



Review

Tools used to identify nursing students at risk of dropping out: a mixed-methods systematic review

Tuuli Paija^{a,b,*}, Emilia Kielo-Viljamaa^c, Camilla Strandell-Laine^{c,d}, Sanna Koskinen^{a,1},
Eliisa Löyttyniemi^{e,f}, Leena Salminen^{a,f,1}, Heli Virtanen^{a,f,1}

^a Faculty of Medicine, Department of Nursing Science, University of Turku, Turku, Finland

^b Faculty of Health and Well-Being, Turku University of Applied Sciences, Turku, Finland

^c Faculty of Health and Welfare, Novia University of Applied Sciences, Turku, Finland

^d Department for Undergraduate Studies, Lovisenberg Diaconal University College, Oslo, Norway

^e Faculty of Medicine, Department of Biostatistics, University of Turku, Turku, Finland

^f Turku University Hospital, Turku, Finland



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ABSTRACT

Background: The global challenge of nursing student dropout is widely studied. However, literature review regarding concrete identification of students at risk of dropping out is lacking.

Aim: To identify and describe existing tools used in identifying undergraduate bachelor-level nursing students at risk of dropping out and the ability of these tools to identify at-risk students.

Design: Mixed-methods systematic review.

Data sources: Five databases, CINAHL (EBSCOhost), MEDLINE (PubMed), ERIC (EBSCOhost), Scopus and Web of Science, were searched in July 2024 and reference lists screened.

Review methods: The review was conducted following the JBI mixed-methods systematic review methodology. Studies describing concrete tools to identify individual bachelor-level nursing students at risk of dropping out were included, without temporal limits. Eligible studies were assessed with JBI Critical Appraisal tools. Convergent integrated approach was followed to synthesize data. In total, 12 studies were included.

Results: Fourteen tools for identifying at-risk nursing students were found, most of them being questionnaires. The tools covered different content areas for dropout-risk identification, ranging from single-area to broad coverage. The tool's ability to identify was examined either as the ability to predict actual or intended dropout, warning signals, or to differentiate at-risk and not-at-risk students, or was not directly measured. Student-registry-based tools seemed to have stronger evidence of their capability compared to questionnaires, yet did not cover a student's personal, emotional or life-situation factors related to dropout, accessible via questionnaires.

Conclusions: Currently, when no tool seems to be superior to another, educators and administrators exploring possibilities to implement these tools need to consider and possibly compromise between predictive accuracy and thoroughness. Further studies are needed to determine the appropriate balance between the objective and subjective factors when developing a valid and reliable tool with the ability to predict either intention or actual dropout of nursing students.

1. Introduction

The dropout of undergraduate nursing students is a worldwide concern, recognised years ago (Eick et al., 2012; Merkley, 2016;

Mooring, 2016; Hamshire et al., 2019). Dropout rates have varied between 10 and 50% (Mooring, 2016), e.g. in England about 21% (Royal College of Nursing, 2024), in Netherlands 14–24%, depending on the study year (Bakker et al., 2019), in the United States 50% (Everett,

* Corresponding author at: Department of Nursing Science, University of Turku, FI-20014, University of Turku, Finland.

E-mail addresses: tuuli.s.paija@utu.fi (T. Paija), emilia.kielo-viljamaa@novia.fi (E. Kielo-Viljamaa), camilla.strandell-laine@novia.fi (C. Strandell-Laine), smtkos@utu.fi (S. Koskinen), eliisa.loyttyniemi@utu.fi (E. Löyttyniemi), leesalmi@utu.fi (L. Salminen), hetuvi@utu.fi (H. Virtanen).

¹ Postal address: Department of Nursing Science, University of Turku, FI-20014, University of Turku, Finland.

2020). However, these figures need to be interpreted with caution, since the definitions and calculation methods vary between countries. At the same time, the shortage of nurses is estimated to be 4.1 million in 2030 (WHO, 2025), resulting a global health emergency (ICN, 2023). Therefore, it is even more important to pay attention to nursing student dropouts and the identification of dropout risk.

Leaving education before completing the programme has been described with different terms in earlier literature, such as dropout, attrition, discontinuation, withdrawal, academic failure or non-completion. Consensus regarding the definitions is however lacking in the existing studies (Dante et al., 2013; Mitchell et al., 2021). For instance, attrition has been defined as failure, for any reason, to complete a nursing programme leading to professional registration (Cameron et al., 2010), as a choice to withdraw from the programme because of inability to meet the programme standards (Mooring, 2016) or as programme delays caused by personal factors and/or academic difficulties (Mitchell et al., 2021). Glossop (2002), on the other hand, defined attrition as the difference between cohort start and finish rates, whereas in some studies, the difference has been made between voluntary attrition for personal reasons and involuntary attrition caused, for instance, by academic failure (Bakker et al., 2020). Retention, closely related to dropout, has been used in parallel with attrition (Mitchell et al., 2021) and defined by Shelton (2012) as “*persistence, or choosing to continue in a nursing program, and successful academic performance, or meeting the necessary academic standards to continue in a nursing program*”. In this study the concept of ‘dropout’ is used and defined as leaving the bachelor-level degree programme of nursing before graduation for any reason, either permanently or temporarily.

A variety of complex and interrelated factors have been identified as related to nursing student dropout (Hamshire et al., 2019), needed to be considered when identifying nursing students at risk of dropping out. These factors include student characteristics, such as age or gender (Cameron et al., 2010; Eick et al., 2012; Pitt et al., 2012), academic competence (Urwin et al., 2010; Eick et al., 2012) and critical thinking skills (Pitt et al., 2012), emotional intelligence (Eick et al., 2012; Shaver and Viveiros, 2024), self-efficacy and ability to cope with stress (Eick et al., 2012), mental health difficulties (Thompson et al., 2025), financial challenges (Cameron et al., 2010; Urwin et al., 2010; Shaver and Viveiros, 2024; Thompson et al., 2025) or family circumstances (Cameron et al., 2010; Urwin et al., 2010). There might also be incongruence between the perception of nursing and the reality of the profession (Cameron et al., 2010; Eick et al., 2012; Chan et al., 2019; Canzan et al., 2022; Shaver and Viveiros, 2024). Unsatisfactory or negative experiences during clinical practicum have contributed to the decision to drop out (Eick et al., 2012; Chan et al., 2019; Canzan et al., 2022; Soerensen et al., 2023; Thompson et al., 2025). Students might have expected nursing studies to be more practical and thus were surprised by the academic demands (Cameron et al., 2010; Chan et al., 2019) feeling or being unprepared academically (Cameron et al., 2010; Mooring, 2016; Shaver and Viveiros, 2024). Inefficient student support services (Mooring, 2016; Chan et al., 2019) and perceived lack of support (Chan et al., 2019; Canzan et al., 2022; Soerensen et al., 2023) have been found to be related to dropping out. These factors influence each student differently; the decision to stay or leave is personal and may vary from one individual to another (Urwin et al., 2010; Eick et al., 2012).

Different theoretical frameworks have also been proposed concerning nursing student dropout. In the Nursing Universal Retention and Success (NURS) model (Jeffreys, 2015) retention decision and persistence are influenced by the interaction of the student's pre-existing characteristics, affective factors, academic and environmental factors, outside surrounding factors, academic and psychological outcomes, and professional integration factors. Another framework by Pusey-Reid et al. (2021) consists of multiple institutional and individual critical constructs or elements that might be risk factors for nursing students and could affect their progression and success. These frameworks further highlight the complexity of nursing students' dropout decisions.

To prevent the dropping out of nursing students, a wide variety of interventions, strategies and programmes have been presented (Freeman and All, 2017; Smith-Wacholz et al., 2019; Bakker et al., 2020; Mitchell et al., 2021), including various combinations of activities, such as mentorship, tutoring, psychological support and study skills (Mitchell et al., 2021). In general, retention activities have been offered to students, e.g., due to academic underperformance (Mee and Schreiner, 2016; Mitchell et al., 2021) or based on presumptions (Mitchell et al., 2021). Since retention measures should meet the specific needs of an individual student (Mooring, 2016; Custer, 2018; Smith-Wacholz et al., 2019), the identification of students at risk of dropping out should also be based on diverse methods to enable tailored support.

A wide range of previous literature reviews, addressed above, already exist concerning nursing student dropout and the factors associated with it. Likewise, retention interventions, strategies and programmes reducing dropout have also been widely reviewed, though evidence for the effectiveness of these methods remains limited (Bakker et al., 2020; Mitchell et al., 2021; Hughes et al., 2024). There is, however, a gap in the literature regarding how nursing students at risk of dropping out are concretely identified. This systematic review focuses on the concrete tools used or developed to identify undergraduate nursing students at risk of dropping out. In this review, the term “tool” refers to any form of measure, including instruments, questionnaires, scales, surveys and other methods, that could be used to concretely identify an individual student at risk.

2. Aim of the review

The aim of this systematic review was to identify and describe existing tools used in identifying undergraduate bachelor-level nursing students at risk of dropping out and the ability of these tools to identify at-risk students. The review questions were as follows:

- 1) What tools have been used to identify nursing students at risk of dropping out?
- 2) What is the ability of the tools to identify nursing students at risk of dropping out?

3. Methods

3.1. Design

Review followed the JBI mixed-methods systematic review methodology (Lizarondo et al., 2020). First, the review protocol was established and registered on 25th of June 2024 (PROSPERO CRD42024558216). Reporting was guided by the PRISMA 2020 statement (Page et al., 2021a; Page et al., 2021b), and the PRISMA-S (Rethlefsen et al., 2021) was applied when reporting the literature searches.

3.2. Search strategy and eligibility criteria

Systematic searches were conducted in July 2024 in five electronic bibliographic databases: CINAHL (EBSCOhost), MEDLINE (PubMed), ERIC (EBSCOhost), Scopus and Web of Science. The search strategies for each database were formed with free text words and appropriate subject headings or index terms. An information specialist was also consulted. No temporal limits were used, however the searches were limited to articles published in English. In addition, limits for abstract and peer review were used in those databases where possible, since only original qualitative, quantitative and mixed-methods studies published in peer-reviewed journals were included in the review, and grey literature was excluded (Appendix 1) Additionally, the reference lists of all included studies and relevant review articles found in the database search were screened to identify eligible studies.

The eligibility criteria for this review were piloted by two authors

(TP, EK-V) and 60 articles from a preliminary search in June 2024 in CINAHL (EBSCOhost), using the final search strategy. Eligibility criteria concerned concreteness and content of the tool, timing of the use of the tool and study type (Table 1).

3.3. Study selection

The citations retrieved from the database search were imported to Rayyan review software (Ouzzani et al., 2016), and duplicates were removed. Two authors (TP, EK-V) independently screened titles and abstracts, and assessed full texts based on eligibility criteria. In addition, the author of one article was contacted for additional information concerning the sample characteristics. The reference lists of included articles and relevant review articles were independently screened by two authors (TP, EK-V), and those articles that either of the authors

Table 1
Eligibility criteria for the review.

Elements of PICo and study type	Inclusion criteria	Exclusion criteria
Participants/ population	PAIN1. Studies examining undergraduate bachelor-level nursing students (including, for example, pre-graduate nursing students, accelerated nursing students)	PAEX1. Studies in which the results of undergraduate bachelor-level nursing students cannot be distinguished from other data
Phenomena of interest	ININ1. Studies describing a tool which has been used and/or developed for the purpose of identifying individual nursing students at risk of dropping out	INEX1. No concrete tool is described in the study that could be used to identify individual nursing students at risk of dropping out INEX2. Studies examining actions or interventions to promote retention of nursing students without targeting interventions based on concrete identification of at-risk nursing students or targeting interventions based only on presumptions, such as for minority nursing students INEX 3. Studies exclusively examining a test or exam that evaluates or measures competence as the only tool used to identify nursing students at risk of dropping out INEX4. Studies examining tools based solely on academic success of nursing students (such as course grades or grade point averages)
Context	COIN1. Studies describing tools that can be used after the nursing students have started their nursing studies	COEX1. Studies describing tools that can be used to identify nursing students at risk of dropping out during the admission phase COEX2. Studies describing tools used exclusively for identifying nursing students at risk of final or licensure examination success or failure
Type of study	TYIN1. Original qualitative, quantitative or mixed-methods study TYIN2. Published in peer-reviewed journal TYIN3. English language	TYEX1. Not an empirical study TYEX2. Review study TYEX3. Not published in peer-reviewed journal TYEX4. Language other than English

considered relevant were selected, first for the review of the abstract and then for the full text screening. Due to the conceptual discrepancies in literature, throughout the selection phase both authors specifically checked that the definition of dropout used in this review matched with the definition or meaning used in the eligible studies, even though another term or concept might have been used. In all selection steps, disagreements were discussed until a consensus was reached, and a third reviewer (CS-L) was consulted when needed.

3.4. Critical appraisal

JBIC Critical Appraisal tools were used to assess the eligible studies according to their designs, independently by two authors (TP, CS-L). However, some studies did not clearly report their design, requiring the authors to make assumptions. First, both authors made an independent choice of the appropriate tool for each article, and the final choice was reached by discussion. The critical appraisal tools were chosen for cohort studies (Moola et al., 2020), quasi-experimental studies (Barker et al., 2024), analytical cross-sectional studies (Moola et al., 2020) and qualitative research (Lockwood et al., 2015). Consistent use of tools was ensured by piloting each with one article independently by both authors and discussing choices and justifications. After pilot assessment, both authors independently assessed the studies, and any discrepancies were discussed to reach a consensus, consulting a third author (EK-V) when necessary.

3.5. Data extraction and synthesis

Data from eligible studies were extracted independently by two authors (TP, EK-V) using a researcher-designed data extraction table (Supplementary File 1) piloted by both authors. The extracted data included a description of the tool, results concerning the ability of the tool to identify at-risk students and general study-related information, such as author, year, country, purpose, design, sample characteristics, data collection and analysis. Extracted data were compared and a consensus reached by discussion. The data were extracted from all included studies regardless of the quality assessment results.

A convergent integrated approach (Stern et al., 2020) was followed for data synthesis to address the research questions. Initially, the extracted quantitative data were qualited, meaning they were transformed into textual descriptions for narrative synthesis. This transformation was necessary to answer the second research question. The first review question was addressed by analysing verbatim text extracts from the studies. All textual data were synthesised following the steps outlined by Lucas et al. (2007). In the first step, qualited descriptions and verbatim text extracts were assembled and repeatedly examined to identify subgroups based on similarity of meaning. For example, in analysing the content areas of the tools, similarities were identified, and related content needed to appear in at least one other tool to form a subgroup, which could then be grouped further. In the second step, commentaries summarising the main points of each subgroup were produced. In the final, third step, subgroup syntheses were finalised through narrative writing. To ensure rigour, the synthesis process was conducted by the lead author (TP), checked by the second author (EK-V), and confirmed by the research team.

4. Results

4.1. Study inclusion

Overall, 7036 articles were found in the database search, and after removing duplicates, 3048 articles were screened by title and abstract. Full texts of 63 articles were reviewed, and in total 12 articles were included. No eligible studies were found in the reference lists of the included studies or relevant reviews. The full text studies that were excluded, and the reasons for exclusion are listed in Supplementary File

2, and the complete search and selection process is presented in Fig. 1.

4.2. Methodological quality

The methodological quality of the included studies varied. Over half of those studies which were appraised with quantitative criteria reached good quality, some even particularly good (Worthington et al., 2013; Donnell, 2015; Roso-Bas et al., 2016; Hannaford et al., 2021). Yet, some studies had lower scores, for instance all quasi-experimental studies (Elder et al., 2015; Donnell et al., 2018; Williams and Dahan, 2022) had scores ranging between 2/9–4/9, and the qualitative part of a one mixed-methods study (Fowler and Norrie, 2009) scored 2/10. No studies were excluded based on quality appraisal, given the small number of eligible studies overall and our aim to discover potential tools. Results of the critical appraisal are presented as summary scores in Table 2, and in more detail in Supplementary File 3.

4.3. Characteristics of included studies

The studies (Table 2) were conducted in the USA (n = 7), UK (n = 2), Australia (n = 1), Morocco (n = 1) and Spain (n = 1). The data were collected using questionnaires (n = 3), register data (n = 2), questionnaires together with register data (n = 6) or with individual interviews (n = 1). The participants were nursing students, though in one study (Fowler and Norrie, 2009), midwife students were also included. The students were mostly female (ranging from 77% to 88%) and in their first (n = 4) or second (n = 3) study year. Third-year students (n = 2), or students in different stages of their studies (n = 2), were also examined, or the study year was not reported (n = 2). The sample size varied between 144 and 6275. The studies were conducted in different undergraduate and bachelor-level nursing programmes in either universities, colleges of nursing, schools of nursing or nursing training institutes. One

study (El Fadely et al., 2024) did not specify the educational programme and another (Elder et al., 2015) the educational institution; in two studies (Fowler and Norrie, 2009; Johnson et al., 2009), the programme and institution were referred to as nursing programmes in nursing schools, however, based on other relevant information from the study articles, the educational programme could be assumed to be undergraduate, bachelor-level.

4.4. Tools identifying nursing students at risk of dropping out

In total, 14 tools for identifying nursing students at risk of dropping out were found (Table 3).

The tools included two sources of information for identification of at-risk students (Table 4). The tools (n = 12) were mainly *questionnaires based on self-assessment* of the nursing students. Two of these (tools no. 10, no. 11) included multiple instruments (Donnell, 2015; Roso-Bas et al., 2016), and one tool (no. 5) contained a set of pre-criteria used to select the programme entrants and, consequently, the survey respondents (Elder et al., 2015). The two remaining tools (no. 1, no. 3) were *machine learning methods using register data* from student records.

The origin of the tools, i.e. the purpose for which the tool was developed, varied (Table 3, Table 4), yet most of the tools (n = 10) were, from the start, *developed for identification of at-risk nursing students*, and only one of these (tool no. 2) was originally developed for college students in general, rather than specifically for nursing students (Betts et al., 2017). Two of these nine tools (no. 12, no. 14) were created post-study, based on the findings and conclusions made during the study (Fowler and Norrie, 2009; Elder et al., 2015). The remaining four tools (no. 4, no. 5, no. 10, no. 11) were used in the included studies to identify nursing students at risk of dropping out; however, these tools were *initially developed for other purposes*, e.g. tool no. 4 to measure professional identity of health and social care students (Worthington et al.,

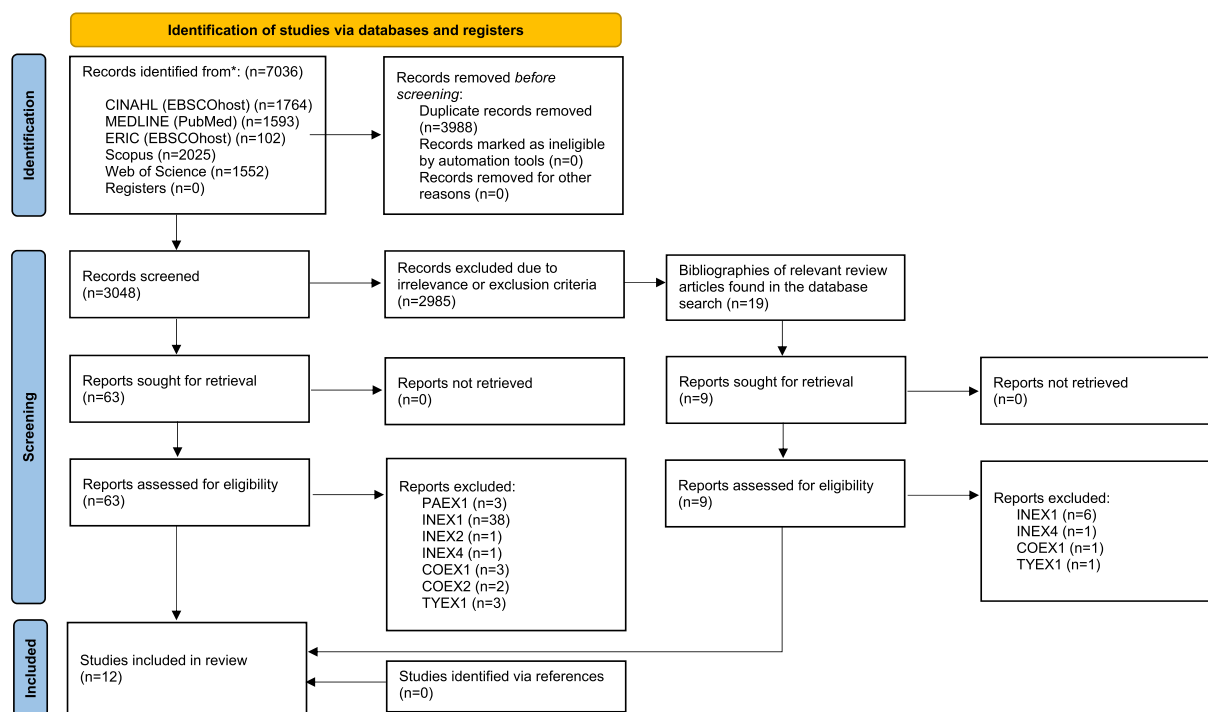


Fig. 1. Modified PRISMA 2020 flow diagram (Page et al. 2021).

Abbreviations: PAEX1 = Results of undergraduate bachelor-level nursing students cannot be distinguished from other data; INEX1 = No concrete tool described in the study that could be used to identify individual nursing students at risk of dropping out; INEX2 = Studies examining actions or interventions to promote retention of nursing students without targeting interventions based on concrete identification of at-risk nursing students or targeting interventions based only on presumptions, such as for minority nursing students; INEX4 = Studies examining tools based solely on academic success of nursing students (such as course grades or grade point averages); COEX1 = Studies describing tools that can be used to identify nursing students at risk of dropping out during the admission phase; COEX2 = Studies describing tools used exclusively for identifying nursing students at risk of final or licensure examination success or failure; TYEX1 = Not an empirical study.

Table 2
Overview of included studies.

Author (year), country	Purpose of the study	Participants a) sample, b) year of study, c) gender d) age e) educational programme and f) institution	Method a) design, b) data collection and c) data analysis	Tool identifying nursing student at risk of dropping out	Quality appraisal JBI
Betts et al. (2017), USA	To determine academic and social risk factors related to nursing student attrition using the CPQ	a) n = 163 nursing students, based on expert evaluation divided into at-risk and not-at-risk groups b) first year c) female 80.9% (n = 132), male 19.0% (n = 31) d) not reported e) baccalaureate nursing programme (BSN) f) one southern College of Nursing (CON)	a) quantitative, descriptive pre-test/post-test pilot study (for this paper pre-test questionnaire) b) online pre-test questionnaire, 2013–2014 c) descriptive statistics, inferential statistics	College Persistence Questionnaire (CPQ)	JBI Critical Appraisal Checklist for Cohort Studies: 5/9 N: Q5 & Q11 UC: Q2 & Q3 NA: Q9 & Q10
Donnell (2015), USA	To examine the associations among language, participation in a reading comprehension programme, and attrition rates of pre-licensure nursing students in Texas	a) n = 3258 nursing students b) not reported c) female 83.3% (n = 2714), male 16.7% (n = 544) d) age: min 18, max 72, mean 28.3, SD 8.652 (missing n = 13) e) initial RN licensure programme f) 27 programmes in Texas	a) retrospective, longitudinal correlational study b) online survey, student status (on track, off track/out) from participating programmes, data about reading comprehension programme use from website, June 2011 – May 2012 c) SPSS 21.0, descriptive statistics, logistic regression a) not reported	SATIN survey: - the nursing student survey-1 & 2 - the student perception appraisal-1 - self-efficacy scale	JBI Critical Appraisal Checklist for Cohort Studies: 9/10 UC: Q1 NA: Q10
Donnell et al. (2018), USA	To identify students at risk of attrition and implement interventions to decrease the risk	a) n = 6275 nursing students, based on SATIN survey divided into at-risk (n = 1255) and not-at-risk (n = 4962) groups b) not reported c) female 84% d) not reported e) initial RN licensure programme f) 27 programmes in Texas	b) online survey, at-risk status (statistical models applied to survey results), student status (on track, off track/out) from participating programmes, data about reading comprehension programme use from website, intervention activities from faculty weekly logs, June 2011 – May 2013 c) descriptive statistics, general linear logistic regression a) not reported	SATIN survey: - the nursing student survey-1 & 2 - the student perception appraisal-1 - self-efficacy scale	JBI Checklist for quasi-experimental studies: 3/9 N: Q2, Q4 UC: Q3, Q5, Q8, Q9
Elder et al. (2015), USA	To evaluate a comprehensive programme to identify and support students at risk for failure in nursing courses or NCLEX-RN	a) nursing students (n = 183) based on CMM criteria divided into at-risk (n = 83) and not-at-risk (n = 100) groups b) first year (second semester) c) not reported d) not reported e) bachelor of science nursing programme f) not reported	a) not reported b) questionnaire, admission GPA, grades, success on NCLEX-RN and graduation from register c) descriptive statistics, inferential statistics	Motivated Strategies for Learning Questionnaire (MSLQ) + Case management model (CMM) eligibility criteria Self-Evaluation of Nursing Students	JBI Checklist for quasi-experimental studies: 2/9 N: Q5 (outcomes 1, 2) UC: Q2, Q3, Q4, Q6, Q7, Q8 (outcome 2, result 1), Q9 NA: Q5 (outcome 3)
El Fadely et al. (2024), Morocco	To explore the factors driving students to choose nursing to leave their programmes and the relationship between reasons for choice and intentions to withdraw	a) n = 696 nursing students b) second and third year c) female 77.0% (n = 536), male 23.0% (n = 160) d) age: 18–23 n = 691 (99.3%), 24–29 n = 4 (0.6%), 30–35 n = 1 (0.1%); average age of the students (all options combined) was 20.58 ± 1.18 years, with extremes of 18 and 35 years e) not reported	a) multi-center cross-sectional study b) questionnaire, April – May 2023 c) SPSS 22.0, descriptive statistics, internal consistency, binary logistic regression	Questionnaire by El Fadely et al.	JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies: 3/8 N: Q6, UC: Q2, Q3, Q5, Q7

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Table 2 (continued)

Author (year), country	Purpose of the study	Participants a) sample, b) year of study, c) gender d) age e) educational programme and f) institution	Method a) design, b) data collection and c) data analysis	Tool identifying nursing student at risk of dropping out	Quality appraisal JBI
Fowler and Norrie (2009), UK	To identify underlying reasons why pre-registration nurses and midwives may consider leaving their programme of study	f) 3 public nursing training institutes in Marrakech, Essaouira and Safi in Morocco a) n = 605 students in nursing or midwifery (questionnaire); n = 10 students in nursing or midwifery (from the sample of 605), n = 35 lecturers (interviews) b) not reported c) female 88.4% (n = 535), male 10.7% (n = 65) d) age: mean age of 27.8 years, a median age of 25 years and a mode of 18 years e) nursing and midwifery programmes	a) not reported b) questionnaire, individual interviews, December 2007 – March 2008; student attrition records and exit forms for the last 4 years c) SPSS 14.0, descriptive statistics, inferential statistics, multiple regression analysis; qualitative data reviewed to identify emerging themes	Questionnaire by Fowler & Norrie Student support requirements - prediction tool	JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies: 5/8 N: Q3 UC: Q2, Q7 JBI Critical Appraisal Checklist for Qualitative Research: 2/10 N: Q1, Q4, Q7, Q8 UC: Q2, Q3, Q5, Q6
Hannaford et al. (2021), USA	To determine the effectiveness of popular machine learning algorithms to build multiple models and predict possible dropout students at the beginning of each academic year starting from the first enrolment in a traditional baccalaureate nursing programme. In addition, factors related to successful graduation are to be identified using several of the algorithms	f) one medium-sized UK school of nursing and midwifery a) n = 773 nursing students b) each study year c) not reported d) not reported e) a traditional 4-year baccalaureate nursing programme f) one College of Nursing in a private university in an urban Midwest city, USA	a) quantitative descriptive design b) demographic background, high school information, college GPA and graduation status from register, over the entry period 2004–2012 c) R language, machine-learning models constructed by 9 algorithms and combining different variable sections	Student registry data by Hannaford et al.	JBI Critical Appraisal Checklist for Cohort Studies: 8/8 NA: Q1, Q2, Q10
Johnson et al. (2009), USA	To investigate whether and to what degree PBPS risks (PBPS-identified noncognitive and cognitive risks, challenges or concerns that can compete with or inhibit effective academic performance) predict adverse academic status events (AASE). To assess the predictive validity and reliability of the PBPS for newly matriculated underrepresented minority students (URMS) and non-URMS in two diverse nursing schools	a) n = 375 nursing students (2004: n = 187; 2005: n = 188) b) 2004: first year, second year; 2005: first year c) female: 2004 nursing school A 86.1% and B 86.6%; 2005 nursing school A 84.1% and B 92.8% d) age: older than 30 years: 2004 nursing school A 4.2% and B 22.3%; 2005 nursing school A 11.1% and B 22.4% e) nursing programme f) two southwestern U.S. nursing schools (nursing school A, nursing school B)	a) not reported b) questionnaire, 2004–2005; first and second year adverse academic status event (AASE) occurrence from student records c) SPSS 14.0, descriptive statistics, binary logistic regression	Personal Background and Preparation Survey (the 2004 PBPS) Personal Background and Preparation Survey (the 2005 PBPS)	JBI Critical Appraisal Checklist for Cohort Studies: 4/9 N: Q4, Q5, Q7, Q8 UC: Q3 NA: Q2, Q10
Moseley and Mead (2008), UK	Not reported	a) n = 528 nursing students b) during studies (the exact study year not mentioned) c) not reported d) not reported e) undergraduate (bachelor) nursing programme (personal notification from Moseley 11/2024) f) university	a) not reported b) time-invariant (age, gender, entry qualifications, branch of nursing) and time-varying (grades, attendance) data from student record, over a 5-year entry period c) SPSS, univariate and multivariate analyses, rule induction (CHAID)	Student registry data by Moseley & Mead	JBI Critical Appraisal Checklist for Cohort Studies: 6/8 UC: Q8, Q11 NA: Q1, Q2, Q10

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Table 2 (continued)

Author (year), country	Purpose of the study	Participants a) sample, b) year of study, c) gender d) age e) educational programme and f) institution	Method a) design, b) data collection and c) data analysis	Tool identifying nursing student at risk of dropping out	Quality appraisal JBI
Roso-Bas et al. (2016), Spain	To explore the relationship between variables of the emotional sphere (emotional intelligence, optimism/pessimism, depressive rumination), and academic performance and tendency to dropout in a sample of nursing students in Spain	a) n = 144 nursing students b) third year c) female 82% (n = 118), male 18% (n = 26) d) age: mean age of 25 years (SD = 6.9; mode 20 years old, range 19–52) e) 4-year undergraduate nursing programme f) the University of the Balearic Islands in Spain	a) cross-correlational b) questionnaire c) SPSS 19.0, descriptive statistics, internal consistency, bivariate correlations, multiple regression analysis	Questionnaire by Roso-Bas et al.: - Trait Meta-Mood Scale, Spanish Version (TMMS-24) - Life Orientation Test—Revised, Spanish Version (LOT-R) - Ruminative Responses Scale, Spanish Version (RRS)	JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies: 7/8 UC: Q8
Williams and Dahan (2022), USA	To identify at-risk nursing students early to ensure student success through appropriate referrals on campus	a) n = 161 nursing students b) second year c) not reported d) not reported e) bachelor of science in nursing (BSN) programme f) School of Nursing, Rutgers University–Camden	a) not reported b) electronic pre-test and post-test survey, aggregate use of retention services from student success management software, secondary analysis of the data obtained September–December 2020, retention rate Fall 2021 c) Stata statistical software 17, descriptive statistics, internal consistency, test-retest reliability, factor analysis	Student Perception Appraisal-Revised 1 (SPA-R1) and 2 (SPA-R2)	JBI Checklist for quasi-experimental studies: 4/9 N: Q2, Q4, Q8 UC: Q7, Q9
Worthington et al. (2013), Australia	To evaluate the psychometric properties of a professional identity scale and to determine the relationship between professional identity and student retention in a large group of first year nursing students	a) n = 540 nursing students b) first year c) female 82% d) age: the mean age of the sample was 25.3 (SD: 8.4), ranging from 17 to 52 years e) bachelor of nursing (BN) course f) one Australian university in Sydney	a) survey study (part of larger longitudinal follow-up study) b) questionnaire, August–September 2009, student dropout rates 12 months later c) SPSS 17.01, construct validity, internal consistency, discriminant power, corrected item-total correlation, logistic regression	Macleod Clark's 9-item Professional Identity Scale (MCPIS-9)	JBI Critical Appraisal Checklist for Cohort Studies: 8/8 NA: Q1, Q2, Q10

2013) or tool no. 5 to assess college students' motivational orientations and use of learning strategies (Elder et al., 2015).

The tools also included suggestions for actions after identification of at-risk students (Table 4). Half of the tools (n = 7) guided to *offer targeted support actions based on identification*, since these tools enabled recognition of the specific risks for the identified student and recommended support for these individual needs. Three tools (no. 2, no. 3, no. 4) proposed that, *based on identification, support should be offered*; however, there was no mention that this support could be targeted specifically to the needs of the identified student with the help of this tool. The remaining four tools (no. 1, no. 8, no. 9, no. 10) contained *no suggestion of concrete actions* with which to proceed after identification.

The tools consisted of student-, study- and support-related content areas for dropout risk identification (Table 5).

One of the student-related content areas was the *psychological and emotional characteristics* of the student (n = 9), which included self-efficacy (tools no. 2, no. 5, no. 6, no. 7, no. 9, no. 11, no. 12, no. 13) and other motivation-related characteristics, such as determination (tools no. 6, no. 7, no. 12), task value beliefs (tools no. 2, no. 5) or academic conscientiousness (tool no. 2). Perceived emotional intelligence, optimism/pessimism, ruminative response style (tool no. 10) and stress (tool no. 2) were also included in this content area. *Personal life*

responsibilities and events (n = 7), on the other hand, referred to having substantial home life or family responsibilities (tools no. 9, no. 13), having children (tool no. 6, no. 7, no. 13, no. 14) or other dependents (tool no. 14) or having difficult personal or family situations (tools no. 2, no. 6, no. 7, no. 12, no. 14). Another student-related content area was *professional identification and commitment* (n = 6) which concerned identifying positively with the nursing profession (tool no. 4), reasons for selecting nursing as career (tool no. 8), having former knowledge or experience of nursing (tool no. 14), commitment to earning a degree (tool no. 2) or pursuing a career in nursing (tool no. 9) and professional integration and engagement (tool no. 13).

Study-related content areas included the student's *academic performance* (n = 8), which consisted of both objective measures, such as grades and marks (tools no. 1, no. 5, no. 9, no. 11, no. 14), grade point averages (tool no. 3), scores in standardised testing (tool no. 5) or academic outcomes in previous educational institutions (tool no. 3, no. 11, no. 14), and subjective measures, such as the respondent's own perception of academic performance (tools no. 12, no. 13). *Study skills and ability* (n = 8) of the student concerned test-taking skills, time management and self-discipline (tool no. 12), critical thinking and metacognitive self-regulation (tool no. 5), personal academic factors (tool no. 13), learning differences (tool no. 14), experiences from

Table 3
 Characteristics of the tools identifying nursing students at risk of dropping out.

Tool identifying at-risk students	Study (year)	Origin of the tool	Description and content	Response scale	Suggestion of targeted support
No. 1. Student registry data by Moseley & Mead	Moseley and Mead (2008)	A rule induction package available from SPSS Used for the first time to predict the dropout behaviours of nursing students	Student registry data analysed by rule induction (method used in machine learning), which induced IF-THEN rules to explain the relationship between independent variables and probability of withdrawing prematurely Rules created automatically by the system, from time-invariant (e.g., age, gender) and time-varying items (grades, attendance) available on university's database system	NA	Not mentioned
No. 2. College Persistence Questionnaire (CPQ)	Betts et al. (2017)	Developed by Davidson et al. (2009) to identify students at risk of dropping out of college, ensure why student is dropping out and identify persistence variables	Questionnaire with 53 items forming six factors: 1) institutional commitment, 2) degree commitment, 3) academic integration, 4) social integration, 5) support services satisfaction, 6) academic conscientiousness	3-point Likert scale, response options varied from one item to another	Not mentioned
No. 3. Student registry data by Hannaford et al.	Hannaford et al. (2021)	Developed by researchers during the study to predict possible dropout students at the beginning of each academic year	Student registry data analysed by machine-learning models constructed with 9 algorithms (C5.0, random forest, xgboost, neural networks, support vector machine, Naïve Bayes, K-nearest neighbour, logistic regression, stacked ensemble method) 14 scenarios built for each algorithm through different variable combinations (demographic background, high school information, college GPA from register) at 5 time points (start of year 1, 2, 3, 4, graduation). Altogether 126 models constructed to predict at-risk students and investigate which model is the best predictor	NA	Not mentioned
No. 4. Macleod Clark's 9-item Professional Identity Scale (MCPIS-9)	Worthington et al. (2013)	Developed by Macleod Clark et al. (Adams et al., 2006) to measure professional identity in health and social care students for the purpose of examining the impact of professional identity on interprofessional education	Questionnaire ^a with 9 items concerning feelings about belonging to, and positively identifying with the nursing profession	6-point Likert scale, responses ranging from strongly disagree to strongly agree	Not mentioned
No. 5. Motivated Strategies for Learning Questionnaire (MSLQ) + Case management model (CMM) eligibility criteria	Elder et al. (2015)	MSLQ developed by Pintrich et al. (1991) to assess college students' motivational orientations and their use of different learning strategies CMM eligibility criteria developed by the researchers to evaluate which students eligible for case management model (CMM) programme, in which the MSLQ was used in this study (Elder et al., 2015)	Questionnaire with 4 subscales selected from two sections (motivation, learning strategies) of the MSLQ: 1) student's self-efficacy for learning and performance, 2) task value beliefs for a course, 3) critical thinking, 4) metacognitive self-regulation Criteria for CMM programme: 1) ATI scores less than 50th percentile or, 2) grade C or less in a prerequisite science course or, 3) grade C or less in a nursing course	Not mentioned	Used with list of specific recommendations given to students for each area they indicated having difficulty
No. 6. Personal Background and Preparation Survey (the 2004 PBPS)	Johnson et al. (2009)	Developed by the researchers to facilitate primary (identifying at-risk students early to prevent attrition) and	Questionnaire ^a with 69 items, including 47 PBPS risk items which assess 10 categories of noncognitive and cognitive	5-point Likert scale, dichotomous response alternatives, other forms of nonmetric multiple	Used with individualised PBPS Reports presenting overall and categorised risk totals, naming

(continued on next page)

Table 3 (continued)

Tool identifying at-risk students	Study (year)	Origin of the tool	Description and content	Response scale	Suggestion of targeted support
		secondary (identifying early students entering the attrition process) level prevention strategies	risks, challenges and concerns: 1) personal, 2) familial, 3) academics, 4) self-concept, 5) support, 6) financial, 7) leadership, 8) discrimination, 9) community service, 10) long-range goals	response alternatives For each risk item risk responses identified and scored dichotomously (1 = risk response, 0 = non risk response)	identified risks and prescribing interventions or resources
No. 7. Personal Background and Preparation Survey (the 2005 PBPS)	Johnson et al. (2009)	Revised from the original 2004 PBPS version based on feedback: risk responses and categories further developed, implemented and modified	Questionnaire ^a with 83 items, including 64 PBPS risk items which assess 10 categories of noncognitive and cognitive risks, challenges and concerns: 1) personal, 2) familial, 3) academics, 4) self-concept, 5) support, 6) financial, 7) leadership, 8) discrimination, 9) community service, 10) long-range goals	5-point Likert scale, dichotomous response alternatives, other forms of nonmetric multiple response alternatives	Used with individualised PBPS Reports presenting overall and categorised risk totals, naming identified risks and prescribing interventions or resources
No. 8. Questionnaire by El Fadely et al.	El Fadely et al. (2024)	Developed by the researchers to explore the factors driving students to choose nursing to leave their programmes and the relationship between reasons for choice and intentions to withdraw	Questionnaire with 13 items concerning reasons influencing the selection of nursing as career Included 1 item concerning intention to stop studies and if answered yes, asked to answer 10 items indicating reasons for intention to discontinue	5-point Likert scale, responses ranging from strongly disagree to strongly agree	Not mentioned
No. 9. Questionnaire by Fowler & Norrie	Fowler and Norrie (2009)	Developed by the researcher to explore the relationship between how seriously students had considered resigning and predictor variables	Questionnaire with 27 items regarding factors that may cause students to consider leaving or help them stay Included 1 item recording how seriously students had considered resigning	Not mentioned 4-point Likert scale, (1 = a lot, 2 = quite often, 3 = once or twice, 4 = never)	Not mentioned
No. 10. Questionnaire by Roso-Bas et al.: - Trait Meta-Mood Scale, Spanish Version (TMMS-24) - Life Orientation Test—Revised, Spanish Version (LOT-R) - Ruminative Responses Scale, Spanish Version (RRS)	Roso-Bas et al. (2016)	TMMS-24 developed by Salovey et al. (1995), Spanish Version by Fernandez-Berrocá et al. (2004) to measure perceived emotional intelligence LOT-R developed by Scheier et al. (1994), Spanish Version by Ferrando et al. (2002) to measure dispositional optimism-pessimism RRS developed by Nolen-Hoeksema and Morrow (1991), Spanish Version by Hervás Torres (2008) to assess the ruminative response style	Questionnaire ^a with 24 items, consisting of 3 subscales: 1) emotional attention, 2) emotional clarity, 3) emotional repair Questionnaire ^a with 10 items, consisting of 2 subscales: 1) optimism, 2) pessimism Questionnaire ^a with 22 items, consisting of two factors: 1) rumination depression, 2) rumination reflection Included also two items concerning intention to abandon studies	Not mentioned 5-point Likert scale, responses ranging from strongly disagree to strongly agree 4-point Likert scale, responses ranging from almost never to almost always 7-point Likert scale, responses ranging from strongly disagree to strongly agree	Not mentioned
No. 11. SATIN survey: - the nursing student survey-1 & 2 - the student perception appraisal-1 - self-efficacy scale	Donnell (2015) Donnell et al. (2018)	Developed by the researchers to collect information on each student regarding demographics, preadmission academic outcomes, perceptions of family and social support, and perceptions of personal qualities, and this information used to determine if student considered at risk for attrition (Donnell, 2015)	Questionnaire ^a consisting of 4 separate surveys: 1) the nursing student survey-1 2) the nursing student survey-2 3) the student perception appraisal-1 4) a self-efficacy scale (Donnell, 2015) At risk determination statistical models applied to survey results categorising them as “at-risk” or “not-at-risk” (Donnell et al., 2018)	Not mentioned	Used with at-risk determination form, listing at-risk students and indicating individual flags on key attributes and interventions provided based on student needs
No. 12. Self-Evaluation of Nursing Students	Elder et al. (2015)	Developed post-study by the researchers and using the MSLQ as a guide, to identify students having difficulties and to help the instructor direct activities that can	Questionnaire ^a with 17 items concerning performance in nursing didactic and clinical courses, performance in the pre-requisite science courses, standardised examinations	5-point scale, (5 = having no problem, 1 = having difficulty in this area)	Used with written feedback given by faculty member and including standardised recommendations personalised for the areas with low scores

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Table 3 (continued)

Tool identifying at-risk students	Study (year)	Origin of the tool	Description and content	Response scale	Suggestion of targeted support
No. 13. Student Perception Appraisal-Revised 1 (SPA-R1) and 2 (SPA-R2)	Williams and Dahan (2022)	improve chances for being successful with nursing school and NCLEX-RN Developed by Jeffreys (2007) to measure and evaluate students' perceptions of how restrictive or supportive select academic, environmental and professional integration occurs within the programme	(ATI), test-taking skills, time management and self-discipline Questionnaire with 27 items assessing the 8 factors of Jeffreys' NURS model: 1) interaction of student profile characteristics, 2) student affective factors, 3) academic factors, 4) environmental factors, 5) academic outcomes, 6) psychological outcomes, 7) outside surrounding factors, 8) professional integration 4 multi-item subscales identified (Williams and Dahan, 2022) and used to tag at-risk students: 1) low personal/college support, 2) financial challenges, 3) excessive work hours, 4) substantial family obligations	6-point Likert scale, (1 = does not apply, 2 = severely restricts, 3 = moderately restricts, 4 = does not restrict or support, 5 = moderately supports, 6 = greatly supports)	Used with student success management software tagging factors in student's record if individual rating deviated from the mean on any subscale. Based on tags referrals made by faculty using resources matched for each subscale factor
No. 14. Student support requirements - prediction tool	Fowler and Norrie (2009)	Developed post-study by the researchers, based on the findings of the study (Fowler and Norrie, 2009), to identify students at risk of leaving the course and to some extent quantify that risk	Questionnaire ^a with 12 items presenting risk factors and general criteria for them Risk factors: academic entry, age, year of programme, previous experience, dependents (children and partner or parents), learning differences, programme attendance, previous module results, finance, additional work, additional life events	Score from 0 to 3, (0 = not relevant, criteria for 1-3 varied from item to another)	Used with corresponding guidance tool with suggestions and contact details for support services available. Support individually targeted

^a In original articles varied terms were used.

previous studies (tools no. 6, no. 7, no. 9) and study attendance (tool no. 1, no. 14). Additionally, content related to *clinical practice* (n = 2), such as negative or positive experiences during clinical practicum (tool no. 9) or perception of clinical performance (tool no. 12), was one of the study-related content areas.

Support-related content areas contained the student's *personal support* (n = 7), referring to support from friends, family (tools no. 2, no. 9, no. 11, no. 13) and other students (tools no. 2, no. 9, no. 12), and having someone who listens and helps (tools no. 6, no. 7). Second, this content area included *organisational support* (n = 3), consisting of satisfaction with support services from the organisation, such as counselling or advising (tools no. 2, no. 9, no. 13), tutoring or mentoring (tools no. 9, no. 13) and support from faculty (tool no. 2, no. 9). Support-related content also included the student's *financial status* (n = 6), consisting of financial challenges, concerns or strain (tools no. 2, no. 6, no. 7, no. 9, no. 13, no. 14) and employment hours or additional work (tools no. 13, no. 14).

4.5. Ability of the tools to identify nursing students at risk of dropping out

The ability of the tools to identify nursing students at risk of dropping out was examined from different perspectives, either as the ability of the tool to 1) predict actual or 2) intended dropout or 3) warning signals, or to 4) differentiate at-risk and not-at-risk students (Table 6). Nonetheless, with four tools (no. 11, no. 12, no. 13, no. 14) the *ability to identify* was not directly measured.

The *ability to predict the actual dropout* was identified with three of the tools (no. 1, no. 3, no. 4). Tool no. 1 was able to identify, at the beginning of the studies, 31% and during studies 84% of those who later dropped out, and it made 94% accurate predictions during studies (Moseley and Mead, 2008). However, with tool no. 3, the sensitivities ranged from 50% to 98%, and overall accuracy from 82% to 99%, at different stages

of nursing studies (Hannaford et al., 2021). With both tools, the predictions improved significantly with growing data on student performance (Moseley and Mead, 2008; Hannaford et al., 2021). With tool no. 4, students with high scores were more likely to remain in the programme at 12 months, i.e. those with lower scores were more likely to drop out (Worthington et al., 2013).

The *ability of the tool to predict the nursing student's intention to drop out*, instead of actually dropping out, was examined using three tools (no. 8, no. 10, no. 9). With tool no. 8, six career choice factors were significantly associated, three positively and three negatively, with the nursing student's intention to drop out, being true in 84% of cases (El Fadely et al., 2024). As for tool no. 10, two significant predictors, age and pessimism, were identified and correlated positively with the intention to drop out (Roso-Bas et al., 2016). Eight significant items associated with intention to drop out were identified with tool no. 9, four of these being positively and four negatively associated (Fowler and Norrie, 2009).

The *ability to predict actual dropout or warning signals* was examined with tools no. 6 and no. 7. With these tools, the standardised total risks significantly predicted adverse academic status event (AASE) occurrence, which referred to the presence of certain codes in student's record. These codes included actual dropout but also events that may lead to or promote dropping out; thus, acting as warning signals, for instance semester warning, remedial assistance or repeating a course. The overall accuracy for tool no. 6 ranged from 70% to 73% and sensitivity from 75% to 81%; whereas, with tool no. 7, the overall accuracy was 75% and sensitivity 70%. (Johnson et al., 2009.)

With tools no. 5 and no. 2, the *ability to differentiate at-risk students from not-at-risk students* was examined, and significant differences between these students were identified based on self-efficacy and metacognition (Elder et al., 2015) and 16 individual items (Betts et al., 2017). However, it is noteworthy that, for tool no. 2, the division into at-risk and not-at-risk groups was based on expert experience (Betts et al.,

Table 4
Source of information, origin of the tools and suggestions for actions after identification.

Tool identifying at-risk nursing students	Source of information		Origin of the tool ^a		Suggestions for actions after identification		
	Questionnaires based on self-assessment	Machine learning methods using register data	Developed for identification of at-risk nursing students	Initially developed for other purposes	Based on identification targeted support should be offered	Based on identification support should be offered	No suggestion of concrete actions
No. 1. Student registry data by Moseley & Mead		x	x				x
No. 2. College Persistence Questionnaire (CPQ)	x		x			x	
No. 3. Student registry data by Hannaford et al.		x	x			x	
No. 4. Macleod Clark's 9-item Professional Identity Scale (MCPIS-9)	x			x		x	
No. 5. Motivated Strategies for Learning Questionnaire (MSLQ) + Case management model (CMM) eligibility criteria	x			x	x		
No. 6. Personal Background and Preparation Survey (the 2004 PBPS)	x		x		x		
No. 7. Personal Background and Preparation Survey (the 2005 PBPS)	x		x		x		
No. 8. Questionnaire by El Fadely et al.	x		x				x
No. 9. Questionnaire by Fowler & Norrie	x		x				x
No. 10. Questionnaire by Roso-Bas et al.: - Trait Meta-Mood Scale, Spanish Version (TMMS-24) - Life Orientation Test—Revised, Spanish Version (LOT-R) - Ruminative Responses Scale, Spanish Version (RRS)	x			x			x
No. 11. SATIN survey: - the nursing student survey-1 & 2 - the student perception appraisal-1 - self-efficacy scale	x			x	x		
No. 12. Self-Evaluation of Nursing Students	x		x			x	
No. 13. Student Perception Appraisal-Revised 1 (SPA-R1) and 2 (SPA-R2)	x		x			x	
No. 14. Student support requirements - prediction tool	x		x			x	

^a Origin of the tool described in more detail in Table 3.

2017) and thus is not objective.

5. Discussion

This review found 14 tools to identify an individual bachelor-level nursing student at risk of dropping out. The ability of these tools to identify at-risk students varied and was examined from different perspectives and with diverse statistical methods, or was not measured at all. Due to this, the possibility to compare the tools regarding their ability is limited. While registry-based tools appear to have stronger evidence of their capability to identify at-risk students, the questionnaires are able to consider the important personal, emotional and life-stituation factors excluded from the register data.

The number of identification tools included in this review appears to be relatively small, compared to the wide range of studies concerning the factors associated with nursing student dropout (e.g., Chan et al.,

2019; Shaver and Viveiros, 2024) or retention (e.g., Smith-Wacholz et al., 2019; Bumby, 2020). This may be due to the complexity of combining the multiple related factors (Hamshire et al., 2019), as a concrete tool to measure the dropout risk of an individual student. Several intermediate variables, difficult to control during studies, could affect the results making it difficult to prove the identification ability of the tools. Despite these challenges, the importance of identifying students at risk, to individually support them (Mooring, 2016; Custer, 2018; Smith-Wacholz et al., 2019), deserves concrete methods. In some studies, many concepts were mixed to describe dropping out (Moseley and Mead, 2008; Fowler and Norrie, 2009; Worthington et al., 2013; Betts et al., 2017; Hannaford et al., 2021; El Fadely et al., 2024), and only few defined what they exactly meant by the chosen concept or referred to a theoretical framework (Donnell, 2015; Donnell et al., 2018; Williams and Dahan, 2022). Hence, for future studies, consistent use of concepts and definitions when developing and testing tools should be

Table 5
Content areas of the tools identifying nursing students at risk of dropping out.

Tool identifying at-risk nursing students	Student-related content			Study-related content			Support-related content		
	Psychological & emotional characteristics	Personal life responsibilities & events	Professional identification & commitment	Academic performance	Study skills & ability	Clinical practice	Personal support	Organisational support	Financial status
No. 1. Student registry data by Moseley & Mead				x	x				
No. 2. College Persistence Questionnaire (CPQ)	x	x	x				x	x	x
No. 3. Student registry data by Hannaford et al.				x					
No. 4. Macleod Clark's 9-item Professional Identity Scale (MCPIS-9)			x						
No. 5. Motivated Strategies for Learning Questionnaire (MSLQ) + Case management model (CMM) eligibility criteria	x			x	x				
No. 6. Personal Background and Preparation Survey (the 2004 PBPS)	x	x			x		x		x
No. 7. Personal Background and Preparation Survey (the 2005 PBPS)	x	x			x		x		x
No. 8. Questionnaire by El Fadely et al.			x						
No. 9. Questionnaire by Fowler & Norrie	x	x	x	x	x	x	x	x	x
No. 10. Questionnaire by Roso-Bas et al.: - Trait Meta-Mood Scale, Spanish Version (TMMS-24) - Life Orientation Test—Revised, Spanish Version (LOT-R) - Ruminative Responses Scale, Spanish Version (RRS)	x								
No. 11. SATIN survey: - the nursing student survey-1 & 2 - the student perception appraisal-1 - self-efficacy scale	x			x			x		
No. 12. Self-Evaluation of Nursing Students	x	x		x	x	x	x		
No. 13. Student Perception Appraisal-Revised 1 (SPA-R1) and 2 (SPA-R2)	x	x	x	x	x		x	x	x
No. 14. Student support requirements - prediction tool		x	x	x	x				x

ensured.

The tools differed concerning the emphasis on content areas for dropout risk identification, some tools focusing on only one content area (Worthington et al., 2013; Roso-Bas et al., 2016; Hannaford et al., 2021; El Fadely et al., 2024), and others covering content areas more diversely (e.g., Fowler and Norrie, 2009; Williams and Dahan, 2022). Among the most frequently measured content areas were psychological and emotional characteristics of students, students' academic performance, study skills and ability and personal support. These content areas, strongly supported by former literature reviews on dropout-related factors (e.g. Eick et al., 2012; Mooring, 2016; Chan et al., 2019; Shaver and Viveiros, 2024), seem obvious, even traditional, choices to be included in identification tools. Content related to clinical practice, on the other hand, was least measured among the tools, which appears

surprising considering the influence of placement-related issues on dropout decisions (Eick et al., 2012; Chan et al., 2019; Soerensen et al., 2023; Thompson et al., 2025). Furthermore, none of the tools included an opportunity for the student to rate what factors they consider most important when deciding to drop out or continue, thus assuming that the students would relate similarly to certain risk factors. Since students with similar circumstances would not necessarily end up with the same decision (Urwin et al., 2010), the possibility to prioritise different factors according to personal preferences can be considered in future tools.

The tools also differed based on suggestions for actions after identification of at-risk students. Although recognising a student at risk of dropping out is the main feature of all these tools, the identification of the risk factors and specific needs of an individual student with the help of the tool is essential to enable targeted support to be provided, as

Table 6
The ability of the tools to identify at-risk students.

	Tool a) data source, b) analysis method, c) validation ^a : yes, partly, no	Ability of the tool to identify at-risk students	
Ability to predict actual dropout	No. 1. Student registry data by Moseley & Mead a) register data b) machine learning with Answer Tree Package from SPSS c) NA	Overall accuracy: - 94% during course Sensitivity: - 31% at start of course - 84% during course	Time invariant (poor prediction capability) and time-varying data from student register Time-varying data (student performance) increased sensitivity adding the effectiveness of prediction
	No. 3. Student registry data by Hannaford et al. a) register data b) different machine learning models c) NA	Overall accuracy of stacked models: - 82% after 1. year - 91% after 2. year - 99% after 3. year Sensitivity of stacked models: - 50% after 1. year - 73% after 2. year - 98% after 3. year	Demographic background, high school information and college academic performance College academic performance improved the prediction accuracy and sensitivity; demographic background and high school information did not have a significant impact on the prediction
	No. 4. Macleod Clark's 9-item Professional Identity Scale (MCPIS-9) a) questionnaire b) logistic regression c) yes	High MCPIS-9 scores significantly predicted retention at 12 months: - OR 1.06 (95% CI 1.02–1.10)	MCPIS-9 score
	Tool a) data source, b) analysis method, c) validation ^a : yes, partly, no	Ability of the tool to identify at-risk students	
Ability to predict intention to drop out	No. 8. Questionnaire by El Fadely et al. a) questionnaire b) logistic regression c) partly	Overall accuracy: - 84% 3 factors positively associated: - ease of finding a job: OR 3.587 (95% CI 2.914–4.416) - salary: OR 1.259 (95% CI 1.054–1.504) - opportunities to work and/or study abroad: OR 1.196 (95% CI 1.010–1.417) 3 factors negatively associated: - desire to care for and help others: OR 0.791 (95% CI 0.649–0.963) - positive social image of the nursing profession: OR 0.995 (95% CI 0.502–0.704) - obtaining a diploma: OR 0.586 (95% CI 0.489–0.702)	6 career choice factors: - ease of finding a job - salary - opportunities to work and/or study abroad - desire to care for and help others - positive social image of the nursing profession - obtaining a diploma
	No. 10. Questionnaire by Roso-Bas et al.: - TMM5-24, Spanish Version - LOT-R, Spanish Version - RRS, Spanish Version a) questionnaire b) correlation and regression analysis c) yes	Pessimism positively correlated: - beta 0.39 Age positively correlated: - beta 0.21	Pessimism (measured with LOT-R) Age
	No. 9. Questionnaire by Fowler & Norrie a) questionnaire b) correlation and regression analysis c) partly	4 items positively associated: - committed to profession: β 0.291 - having pre-understanding of studies: β 0.112 - well prepared due to previous studies: β 0.078 - financial assistance: β 0.068 4 items negatively associated: - too much work: β -0.133 - financial difficulties: β -0.077 - not having pre-understanding: β -0.083 - increased home life responsibilities: β -0.60	8 significant items: - committed to profession - having pre-understanding of studies - well prepared due to previous studies - financial assistance - too much work - financial difficulties - not having pre-understanding - increased home life responsibilities
	Tool a) data source, b) analysis method, c) validation ^a : yes, partly, no	Ability of the tool to identify at-risk students	
Ability to predict actual dropout or warning signals	No. 6. Personal Background and Preparation Survey (the 2004 PBPS) a) questionnaire b) logistic regression c) yes	Standardised 2004 PBPS total risks significantly predicted AASE occurrence: - OR 1.56 (95% CI 1.06–2.29) during 1. year - OR 1.57 (95% CI 1.07–2.31) during 2. year - OR 1.58 (95% CI 1.08–2.32) during 1. or 2. year Overall accuracy: - 70% after 1. year - 73% after 2. year - 73% for either year Sensitivity: - 75% after 1. year - 80% after 2. year - 81% for either year	The standardised 2004 PBPS total risks
	No. 7. Personal Background and Preparation Survey (the 2005 PBPS) a) questionnaire b) logistic regression c) yes	Standardised 2005 PBPS total risks significantly predicted AASE occurrence: - OR 1.47 (95% CI 1.04–2.09) during 1. year Overall accuracy: - 75% after 1. year Sensitivity: - 70% after 1. year	The standardised 2005 PBPS total risks
	Tool a) data source, b) analysis method, c) validation ^a : yes, partly, no	Ability of the tool to identify at-risk students	
Ability to differentiate at-risk students from not-at-risk students	No. 5. Motivated Strategies for Learning Questionnaire (MSLQ) + Case management model (CMM) eligibility criteria a) questionnaire b) t-test c) yes	Significant differences between at risk and not-at-risk student groups (divided based on the CMM eligibility criteria): - self-efficacy: mean significantly higher for at-risk group - metacognition: mean significantly higher for at-risk group	Self-efficacy Metacognition
	No. 2. College Persistence Questionnaire (CPQ) a) questionnaire b) chi-square test c) yes	Significant differences between at-risk and not-at-risk student groups (divided based on the expert assessments): - 16 individual items significantly different between the groups, but direction of the difference is unknown	16 items of the CPQ

^ayes = both reliability and validity measured; partly = either reliability or validity measured; no = no measure of reliability or validity.

literature suggests (Mooring, 2016, Custer, 2018, Smith-Wacholz et al., 2019). The appropriate support provided in a timely manner has been reported recently by nursing students as having a positive impact on dropout risk factors (Thompson et al., 2025). It has even been discussed that instead of offering voluntary support programmes to students, mandatory participation should be required (Freeman and All, 2017), since those students identified as at risk may not choose to participate voluntarily on retention strategies (Mitchell et al., 2021).

In general, the ability of the tools to identify nursing students at risk of dropping out was examined narrowly or was not measured at all. Since the ability was examined from varied perspectives, (as an ability to predict actual dropout, intention or warning signals, and ability to differentiate at-risk and not-at-risk students) it is also not straightforward to summarise the identification ability of the tools. Intention, of course, is not the same as actual dropping out. In fact, half of the nursing students completing the programme have considered dropping out (Cameron et al., 2011). However, based on a recent systematic review in the field of post-secondary education (Findeisen et al., 2024), intention has been identified as positively related, and in some studies, as the most important predictor of dropping out. It is important to identify and support students who are considering dropping out, not only to help them continue their studies, but also to retain them in the profession after graduation, especially as early career stress (Flinkman and Salanterä, 2015) and rising turnover rates (Lyu et al., 2024) remain concerns for new nurses. In view of the above, it may be noted that identifying the intention to drop out, not only actual dropout, can be considered relevant.

Due to the heterogeneity of studies and differences in measurement perspectives, comparing or ranking the tools based on their ability to identify nursing students at risk of dropping out is limited. However, it can be said with caution that tools based on student registry data appear to show stronger evidence of the ability to identify students at risk of dropout, compared to other tools included in this review, which was also supported by the methodological quality of these studies (Moseley and Mead, 2008; Hannaford et al., 2021). As the data on academic performance increased, the predictions improved significantly with both tools (Moseley and Mead, 2008, Hannaford et al., 2021), thus, it can be said that objective measurement of student performance has an important role in identification also based on this review. In addition, these register-based tools, analysed with machine-learning methods, gather readily available data automatically from the registry (Moseley and Mead, 2008, Hannaford et al., 2021), thus saving resources needed to implement a questionnaire. Another advantage is the lack of non-response bias affecting questionnaire results (Phillips et al., 2016). On the other hand, there are certain limitations that need to be considered with machine-learning methods, for instance student data privacy concerns and potential misuse of predictive data (Jones et al., 2020a; Almalawi et al., 2024), risk of retaining biases present in historical data (Almalawi et al., 2024) and lack of algorithmic transparency (Jones et al., 2020b; Almalawi et al., 2024). In addition, while focusing only on predictive accuracy, comprehensiveness is compromised, since with these tools, only student register data, such as academic performance and background information, can be gathered, leaving other potentially essential aspects, such as the student's personal experiences and perspectives (Soerensen et al., 2023, Thompson et al., 2025) beyond the scope of these tools. In turn, the tools covering more comprehensively different content areas, including the earlier mentioned aspects, had only limited evidence on their ability (Fowler and Norrie, 2009; Betts et al., 2017) or the ability was not measured in the included studies (Elder et al., 2015; Williams and Dahan, 2022), and there were also deficiencies in the methodological quality of the studies underlying these tools. To summarise, further studies are needed to determine the appropriate balance between the objective factors (e.g., grades from register) and subjective factors (e.g., perception of support) when developing a tool to identify nursing students at risk of dropping out.

6. Limitations and strengths

This review has limitations and strengths related to search strategy, eligibility criteria, quality appraisal and lack of reported data in included studies, which might have affected the study results.

While developing search strategies an information specialist was consulted to make them as comprehensive as possible. However, due to the complexity and lack of consensus regarding the concepts related to dropout, it is possible that some relevant studies have still not been identified. Searches were limited to the English language, which might have excluded some relevant articles. Although there are shared elements and comparable students in many nursing programmes, the limitation to bachelor-level nursing students was considered justified, since bachelor-level nursing students have unique features in their education (Schnelli et al., 2024).

As for the critical appraisal of the studies, some of the study designs were not clearly defined, and interpretations were needed to choose the appropriate criteria. Thus, the critical appraisal of some studies might have been affected by the lack of required information. The reporting quality of the studies varied, and some studies with low quality were included, which needs to be considered when applying the results.

The description of the tools greatly varied in the included studies, since some questionnaires reported the content of the tool on item level, some with factors or sum variables and others only by describing the content covered by the tool in general. Thus, the analysis was based on diverse and heterogenous information from the included studies. The analysis concerning the identification ability of the tools was conducted together with a statistician to ensure correct interpretation of the reported estimates in the included studies.

7. Conclusions and suggestions

This systematic review recognised 14 concrete tools to identify undergraduate bachelor-level nursing students at risk of dropping out during their studies. The tools included mostly questionnaires but also register data, analysed by machine-learning methods, had varied origins and covered different content areas for risk identification. Half of the tools enabled recognition of the specific risks for the identified student and recommended support for these individual needs, promoting the provision of the appropriate support in a timely manner.

The ability of the tools to identify nursing students at risk of dropping out was, in general, examined narrowly, by either using varied methods or not being measured at all. Some tools appeared to have the ability to predict actual dropout of nursing students, such as student registry-based tools; whereas, some tools tried to recognise the intention to drop out. Student registry-based tools seemed to have stronger capability compared to questionnaires, yet did not cover the student's personal aspect of dropout-related factors, which can be reached through questionnaires. Currently, when no tool seems to be superior to another, educators and administrators exploring possibilities to implement these tools need to consider and possibly compromise between predictive accuracy and thoroughness. Based on this systematic review, no conclusions can be made concerning the appropriate balance between the objective and subjective factors of a tool to identify nursing students at risk of dropping out. This gap should be addressed in future studies by developing a valid and reliable tool with the ability to predict either intention or actual dropout, while also securing consistent use of dropout-related concepts and definitions to enable comparisons of the results. Focusing the scope of future reviews to only certain types of tools would allow thorough critical and statistical comparisons. In addition, utility and feasibility studies are needed to ensure the developed tools can be implemented in educational organisations possibly struggling with scarce resources, to ensure consistent practice in the identification of at-risk nursing students and the provision of individual support.

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