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Critical Appraisal of Student Dropout and Factors Affecting the Retention in Higher Education: A Systematic Review and Meta-analysis

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Abstract

The growing concern about student dropout rates in higher education institutions has prompted researchers to identify key factors influencing student persistence and success. This systematic review and meta-analysis aimed to provide a critical appraisal of student dropout in higher education, identify approaches to addressing it and model the factors leading to student discontinuation from the academic program. In total, 84 research studies using the keywords student, dropout and higher education were identified in Scopus, Web of Science and the Educational Resource Information Center (ERIC) database. Of these 84 studies, 34 were excluded due to irrelevant content. As a result, 57 research studies were identified and screened. A total of 34 full-text research manuscripts were discovered during the search. Of these 34 studies, 12 were reviewed for the problem statement, methodology, main results, conclusion and gaps. Comprehensive meta-analysis V4 was used and the prediction interval for student dropout was 0.345 [0.074-0.778]; however, no significant publication bias was found in the included studies. Student dropout rate in the first year of enrollment was 0.353 [0.001-0.997]. The synthetic results showed that the leading factors in student dropout were low entry grades, curriculum type (such as longer-duration programs) and gender-based choice in adapting to the program, student performance and socio-economic conditions. Overall, the synthesis of these studies underscores the necessity for integrated strategies that combine predictive analytics with theoretical insights to improve student retention and success in higher education.

Keywords: Dropout, Factors, Higher Education, Meta-analysis, Student.

Introduction

The higher education system has rapidly expanded in recent years to produce specialists in the major economic fields of developed and underdeveloped countries, in line with community needs. Despite this growth, it is significantly affected by a high worldwide dropout rate. Many students in higher education programs do not complete their degrees. Statistical evidence indicates that nearly 25% of Australian students who began higher education programs in 2017 had dropped out by 2022 (1). In its 2023 report, the United States' National Center for Education Statistics (NCSE) reported pre-pandemic (COVID-19) dropout rates of 23.3% for full-time students and 55.5% for part-time students (2). The academic literature uses a range of overlapping terms to describe student dropout and related forms of discontinuation. Permanent withdrawal is typically labeled student dropout, academic dismissal, attrition, transfer or migration, degree non-completion, premature leaving, or program withdrawal. Temporary interruptions are often labeled stop-out, academic interruption, temporary withdrawal, exception absence, study break, enrollment interruption, academic pause, gap year, or suspension (3, 4). Higher education institutions play a leading role in advancing human capital development, facilitating social mobility and contributing to economic growth. Nevertheless, persistently high dropout rates hinder the achievement of these goals by reducing the number of skilled graduates in the targeted fields, increasing financial burdens for students and institutions and intensifying socio-economic disparities. Concerns about student dropout rates at higher education institutions have prompted research into the key factors that influence student persistence and success (5). Student dropout can be broadly classified as

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either personal (voluntary), initiated by the student with or without a formal withdrawal process, or informal non-return, or institutional (involuntary), resulting from institutional action in accordance with established regulations. Both types lead to non-completion, although the underlying causes and subsequent effects vary in intensity, duration and policy implications. Personal factors include academic performance, developing rapport, financial constraints, loss of interest, physical or mental health challenges and family obligations (6). Institutional factors include a lack of academic advising, counseling and connections with peers or faculty; irrelevant course content; discrimination; isolation; or harassment. External factors include a preference for immediate employment, financial instability and changes in student loan policies or government support (7).

In this context, the student is not only responsible for a lack of seriousness, casual commitment, a misleading career path and an inability to fit into the learning environment. However, concerns have been raised about the program's performance, credibility, the institution's reputation and resource waste (8, 9). Program management is primarily responsible for the correct selection of students for specific programs and students must self-identify as appropriate candidates for the program based on natural aptitude and personal interests. Pre-enrolment guidance, program orientation, career counselling, curricular roadmap, foundation courses and early interactions between prospective students and the program faculty, along with their feedback, may help program management detect risks early and provide an opportunity for students to adapt (9, 10).

Various statistical and machine learning methods have been employed to predict dropout risk, with a focus on developing data-driven approaches that support targeted interventions for at-risk students. Key risk indicators were identified, including low grades on early assessments, failed or delayed assignment submissions, under-rated performance in interactive sessions and foundation courses, low participation and low attendance. The effectiveness of early warning systems is highlighted as a crucial tool for early detection of students at risk of dropping out, enabling universities to implement preventive measures (11, 12).

The existing literature demonstrates multidisciplinary engagement in identifying the determinants of student survival and dropout. Quantitative studies primarily examine predictive factors such as academic performance, attendance and socio-demographic characteristics, whereas qualitative research investigates students' lived experiences, motivation and institutional barriers. There are very few systematic reviews in this important area of academic interest. A recent systematic review covered only the Scopus database and focused on the dropout trend in higher education in rural areas. The limited sample sizes and pronounced social disparities in certain countries limited the generalizability of these studies, potentially reducing the significance of their findings. Nevertheless, these studies provided an overview of the individual and academic determinants of student dropout in peripheral and remote zones (13).

Another systematic review focused only on the dropout trend in universities in Spain. It was challenging to proceed given the scarcity of empirical evidence, as the existing scientific literature was insufficient to robustly evaluate the results from a correlational perspective. The theoretical basis of each of the studies analyzed, the methods described, the universities and the students studied have, in turn, been highly varied and therefore complex, which made it difficult to synthesize the information (14).

Therefore, no comprehensive systematic review of dropout trends in higher education worldwide has been reported, covering multiple databases, nor has a meta-analysis of these trends. This systematic review and meta-analysis aimed to provide a critical appraisal of student dropout in higher education identify approaches to address it and model factors that lead to student discontinuation from the academic program.

Methodology

Following the PRISMA-P guidelines for systematic reviews, inclusion criteria were defined: (i) Full-text English-language research articles and proceeding papers, (ii) Published before 11th November 2024, (iii) Scientific publications based on dropout in higher education degree programs, including bachelor's and postgraduate programs,

conducted regardless of geographic location. However, previous review articles, reports/theses and conference review reports were excluded (15). The targeted data were retrieved from three scientific databases: Scopus, Web of Science and the Educational Resource Information Center (ERIC) by applying the following research queries on 2024-11-05 at Imam Abdulrahman bin Faisal University (IAU), Dammam, Saudi Arabia. It provided 50 results from Web of Science Core Collection:

(TS=("Student Dropout" OR "Student Attrition" OR "School Withdrawal" OR "Academic Disengagement" OR "Student Non-Completion" OR "Early School Leaving" OR "Educational Abandonment" OR "Course Discontinuation" OR "Dropout Rate" OR "Student Exit" OR "Unenrollment" OR "School Leaver" OR "Program Withdrawal" OR "Disenrollment" OR "Educational Dropout" OR "Academic Withdrawal") AND TS=(Higher Education OR universit*)) AND TS=(survival)

Two review articles were excluded, leaving 48 results in the Web of Science Core Collection.

Scopus database provided 77 search results on the advanced query:

(TITLE-ABS-KEY ("Student Dropout" OR "Student Attrition" OR "School Withdrawal" OR "Academic Disengagement" OR "Student Non-Completion" OR "Early School Leaving" OR "Educational Abandonment" OR "Course Discontinuation" OR "Dropout Rate" OR "Student Exit" OR "Unenrollment" OR "School Leaver" OR "Program Withdrawal" OR "Disenrollment" OR "Educational Dropout" OR "Academic Withdrawal") AND TITLE-ABS-KEY ("Higher Education" OR universit*) AND TITLE-ABS-KEY ("survival"))

Four review articles and 1 conference review were excluded and resulted 72 documents. Consolidated WOS and Scopus data having DOIs and removed duplicate records by matching DOI in MS Excel and removed 23 duplicate records. Separated WOS Scopus records not having DOIs and consolidated as separate file and sorted on title to check duplicate records only one duplicated record found that was removed. ERIC database provided 38 records.

("student dropout" OR "student attrition" OR "school withdrawal" OR "academic disengagement"
OR "student non-completion" OR "early school leaving" OR "educational abandonment"
OR "course discontinuation" OR "dropout rate" OR "student exit" OR unenrollment
OR "school leaver" OR "program withdrawal" OR disenrollment OR "educational dropout"
OR "academic withdrawal") AND ("higher education" OR universit*) AND survival

All 38 items were screened manually due to the unavailability of DOIs.

Search results from Scopus, the Web of Science and the Educational Resource Information Center (ERIC) database identified 50, 77 and 38 scientific studies, respectively. A total of 23 duplicate records were removed based on DOIs. The scientific content was screened and reviewed by two independent expert contributors to assess eligibility for inclusion or exclusion in this systematic review. Automated tools marked 37 records as ineligible based on titles. A total of 33 ERIC records were manually assessed based on titles lacking DOIs. Hence, 57 records were screened after initial scrutiny and 16 were excluded based on the abstract. A total of 41 articles were searched to retrieve full-text reports, of which 7 reports couldn't be retrieved.

Therefore, 34 full-text reports were assessed for eligibility, of which 19 were not related to higher education, 1 was not available in English and 2 were thesis reports. Finally, 12 studies meeting the inclusion criteria were included in this systematic review, as illustrated in Figure 1.

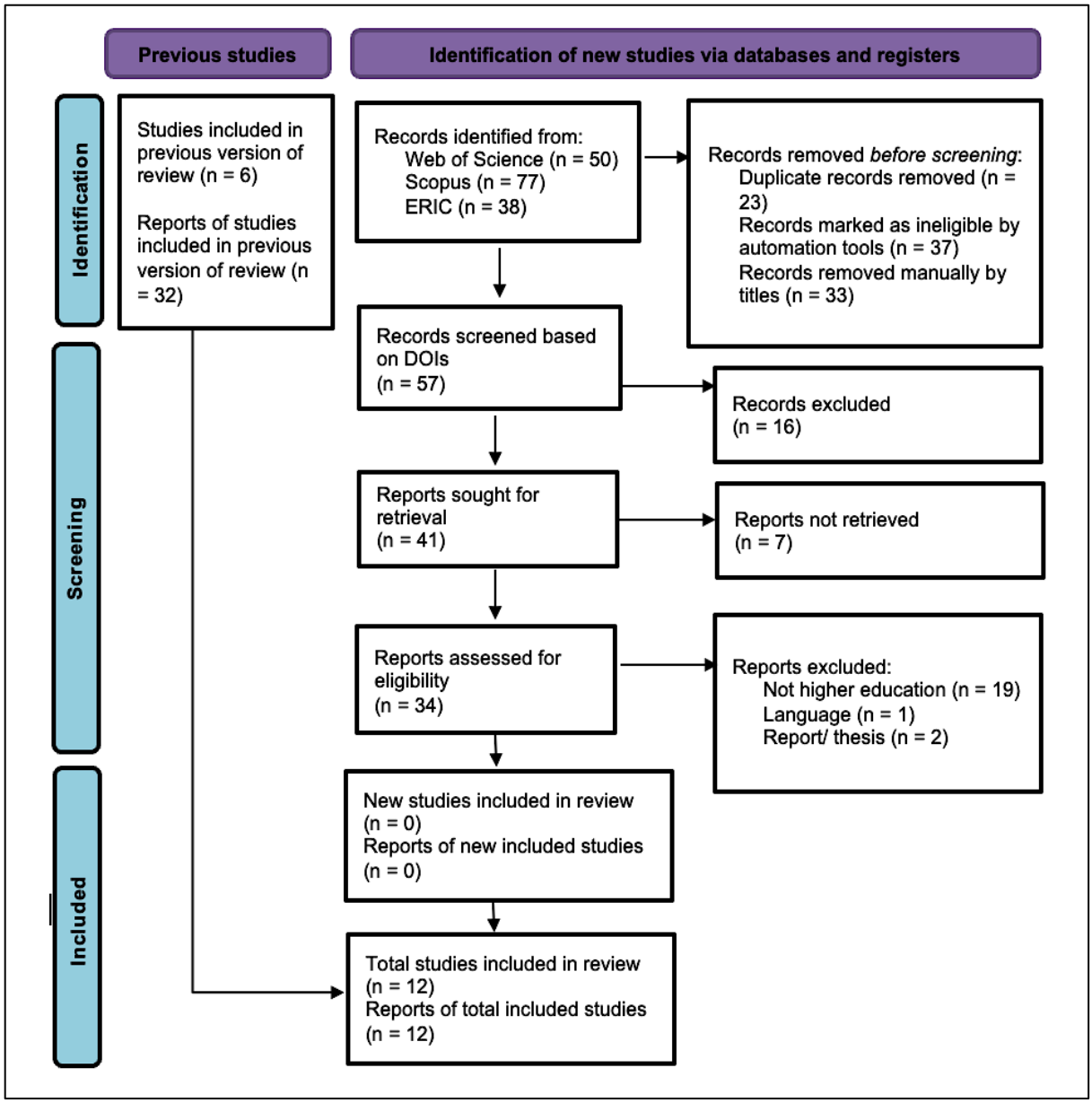


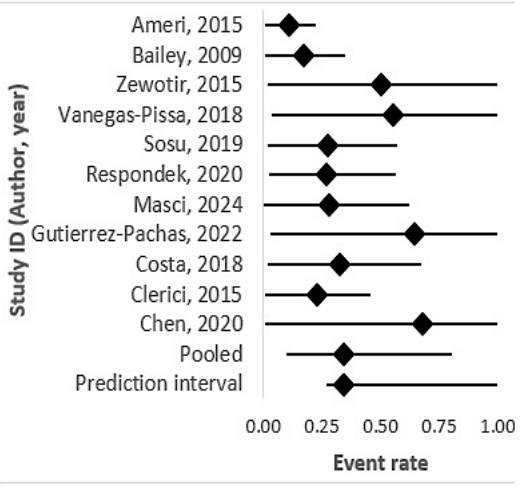
Figure 1: PRISMA-P Flow-Chart of Electronic Search Database Results and Eligibility

Results

All 12 studies included in this systematic review reported student dropout rates. A random effects meta-analysis was performed to assess the student dropout pattern across 11 studies; in one study, the sample size was reported (16). Figure 2 shows the dropout trend in the reported studies. The pooled rate across studies, 0.345 [0.248-0.458], indicates no substantial heterogeneity among the reported studies, as shown in Figure 2A. The highest dropout rates reported were 0.677, 0.653, 0.55, 0.50, 0.326, 0.280, 0.274, 0.268 and 0.227 (8, 12, 17–23). The lowest dropout rates reported were 0.11 and 0.17 (24, 25). The prediction interval [0.074-0.778] in the forest plot indicates that the future study may predict the student dropout rate between 0.074 and 0.778, with a more likely dropout rate of 0.345, as illustrated in Figure 2B.

Study	Rate	LL	UL
Ameri, 2015	0.110	0.104	0.116
Bailey, 2009	0.170	0.162	0.178
Zewotir, 2015	0.500	0.480	0.520
Vanegas-Pissa, 2018	0.552	0.516	0.587
Sosu, 2019	0.274	0.253	0.296
Respondek, 2020	0.268	0.242	0.296
Masci, 2024	0.280	0.276	0.340
Gutierrez-Pachas, 2022	0.643	0.612	0.665
Costa, 2018	0.326	0.308	0.345
Clerici, 2015	0.227	0.222	0.232
Chen, 2020	0.677	0.668	0.686
Pooled	0.345	0.248	0.458
Prediction interval	0.345	0.074	0.778

A



B

Figure 2: Forest Plot of an Overall Event Rate And 95% Confidence Interval - (A) Overall Event Rate with 95% Confidence Interval (B) Forest Plot of The Dropout Rate (The X-Axis Represents Proportions and the Y-Axis Shows the Included Studies and the Pooled Dropout Rates)

A precision funnel plot by logit event that does not conform to the expected funnel shape is shown in Figure 3. The prediction interval was 0.345 [0.074-0.778], indicating a wide range due to the diversity of geographic locations, institutional policies, financial support and other factors. Begg's test p-value=0.30 and Egger's test p-value=0.53 revealed no significant publication bias in the reported studies, as illustrated in Figure 3.

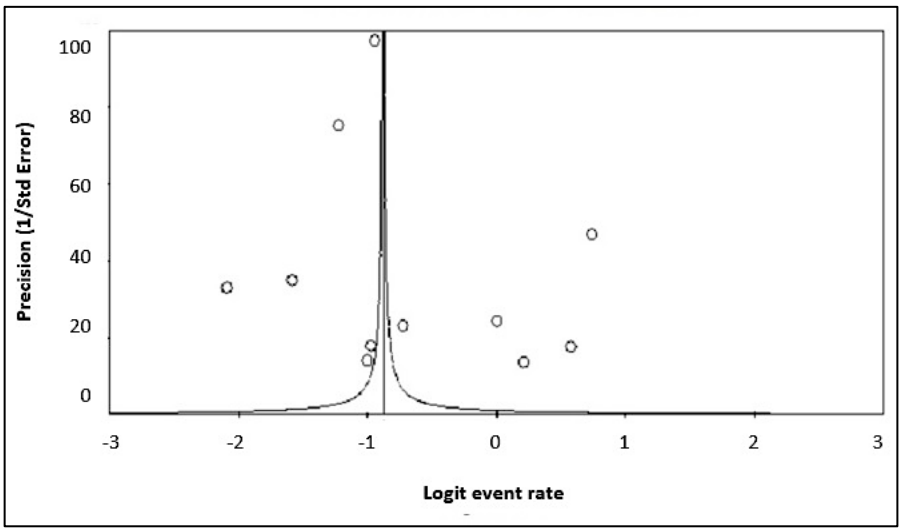


Figure 3: Funnel Plot of Overall Event Rate

In this funnel plot, the x-axis represents the logit event rate and the y-axis shows the precision (1 standard error). It shows no evidence of publication bias according to Egger's test [p=0.53] or Begg's test [p=0.30]. Four studies reported early dropout rates, as shown in Figure 4, ranging from 0.149 to 0.83 in the first year (8, 22). The pooled interval yielded a first-year dropout rate of 0.353 [0.001-0.667], indicating considerable heterogeneity across the reported studies. Whereas the prediction interval [0.001-0.997] in the forest plot indicates that the future study may predict the student dropout rate between 0.001 and 0.997, with a more likely first-year dropout rate of 0.353, as illustrated in Figure 4A. The highest first-year dropout rate was reported by Sosu *et al.*, with a 95% CI (8) as illustrated in Figure 4B.

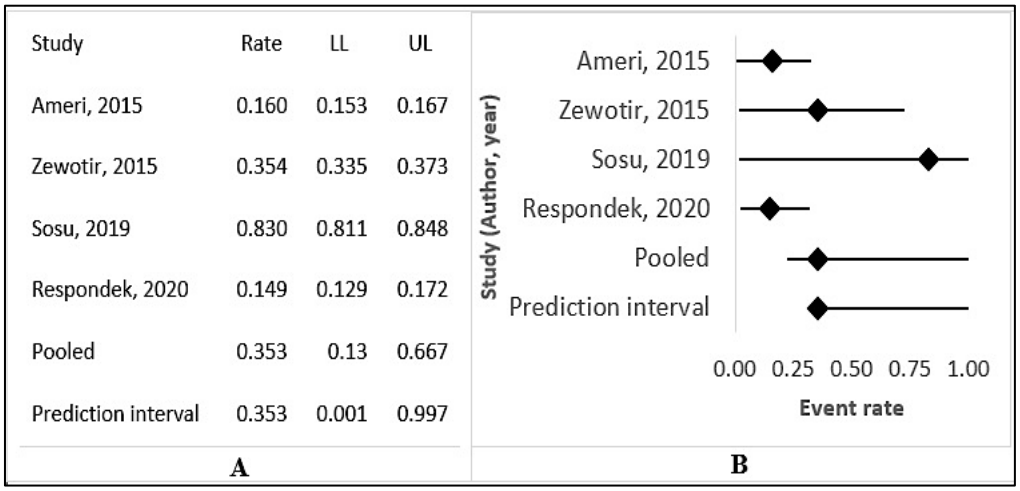


Figure 4: Forest Plot of First-Year Dropout Event Rate And 95% Confidence Interval - (A) The First-Year Event/Dropout Rate with A 95% Confidence Interval (B) Forest Plot of The First-Year Event/Dropout Rate (The X-Axis Represents Proportions and The Y-Axis Shows the Included Studies and the Pooled Dropout Rates)

A funnel plot of precision by logit event is shown in Figure 5, but it does not adhere to the correct funnel shape. Egger's test [p=0.40] or Begg's test [p=0.40] may not be appropriate estimates given the limited number of studies; however, these estimates also support the funnel plot findings of publication bias, indicating a narrow symmetric curve.

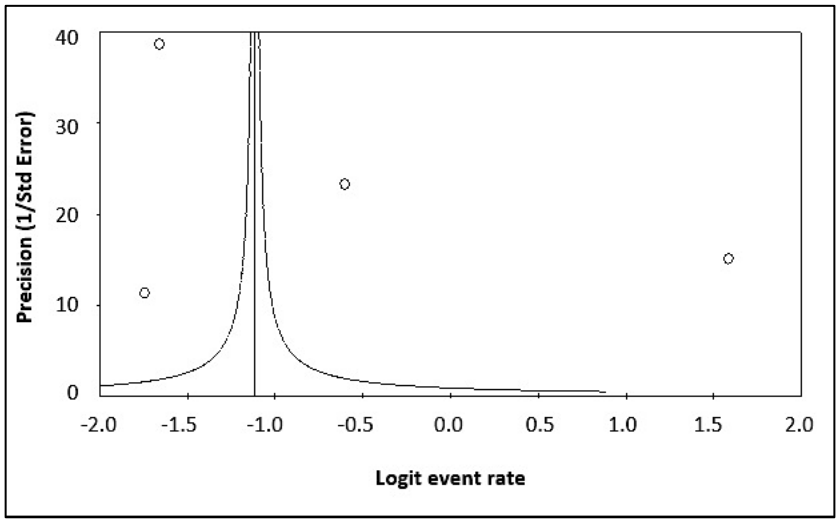


Figure 5: Funnel Plot of First-Year Dropout Event Rate

In this funnel plot, the x-axis represents the logit event rate and the y-axis shows the precision (1 standard error). Begg's test p-value=0.40, Egger's test p-value=0.40. Five studies compared student dropout rates by gender, illustrated in Figure 6. The highest to lowest male dropout rates were 0.623 and 0.210, respectively (20, 25). Costa *et al.* reported the highest male dropout rate (20), as shown in Figure 6A. The pooled rate in these five studies was 0.35 [0.20-0.53], indicating considerable variation in male dropout rates across the reported studies, while the prediction interval was 0-100%, with a male dropout rate more likely to be 0.359 for the future study on student dropout in higher education, as shown in Figure 6B.

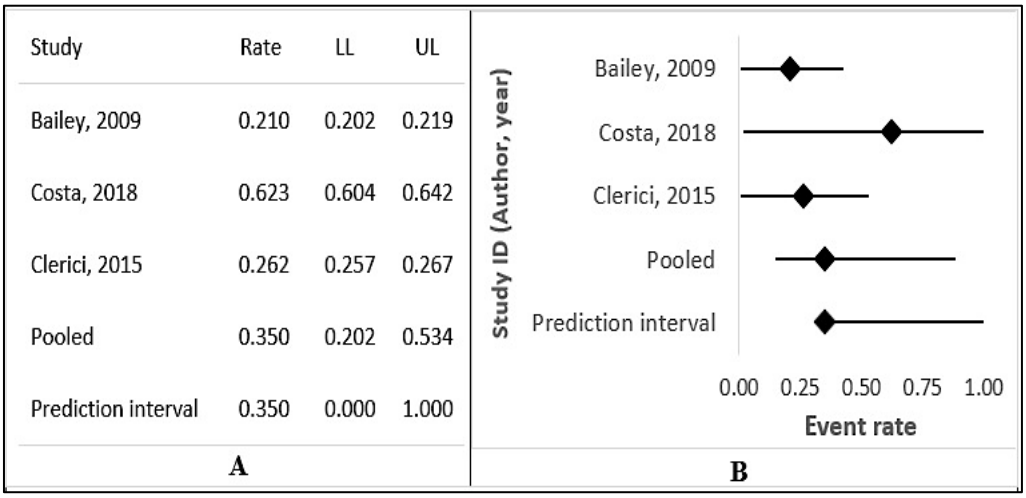


Figure 6: Forest Plot of Male Students' Event Rate and 95% Confidence Interval - (A) The Male Students' Event/Dropout Rate with A 95% Confidence Interval (B) A Forest Plot of The First-Year Event/Dropout Rate (The X-Axis Representing Proportions and the Y-Axis Showing the Included Studies and the Pooled Dropout Rates

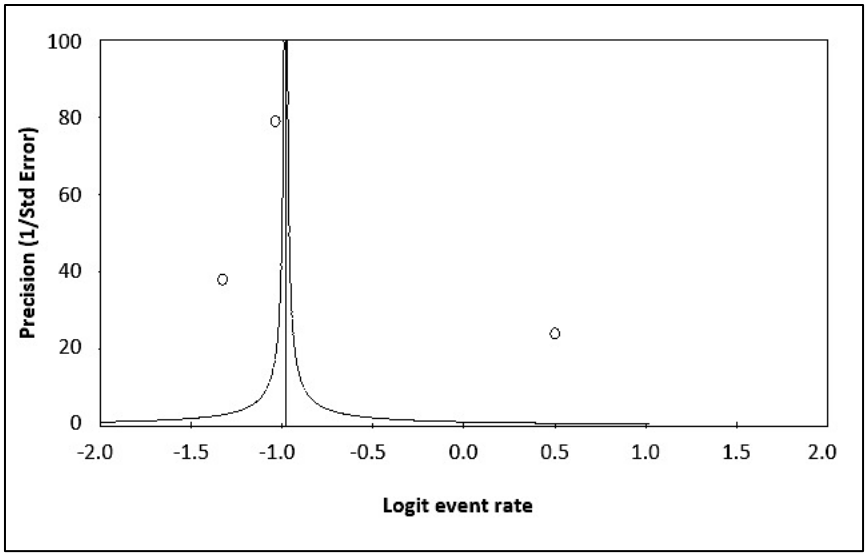


Figure 7: Funnel Plot of Male Student Event Rate

A funnel plot of precision by logit event shows a very narrow, symmetric curve rather than a perfect normal curve, indicating it does not adhere to the correct funnel shape. No publication bias was thus detected, also supported by the Egger's test [p=0.60] or Begg's test [p=0.58], as shown in Figure 7.

In this funnel plot, the x-axis represents the logit event rate and the y-axis shows the precision (1 standard error). Egger's test p-value = 0.58 and Begg's test p-value = 0.60 revealed no significant publication bias. The critical appraisal of the included articles is summarized in Table 1 to provide insights into the major findings and a gap analysis. A Thai study reported a 10% dropout rate between the second and final year, with ORs of 2.17 for dropping out due to low entry grades and 1.32 for dropping out without family support. The cumulative impact of these two factors showed a 30% risk probability of dropping out in the second year. This study was limited to two main predictors and other core determinants, such as students' socioeconomic status and parental education, were neglected (8). Student dropout rates in a study conducted in Peru were significantly higher among those who did not change curricular design, at 69.05%, 73.31% and 84.09% for Industrial Engineering IE1, IE2 and Computer Science CSI, respectively. The highest dropout rates occurred in the first few semesters. A reason for the low number of female students

was the program title, which was informatics engineering, when it was launched (12).

A recent study at the University of Defence in the Czech Republic identified 47% dropout rate in the first two years, emphasizing the need for funding to reduce dropout. It also provided insights for decision makers to take timely initiatives and to plan for students' motivation from program entry through completion (16). A study done in Cambridge (UK) identified the students' performance and engagement as the most important determinants of their continued participation in the course. However, gender, educational level, number of completed courses and participation in online motivational discussion forums did not affect student survival (17). In a study, the overall program completion rate was 29.9%, with an average of 11-13 semesters. The most common cause of dropout was the multiple repetition of didactic and bridging courses, which contributed to 9% of the dropout (18).

A South African study reported the median time to successful master's completion was slightly more than 2 years; however, within 2 years, more than half of the students graduated or dropped out. The major reason was that older learners in the program had family and part-time professional obligations. Receiving financial aid in some form appeared to reduce the time to graduation (19). The Brazilian study compared curriculum dropout rates and found that longer-duration [10 semesters] programs had a higher dropout rate than shorter-duration [8 semesters] programs. The male students had larger graduation time than female students [$p<0.001$]. The existence of failures or dropouts per course and student grades was significant factors [$p < 0.001$]; however, no effect of age, race, marital status, or private or public high school was seen (20).

In an Italian study, shared frailty Cox model showed an average lower risk of female than male students dropout [HR = 0.84], followed by the students with supportive grants income than medium income [HR = 0.772] and Commuters than Milanese (locals) students [HR = 1.144]. Students from technical or other types of high school, compared with those who attended Scientific schools [HR = 1.088 vs. 1.332], were more prone to drop out (21). A German study evaluated the perceived academic control (PAC) as a unique determinant of student dropouts. Overall dropout risk, based on average PAC grade, was 12.1%, which was negatively predicted by first-year grades and gradually decreased to 1.8% in the third year. It was suggested that early support be provided to elevate students' perceptions of understanding and control over their academic results (22). In another Italian study, it was reported that 47% completed degrees, 22.7% withdrew, 21.4% were delayed and 8.8% made course changes. The students enrolled in professional health studies achieved a 68% completion rate. In scientific studies, male students had lower completion rates than female students (23). In a study conducted in the USA, 53% of students dropped out in the first four semesters of the program. It emphasizes the survival analysis model approach for early warning predictors in the longitudinal trend (24). In a study conducted in Northern Ireland, UK, religion-specific dropout rates were reported of 88.1% for Catholics and 80.7% for Protestants (25).

The Joanna Briggs Institute (JBI) 8-item critical appraisal tool was used to assess the methodological quality of the research studies included in a systematic review. The overall quality of the assessment was 92.4/100, indicating very good methodological quality across the included studies.

Table 1: Critical Appraisal of Survival Models for Students' Attrition

Country	Sample	Conclusion	Gaps	Reference
Thailand	1613	Entry grades significantly negatively impacted dropout rates, with students having lower entry qualifications exhibiting higher hazard odds of dropping out.	Its reliance on administrative data from a single faculty cannot be generalized. Also, the recurrence of students potentially leads to an overestimation of dropout rates.	(8)
Peru, South America	1355	Non-significant difference of dropout between male and females. Notably, female than male students showed a lower likelihood of changing their curricular design, indicating a potential resistance to change.	The effect of socio-economic background was more likely to increase dropout contrarily to the impact of curricular changes and gender-based program adoption.	(12)

Czech Republic	Un-known	To enhance efficiency in military education funding to reduce dropout rates.	The dropout rate related to official leaving dates rather than the reasons behind the decisions to leave, which may limit the understanding of the factors influencing student attrition.	(16)
Cambridge, UK	10014	Addressing students' misconceptions and enhancing engagement strategies can improve retention rates in MOOCs.	No follow-up with learners at the end of the course to gather qualitative data on their experiences for a deeper insight into their dropout decisions. Also limited to formal enrollees, potentially excluding valuable data from irregular participants	(17)
Costa Rica	752	Below 25% on time completion rate, while greater than 50% dropout rate and repeated failure in basic sciences course as major reason of dropout.	Primarily focuses on quantitative than qualitative data from institutional databases, such as personal circumstances or institutional support.	(18)
South Africa	2368	Field of study, international students having financial aid completed their degrees more quickly. Older students take longer in completion.	Non-significant racial effect on dropout rates, international students perform better, however not addressed the reasons behind this trend, such as support systems etc.	(19)
Brazil	2425	Academic performance, curriculum structure and course management strategies play crucial roles in influencing student retention and graduation rates.	Potentially relevant variables, such as student satisfaction and social factors, due to data availability constraints not considered.	(20)
Italy	47000	Timely and accurate predictions of student dropout can facilitate early interventions, to predict "who" and the "when" of dropout occurrences to develop effective support strategies.	Focus on a specific institution, which may limit the generalizability of the findings. Psychological and personal factors were not taken into account that could further influence dropout rates.	(21)
Germany	1007	Overall decline of students' control beliefs within a three-year degree program is associated with poorer grades.	It suggests the need for evidence-based methods to support students' control beliefs.	(22)
Italy	32258	The diverse factors affecting student outcomes is crucial for developing targeted interventions. By focusing on specific at-risk groups, universities can implement policies to enhance student retention and success	Single institutional data, not showing broader Italian higher education system. The lack of information on students' family backgrounds and subjective factors affecting academic success restricts the comprehensiveness of the analysis.	(23)
United States of America	11121	Insights into student dropout patterns and the effectiveness of survival analysis methods in predicting these events.	Censoring issues lead to biased model, focused only early dropout prediction and overlooked later dropout The model relies on only one program.	(24)
Northern Ireland, UK	8631	Attribute differences significantly explain the variations in survival rates between males and females, but not between Protestants and Catholics.	The analysis does not account for other potential factors influencing survival rates, but emphasizes gender and religious differences.	(25)

Discussion

Time-to-event analysis for longitudinal tracking of student retention or dropout remains challenging, whereas simpler models, such as logistic regression and analysis of variance, are typically considered more suitable for institutional policy-making (16, 25). Current studies place a strong emphasis on dropout prediction, using survival models and regression to identify dropout patterns, at-risk students, factors influencing survival and targeted interventions.

Tinto's theoretical model provides a foundational framework for understanding dropout risks, suggesting that academic, economic and social integration significantly influence students' commitment to their educational goals. Across most studies, common factors included gender, racial background, social and financial barriers, performance and discrimination (8, 16, 20, 21, 24). To improve the generalizability of findings across diverse educational contexts, more research is needed. The studies included in this systematic review were narrowly focused on specific demographics, including part-time employment or business, financial support, racial effects, older age, gender preferences for programs and single institutions or programs (12, 18, 19, 24). To assess

factors influencing sustainability, Amiri *et al.* focused on early dropout and overlooked later dropout (24). The South African study found that international students performed well but did not report whether they were financially supported (19). The German study argued for the use of evidence-based methods to support students' control beliefs (22).

Early interventions to build effective support strategies can be facilitated by timely and accurate predictions of student dropout (24). Online tutorials, academic counseling, clubs, mentorship programs, mental health and advisory resources and community-building exercises are examples of flexible learning options. Sports, integrated academic, financial and social support systems and a welcoming, diverse campus community all significantly reduce dropout rates (6, 20).

Furthermore, the synthetic data indicate that dropout risks evolve over time, influenced by changes in academic performance and financial aid dynamics, underscoring the need for a longitudinal approach to understanding student retention. Socio-economic factors, such as family background and financial aid, are critical predictors of student success and retention, highlighting the need for comprehensive support systems. Studies have shown that predictive models, such as logistic regression and decision trees, differ in performance and interpretability, affecting their utility in institutional policymaking. These findings emphasize the importance of understanding the diverse factors affecting student outcomes, including academic performance, socio-economic background and educational history, to tailor interventions effectively.

The primary limitation of the study was the limited number of variables available for meta-analysis. Only a few studies examined the first-year dropout rate and gender differences. Institutional data confidentiality, which includes specific faculty, racial differences, gender-based admission preferences, student academic track record, financial support and other factors, may explain this gap. A synthesized analysis of the determinants of student dropout found that the set of dropout factors reported in the studies was quite diverse, with some articles reporting only a few. As a result, it was impossible to compare similar factors influencing student dropout rates.

Future researchers should focus on key variables, including early dropout events, average survival and graduation times, graduation rates within the enrolled cohort and gender differences in dropout rates, when creating models of student dropout in higher education across diverse programs. Doing so will increase the pool of analyzable data and strengthen future meta-analyses.

Creating national or regional repositories to store anonymous yet consistent institutional data on student admissions, retention, demographics and personal characteristics would enable researchers to access comprehensive datasets. To overcome confidentiality barriers, it is essential to establish research consortia or formal data-sharing agreements. Researchers should conduct multi-institutional studies and incorporate mixed methods approaches to capture a broader range of dropout determinants. Such designs can address data gaps by providing both quantitative and qualitative insights that reflect diverse institutional contexts.

Conclusion

Overall, the compilation of these studies underscores the need for integrated approaches that enhance student success and retention in higher education by combining theoretical insights with predictive analytics. A wide range of student dropout rates in higher education is reported across studies in this systematic review, reflecting the inclusion of a diverse body of published work from different geographic locations, university policies, financial support and other cultural and ethnic norms. However, the dropout trend was similar for early dropouts and gender discrimination. This systematic review synthesizes empirical evidence on student survival and dropout in higher education, examining influencing factors, methodological trends and implications for policy and practice. By integrating findings from diverse contexts and study designs, the review provides a comprehensive overview of current knowledge and identifies areas requiring further investigation. As higher education is a longitudinal model approach, it demonstrates the need for statistical model-based quantitative research by leveraging the significance of time in dropout analysis and serving as a useful tool for identifying at-risk student populations to develop interventions aimed at lowering academic dropout

rates. It will help future researchers in selecting diverse studies for comparative systematic reviews and meta-analyses to generalize and develop key indicators of early warning signs of student dropout in higher education.

Abbreviations

CS: Computer Science, DOI: Digital Object Identifier, ERIC: Educational Resources Information Center, IE: Industrial Engineering, MOOCs: Massive Open Online Courses, NSCE: The United States' National Center for Education Statistics, OR: Odd ratio, PRISMA-P: Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols.

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Author Contributions

Intisar Ahmad Siddiqui: conceptualization, literature search, screening of scientific contents, data review, meta-analysis, writing, review of the manuscript, Siti Meriam Zahari: supervision, literature review, data review, tabulation of critical appraisal, writing, review of manuscript, Nor Azura Md Ghani: co-supervision, literature review, data scoping, tabulation of critical appraisal, writing, review of manuscript, Muhammad Ajmal Khan: scientific literature analysis, literature review, screening of scientific contents, reference citations, bibliography, writing, review of manuscript.

Conflict of Interest

There is no conflict of interest of any author included in the study.

Data Availability

The bibliographic search results and full-text articles are available, which can be provided to the journal as per the requirement (if needed).

Declaration of Artificial Intelligence (AI) Assistance

It is declared that the manuscript is an original write-up; no AI tools were used during the synthetic analysis, tabulation and meta-analysis.

Ethics Approval

No IRB approval is required for this systematic review article.

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