly with reduced academic anxiety, as students believe they possess the cognitive tools required to succeed. [20]

Continuous feedback loops: Formative assessments facilitate the early identification and correction of misconceptions before they become cognitively entrenched. By providing immediate, targeted feedback, these loops mitigate the accumulation of uncertainty that frequently drives assessment-related anxiety. [21] Research by Wisniewski and colleagues underscores that such feedback-rich environments significantly enhance student psychological security and motivation, effectively transforming the testing process from a source of stress into a tool for developmental guidance. [22]

CRITICAL APPRAISAL OF THE EVIDENCE

Although the theoretical evidence and observational data generally favor low-stakes testing, several methodological limitations exist within the current literature. For instance, Roediger and Butler demonstrated strong evidence supporting retrieval practice. [23] the majority of cognitive psychology studies measured knowledge retention rather than anxiety as a primary outcome[24–26]

In health professions education, a growing body of empirical evidence suggests that repeated formative assessments can effectively bolster student confidence and mitigate stress. [27–29] However, the robustness of these conclusions is constrained by critical methodological limitations. Current research is frequently hampered by small sample sizes, an overreliance on subjective, self-reported anxiety scales, significant heterogeneity in intervention design, and the confounding influence of institutional culture. Furthermore, the marked inconsistency in testing frequencies across existing studies complicates efforts to isolate the specific, dose-dependent impact of assessment cadence on psychological outcomes. [30]

Furthermore, the literature is not universally positive. Some evidence suggests that excessive testing frequency may increase workload burden, paradoxically elevating stress rather than reducing it. [31] Additionally, poorly designed quizzes that lack meaningful, constructive feedback fail to demonstrate measurable psychological benefit, suggesting that the *quality* of the formative assessment is just as critical as the *quantity*. [32] Finally, generalizability remains limited because most existing studies originate from North American or European institutions, and there is insufficient evidence specifically isolating second-year medical students as a distinct cohort.

CHALLENGES, LIMITATIONS, AND FUTURE DIRECTIONS

Despite the demonstrated educational and psychological benefits of frequent low-stakes formative testing, several implementation challenges, methodological limitations, and research gaps remain. **Table 1** summarizes the principal barriers and future research priorities identified in the current literature.

Table 1: Challenges, limitations, and future directions of low-stakes formative testing in medical education

Domain	Current challenges	Key limitations in existing evidence	Future directions
Assessment fatigue	Excessively frequent quizzes may lead to cognitive overload and student disengagement, potentially transforming formative assessment into an additional stressor.	Limited studies have evaluated the threshold at which testing frequency begins to increase rather than reduce anxiety. Most evidence focuses on short-term educational outcomes.	Conduct dose-response studies to determine the optimal frequency and spacing of low-stakes assessments that maximize learning while minimizing psychological burden.
Faculty workload	Frequent testing requires substantial faculty effort for question writing, psychometric validation, administration, grading, and feedback provision.	Current literature often underestimates institutional and faculty resource requirements for sustainable implementation.	Develop automated assessment systems supported by artificial intelligence and learning management systems to reduce faculty burden while preserving educational quality.
Quality of feedback	The educational benefit of low-stakes testing depends heavily on timely and meaningful feedback. Poor-quality feedback reduces student engagement and limits anxiety reduction benefits.	Many studies fail to distinguish between the effects of testing itself and the additional benefit derived from structured feedback mechanisms.	Future intervention studies should separately evaluate the relative contribution of testing frequency versus feedback quality on academic anxiety outcomes.
Student perception variability	Students differ considerably in their psychological response to repeated assessments. Some perceive frequent testing as supportive, whereas others experience increased pressure.	Most studies rely on aggregated student data and do not adequately examine personality traits, coping styles, or individual differences affecting outcomes.	Incorporate learner-centered educational models and investigate moderators such as resilience, perfectionism, coping strategies, and personality characteristics.
Methodological heterogeneity	Existing studies use diverse intervention designs, quiz formats, timing schedules, and anxiety measurement instruments, limiting comparability across studies.	Lack of standardized protocols reduces the ability to synthesize findings and perform meta-analysis.	Establish standardized research frameworks for evaluating formative assessment interventions across medical education settings.
Limited longitudinal evidence	Most available studies evaluate immediate or short-term outcomes rather than sustained psychological effects across multiple academic years.	Long-term effects on burnout prevention, resilience development, and academic progression remain poorly understood.	Design prospective longitudinal studies examining the cumulative psychological impact of repeated formative testing throughout undergraduate medical education.
Generalizability across institutions	Educational culture varies substantially across institutions, countries, and curriculum structures, influencing the effectiveness of formative testing interventions.	Existing evidence originates predominantly from North American and European academic institutions, limiting global applicability.	Expand multicenter international studies involving diverse medical schools to improve external validity and cross-cultural applicability.
Second-year student specific evidence	Although second-year medical students appear particularly vulnerable to assessment anxiety, relatively few studies isolate this subgroup specifically.	Most educational studies combine preclinical students into broader cohorts without stratified analysis by year of study.	Conduct targeted studies specifically focused on second-year medical students to identify stage-specific educational interventions and psychological outcomes.
Technology integration	Digital assessment platforms may improve scalability, but unequal technological access and platform design may affect student engagement.	Limited evidence exists regarding the comparative effectiveness of digital versus traditional formative testing systems in anxiety reduction.	Investigate adaptive learning systems, Artificial Intelligence–driven personalized assessments, and digital analytics platforms such as Anki or AMBOSS in supporting individualized anxiety reduction strategies.

Assessment fatigue and workload burden: A primary implementation barrier is assessment fatigue. Excessive quiz frequency may create cognitive overload, and educational programs must be careful not to replace one stressor (high-stakes exams) with another (relentless quizzing). Furthermore, frequent assessments impose a significant burden on faculty, requiring continuous question development, psychometric validation, automated grading infrastructure, and timely feedback mechanisms. [33]

Variability in student perception: Students differ significantly in their response to testing frequency. While many benefit from the structure, some students perceive repeated testing as a form of surveillance rather than pedagogical support. Institutional culture heavily influences this perception; in highly competitive environments, even low-stakes tests can be weaponized for peer comparison, negating their anxiolytic benefits.

Technological integration and future research: Digital assessment platforms present a scalable opportunity to optimize the cadence of formative assessment. Beyond simply increasing frequency, adaptive learning systems enable the personalization of assessment difficulty and interval spacing to suit individual learner needs. Spaced repetition platforms, such as Anki and AMBOSS, are increasingly embedded in medical curricula, leveraging retrieval-based learning to promote robust long-term retention. [34] Emerging evidence suggests that deeper engagement with these platforms—characterized by active question utilization and consistent review schedules—correlates positively with superior academic performance and improved standardized examination outcomes. [35]

Despite these advancements, most current studies evaluate only short-term outcomes. Future research must prioritize robust, longitudinal, multicenter randomized trials. Key areas of inquiry should include long-term anxiety trajectories, the role of formative assessment in burnout prevention, student progression into clinical clerkships, and correlations with performance on national licensing examinations. [36]

CONCLUSIONS

Academic anxiety remains a major challenge in undergraduate medical education, particularly among second-year medical students who face increasing curricular complexity and high-stakes evaluation systems. Current evidence suggests that frequent low-stakes formative testing can substantially reduce anxiety by increasing familiarity with examinations, strengthening retrieval pathways, improving metacognitive awareness, reducing the fear of failure, and enhancing self-efficacy.

The educational value of this approach extends far beyond knowledge retention, contributing meaningfully to overall student well-being. Medical schools should increasingly adopt assessment systems that prioritize continuous learning support rather than episodic judgment. However, these implementations must be carefully designed to avoid assessment fatigue and faculty burnout. Future research should focus on longitudinal evaluation, specifically examining anxiety reduction outcomes in diverse, global medical school environments.

AUTHORS' CONTRIBUTION

All authors have significantly contributed to the work, whether by conducting literature searches, drafting, revising, or critically reviewing the article. They have given their final approval of the version to be published, have agreed with the journal to which the article has been submitted, and agree to be accountable for all aspects of the work.

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The authors disclose the use of AI technologies in the preparation of this manuscript, specifically for linguistic refinement, content restructuring, and figure creation. Despite this assistance, the intellectual framework, analysis, and scholarly conclusions remain the exclusive original work of the authors.

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CONFLICT OF INTEREST

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