An exploration of the predictive validity of selection criteria on progress outcomes for pre-registration nursing programmes—a systematic review


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Title
An exploration of the predictive validity of selection criteria on progress outcomes for pre-registration nursing programmes – A systematic review.

Abstract

Aim: To identify the selection methods currently being used for pre-registration nursing programmes and to assess the predictive power that these methods have on students’ success.

Background: Research into selection methods in nursing education is beginning to emerge, yet it is unclear which methods are most predictive of students’ success.

Design: A systematic review of the literature.

Methods: A systematic search of ten electronic databases; CINAHL, Medline OVID, EMBASE, PROQUEST Health and Medical, PROQUEST Education, COCHRANE Library, Web of Science, ASSIA, SCOPUS and PROSPERO was conducted. The results were expanded by the handsearching of journals, reference lists and grey literature. The PRISMA Statement guided the review. Studies published in English between January 2008 and March 2020 were eligible for inclusion and quality assessment was undertaken using the CASP Checklist for Cohort Studies.

Results: Twenty-five studies met the criteria for inclusion. A range of selection methods were identified including prior academic achievement, admissions tests, interviews, emotional intelligence tests, personal statements and previous healthcare experience. Prior academic achievement and admissions tests appear to be the selection methods most predictive of student success. The evidence surrounding other selection methods such as interviews and personal statements is less conclusive.

Conclusion: Selecting individuals with the appropriate knowledge, interpersonal skills and personal qualities needed to complete an undergraduate nursing programme is an important part of the role of nurse educators. This review shows that a wide variety of selection methods are used across different institutions, some of which are more effective than others in predicting student outcomes.

Relevance to Clinical Practice: Further research is required to justify the continued use of some commonly used selection methods for undergraduate nursing programmes. Selection models that combine various types of selection criteria with predictive power appear to increase the probability of selecting students that will have successful outcomes.

Key Words
Education, Nursing, Baccalaureate
Students, Nursing
Nursing Education Research
Academic Success
Clinical Competence
Selection Criteria
Progress Outcomes
Systematic Review
1. Introduction

In the modern health service nurses must be caring, compassionate and intelligent (Willis 2013). Nurses teach, motivate, coordinate care between multiple professionals and work under immense pressure, whilst maintaining a high level of accountability to their employers and to the general public (Nursing and Midwifery Council 2018). It is a challenging but rewarding role. In the move to an all-graduate nursing profession, the responsibility to select people for entry to this profession falls largely to universities providing pre-registration nursing programmes.

The numbers of applications to nursing programmes are increasing (Timer and Clauson 2011, Talman, Hupli, Puukka, Leino-Kilpi and Haavisto 2018) and there are frequently more applicants than universities can accommodate (Underwood, Williams, Lee and Brunnert 2013). Universities use a variety of methods to select candidates for these sought-after courses, including academic selection, admissions tests, interviews, personal statements, letters of recommendation and previous healthcare experience (Schmitz and MacWilliams 2011, Capponi and Mason-Barber 2020).

Educating nurses at graduate level has had a positive impact on patient outcomes, with fewer hospital deaths and lower levels of clinical complications reported on units with a higher ratio of graduate nurses (Aiken et al. 2014, Liao, Sun, Yu and Li 2016). Despite such positive outcomes, the past decade has seen a number of high-profile investigations into gross failings of the most fundamental aspects of care including patient safety, compassion and dignity (Keogh Mortality Review 2013). One high-profile enquiry was the Francis Report (2013), which recommended that universities should review how they select pre-registration nursing students to undertake their programmes.

The quality of the graduate workforce is directly linked to the quality of the nursing students recruited to pre-registration nursing programmes (Talman et al. 2018). Offering places to individuals who are likely to meet the clinical and academic standards required by their university and professional regulatory body furnishes the healthcare system with professionals who are likely to deliver the high levels of care required. The Francis Report (2013) recommendation to review selection procedures acted as a catalyst for universities to explore the reliability and validity of their selection policies, to determine if their selection methods had the power to predict those likely to succeed in the programme (Gale, Ooms, Grant, Paget and Marks-Maran 2016, Mazhindu et al. 2016, Traynor, Galanouli, Roberts, Leonard and Gale 2016).

The failure of nursing students to succeed can have a negative impact on university resources and the global availability of future nursing graduates (Underwood et al. 2013, Elkins 2015). It can also have a detrimental effect on the wellbeing of the student resulting in a decrease in confidence, a loss of personal finances and limitations to future employment opportunities (Seidman 2012). While some attrition can be expected due to circumstances beyond a student’s control (Rankin 2013), it would clearly be valuable to identify the common attributes that lead to a student’s success and consider these at the point of selection.

Although research into selection methods in nursing education is beginning to emerge, there is still a lack of clarity of the methods that are most effective. It is necessary to gather and synthesise best current evidence of the selection methods that are currently being used and what their predictive power is in selecting students who are likely to succeed. For the purpose of this review, success is defined as a student who has achieved the clinical and academic programme outcomes within the allotted time frame, as set by the university and professional regulatory body.
1.1 Aim

The aim of this paper is to report on a systematic review that identified, appraised and synthesised evidence from studies reporting on the predictive validity of selection methods used to admit candidates into baccalaureate pre-registration nursing programmes.

2. Methods

2.1 Design

A systematic review of the literature.

2.2 Search Strategy

The PICO Framework (Schardt, Adams, Owens, Keitz, and Fontelo 2007) was used to help inform the study focus and search strategy (see Figure 1). Search terms were developed in collaboration with an experienced subject librarian and are presented in Figure 2. Preferred subject headings were used when this option was available within the database.

Figure 1. PICO Framework [insert here]

Figure 2. Search Terms [insert here]

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Statement and Checklist (Moher, Liberati, Tetzlaff and Altman 2009) were used to guide the search and facilitate the reporting of the results (see Supplementary File 1).

A three-stage systematic search of ten electronic databases (CINAHL Complete, Medline OVID, EMBASE, PROQUEST Health and Medical, PROQUEST Education, COCHRANE Library, Web of Science, ASSIA, SCOPUS and PROSPERO) was undertaken. Additional literature was scoped through Google Scholar, the hand searching of nurse education journals and by manually checking the reference lists of relevant papers. The initial search took place between December 2018 and January 2019 and was updated on 30th December 2019. Database alerts were set up to identify any relevant articles published after the search dates up to and including the date that the data extraction was completed, which occurred on 26th March 2020. The results were limited to peer-reviewed articles that were written in English. A ten-year limit was applied from the date that the initial search took place, which meant that only studies that were published after January 2008 could be included. This was to help ensure that the most up to date evidence concerning selection criteria and programme outcomes could be included in the review.

An application was made to prospectively register the review on the PROSPERO database. This application was rejected as the outcome relates to nursing education rather than healthcare.

2.3 Eligibility Criteria

Inclusion: Any primary research using quantitative or qualitative designs that focused on the selection, progress and outcome measures of nursing students who were selected to study a baccalaureate pre-registration nursing programme. Progress could be assessed at any time point.
from the beginning to completion of their course. Studies could include retrospective data or data that had been collected for cross-sectional, observational or longitudinal research.

Exclusion: Studies that were published before January 2008, studies with no English translation available and studies that were not peer reviewed in an academic journal were not eligible for inclusion. In addition, studies were only eligible to be included if they reported on students completing the bachelor’s programme thus studies that investigated nursing students completing associate, diploma or post-graduate courses were excluded. Studies that focused on the validity of selection methods without considering student outcomes, or studies that measured student outcomes and not the selection methods, were also excluded.

The National Council Examination (NCLEX) is a licencing exam taken by nurses after graduation in Canada and the USA (Hinderer, DiBartolo and Walsh 2014). It is not a programme outcome so studies that focused on this as their only outcome were not eligible for inclusion. See Table 1 for a summary of the eligibility criteria and limits that were applied during the search.

Table 1. Summary of eligibility criteria and limits applied [insert here]

2.4 Screening

The search identified 3980 publications, 2512 after duplicates were removed. The title and abstract were screened which excluded 2505 publications, leaving 77 full text articles to be considered for inclusion. The full text articles were retrieved and reviewed and identified 25 primary research studies that were eligible for inclusion. This process is illustrated in the PRISMA Flow Diagram which includes reasons for excluding full text articles (see Figure 3).

All full text studies considered for inclusion were examined independently by two reviewers to verify that they met the inclusion criteria and none of the exclusion criteria. Where disagreement occurred, this was discussed by all reviewers until agreement was reached. In one instance the author of a paper was contacted for clarification of information before it was decided that their study should be included (Donaldson, McCallum and Lafferty 2010). The clarification of information was in relation to the study sample which included nursing students enrolled on the Diploma and the Bachelor of Science (BSc) Common Foundation Programme (CFP). Following the completion of the CFP at the end of year one, the students have the opportunity to transfer to the BSc programme in second year to compete their studies. All students in this sample had been accepted into the programme using the same admissions criteria and were completing the same CFP (which was the final data collection point for this study). It was decided that this study should be included in the review.

Figure 3. PRISMA Flow Diagram [insert here]

2.5 Quality Appraisal

Quality appraisal was carried out using the Critical Appraisal Skills Programme (CASP) Checklist for Cohort Studies (2018).

Cohort studies are characterised by a group of participants in a cohort who are followed over a period of time to observe the associations that different exposures, events, circumstances or characteristics have on measurable outcomes. They can include longitudinal, correlational and
observational studies that are either prospective or retrospective in nature. In this review, the initial exposure is the selection methods, the outcomes are the participants’ clinical and academic assessments, and the correlations are the relationships between the two. Therefore, it was appropriate to conclude that every study included in this systematic review was a type of cohort study. Cohort studies sit at level five in the hierarchy of evidence, below randomised controlled trials at level four and above case studies at level six (Ingham-Broomfield 2016). The CASP Cohort Checklist was considered the appropriate appraisal tool for all studies identified in the search (see Table 2).

The CASP Checklist provides a ‘yes or no’ response to twelve questions which are designed to encourage the reviewer to consider each question systematically, rather than giving a score. Every study was critically appraised by the two reviewers. Inter-rater reliability between reviewers was high and any discrepancies were discussed until agreement was reached. No eligible studies were excluded from the review due to quality. The sample sizes ranged from 55 to 3253 participants and included between 1 and 5 cohorts. Most studies were carried out in one institution and two were conducted in multiple institutions (Wolkowitz and Kelley 2010: 64 institutions; Lui, Codd and Mills 2018: 204 institutions). Sample sizes varied across institutions and appeared to be large enough to answer the aims and objectives of each individual study, with the exception of Traynor et al. (2016) who struggled to get enough volunteers to achieve their target sample. All statistical tests that were used in the methodology were considered appropriate. The risk of bias in most cases was deemed to be low as the majority of studies were undertaken using pre-existing databases with all student profiles being included except for participants with missing data. If volunteers were required, for example in convenience samples, confounding factors were considered by the researchers.

Table 2. CASP Cohort Checklist [insert here]

2.6 Data extraction

Data were extracted using a table which was developed in Microsoft Word pertaining to authors, year, country, study aim and design, data collection tools, year of data collection, statistical analysis, selection methods, outcome measures, sample characteristics, results and key findings (see Table 3). Only data that related to nursing students on baccalaureate programmes was extracted, which excluded participants in the samples who were from other healthcare programmes such as midwifery. Where nursing students could not be identified from the sample, or where data from nursing students were otherwise incalculable, the study was excluded which happened in one case. Many studies reported findings into correlations between student demographics and course outcomes such as age and gender. Demographic characteristics are not used in student selection so the data pertaining to these results were not included in the review.

Table 3. Data Extraction Table [insert here]

Selection Methods

From the review of selection methods, two overarching categories became apparent following the data extraction: cognitive (academic) and non-cognitive (non-academic) screening. Cognitive screening was further divided into sub-categories such as prior academic achievement, prior academic achievement in science and admissions tests. Non-cognitive screening was sub-divided into interviews, emotional intelligence, psychometric tests, personal statements and previous
healthcare experience. A third category then emerged from the data. This was a hybrid model comprising a combination of selection formula, often based on prior statistical testing conducted by the authors, with a view to identify the most predictive methods before combining them. These will be reported separately as ‘combined screening.’ The selection methods were categorised as shown in Figure 4.

*Figure 4. Selection Method Categories [insert here]*

**Outcome Measures**

The studies used a variety of outcome measures including grade point average (GPA), examination results, clinical assessments and mentor grading. Due to the variety of data collection time points from the beginning to the completion of the course, it was difficult to compare the selection methods to individual outcome measures, thus three time-point categories were created:

- Early success – any clinical or academic assessment administered in the first year of the programme.
- Continued success – any clinical or academic assessment administered between the second and final years of the programme.
- On time completion – course completion within the approved duration of study of the programme, without stopping or dropping out.

**2.7 Data Synthesis**

All studies that met the eligibility for inclusion used a quantitative design. Due to the variety of study designs, analysis and reporting of findings, a meta-synthesis of results was not considered appropriate and the results are thus reported in narrative synthesis format.

**3. Results**

**3.1 Total Included in Review**

Twenty-five studies met the eligibility criteria for inclusion.

**3.2 Study Characteristics**

**Country of origin**

carried out in Canada (Wolkowitz and Kelley 2010, Timer and Clauson 2011). Only one study was selected from these countries: Jordan (Ahmad and Safadi 2009), New Zealand (Shulruf, Wang, Zhao and Baker 2011), Italy (Lancia, Pettrucci, Giorgi, Dante and Grazia-Cifone 2013), Australia (Pitt, Powis, Levette-Jones and Hunter 2015) and Israel (Sharon and Grinberg 2018). The English language limiter may have created a bias for studies conducted in countries where English is the primary language.

Participants
All participants were undergraduate nursing students enrolled on a pre-registration BSc Nursing Programme with the exception of Donaldson et al. (2010). A total of 10370 unique participants were included, with 5323 participants contained within two multicentre studies (Wolkowitz and Kelley 2010, Lui et al. 2018).

Demographic Information
The demographic details of participants were not fully or consistently reported in all studies.

Age was reported in 16 of the studies and participants’ ages ranged from 19 to 62 (Traynor et al. 2016, Van Hofwegen et al. 2019). The mean age was documented in most studies and ranged from 21.2 to 29 (Lui et al. 2018, Sharon and Grinberg 2018).

Gender was cited in 16 studies, with males and females present in all samples (Ahmad and Safadi 2009, Shulruf et al. 2011, Timer and Clauson 2011, Díaz et al. 2012, Lancia et al. 2013, Rankin 2013, Cunningham et al. 2014, Hinderer et al. 2014, Cheshire et al. 2015, Elkins 2015, Pitt et al. 2015, Gale et al. 2016, Traynor et al. 2016, Sharon and Grinberg 2018, Tartavoulle et al. 2018, Van Hofwegen et al. 2019). Females formed the largest group in most studies apart from Ahmad and Safadi (2009) (58.5% male) and Lancia et al. (2013) (57% male). The rest of the studies reported that the female participants accounted for 64% (Sharon and Grinberg 2018) to 95% (Rankin 2013) of the samples.

Caucasian students made up the largest percentage in each cohort and ranged from 39% (Van Hofwegen et al. 2019) to 99.4% (Rankin 2013). Other ethnic groups of students reported in the samples were Pakeha (35%) (Shulruf et al. 2011), Asian ranging from 1.8% (Cunningham et al. 2014) to 28% (Shulruf et al. 2011) and African American students ranging from 5% (Cheshire et al. 2015) to 9.4% (Tartavoulle et al. 2018). A detailed report of the ethnicity of all participants is presented in Table 3.

Most studies revealed a homogeneous sample of Caucasian females in their early twenties. Two studies were conducted with a more divergent group of students. Shulruf et al. (2011) investigated a cohort of school-leavers and Van Hofwegen et al. (2019) focused on military veterans who had received priority admission into their nursing course. This limits the transferability of these results to other student cohorts, considering the wide variety of pathways into nursing education (Donaldson et al. 2010).

Research Designs
All studies were quantitative and reported a range of designs including correlational studies (Timer and Clauson 2011, Underwood et al. 2013, Elkins 2015), correlational studies with predictive design

Data Collection Period


Cognitive Screening

Prior Academic Achievement

Prior academic achievement is defined as any single or combination of academic assessments, such as examinations or assignments, that are taken prior to entering the nursing programme. Fourteen studies reported results on prior academic achievement. There is a significant relationship between pre-programme GPA and continued success in the nursing programme. Participants with a higher GPA on admission were more likely to complete the course, graduate on time (Hinderer et al. 2014, Elkins 2015, Tartavolle et al. 2018) and have continued academic success throughout the programme (Strickland and Cheshire 2017). Prior academic grades have a direct impact upon final year GPA with those with a higher pre-admission GPA attaining a higher final GPA (Ahmad and Safadi 2009, Timer and Clauson 2011, Lancia et al. 2013, Cunningham et al. 2014). In contrast, two studies reported a non-significant correlation between prior academic achievement and graduation rates. Whambuguh et al. (2016) found that prior study at degree level had no bearing on the likelihood of a participant graduating from the nursing programme, and Newton and Moore (2009) reported that a participant’s pre-nursing GPA was not predictive of attrition that was attributed to academic failure. Shulruf et al. (2011) found that prior academic achievement also predicts early success in the nursing programme, specifically GPA at the end of year one of the programme of study. The same is reported by Rankin (2013), whose findings support the use of pre-admission academic grades as a predictor for academic success in first year, but not for clinical success or programme progression into second year. This is disputed by Strickland and Cheshire (2017) who reported that pre-admission GPA did not correlate with examinations administered before the end of semester one and two of the nursing programme, and these results were corroborated by Díaz et al. (2012) who found no correlation between prior GPA and early academic success.
Prior Academic Achievement in Science

Prior academic achievement in science is defined as any single or combination of scientific academic assessments in topics such as anatomy, physiology, biology, chemistry or physics, that are taken prior to entering the nursing programme. Six studies reported results on prior academic achievement in science. The results suggest that prior academic achievement in science has the power to predict continued academic success (Strickland and Cheshire 2017) and on time graduation (Hinderer et al. 2014, Tartavoulle et al. 2018), with one study claiming that prior academic achievement in science had greater power to predict academic outcomes than the cumulative pre-admission GPA (Cunningham et al. 2014). Whambuguh et al. (2016) and Van Hofwegen et al. (2019) found that, although prior academic achievement in science GPA did not have the power to predict the probability of graduating, it did predict those who would graduate with a GPA of 3.25 and 3.13 or above respectively. The highest GPA attainable is 4.0 and the lowest is 0.0. A grade of 2.0 is required to pass the degree programme (Whambuguh et al. 2016).

Admissions Tests

Admission tests are defined as examinations or assignments that are administered to every candidate for the nursing programme as part of the application process. These can be standardised, for example the Test of Essential Academic Skills (TEAS) or designed in-house by faculty staff. Seventeen studies reported results on admissions tests. Wolkowitz and Kelley (2010) and Lui et al. (2018) found a significant relationship between the TEAS sub-scores and early nursing school success in the RN-Fundamentals examination. The Science component had the largest correlation followed by Reading, English and Mathematics. Wolkowitz and Kelly (2010) add that the TEAS cumulative score was even more predictive than individual sub-scores. Díaz et al. (2012) found that the TEAS cumulative score was predictive of the RN-Fundamentals examination, but that the sub-scores and the TEAS Critical Thinking scores were not. Whambuguh et al. (2016) add that the TEAS score was a significant predictor of successful completion and obtaining a graduating GPA of ≥ 3.25. Cunningham et al. (2014) found it to be a particularly strong predictor of a higher GPA in the second semester of year one and in the final year. Newton and Moore (2009) found that the TEAS cumulative score was not predictive of attrition due to academic failure late in the programme, and Van Hofwegen et al. (2019) found that the TEAS scores did not correlate with completion of the nursing programme.

Underwood et al. (2013) investigated the impact of the cumulative and sub-section scores of the Health Education Systems Incorporated (HESI)-A2 test. They report that all scores had a positive significant correlation with the end of semester one module outcomes, which comprised elements of academic and clinical practice assessment. The composite score and English sub-score had large correlations, Anatomy and Physiology had moderate and Mathematics had a small correlation. Hinderer et al. (2014) found a moderate correlation between HESI-A2 cumulative examination scores and final nursing graduation GPA, but not with timely progression. Contrary to this, Tartavoulle et al. (2018) found that participants with lower HESI-A2 cumulative examination results took longer to complete the course than participants with higher results. Strickland and Cheshire (2017) evaluated the Critical Thinking subsection of the HESI-A2 test and found that it did not correlate with any examination results in semester one or two of a five semester programme. This is the only sub-score of the HESI-A2 that did not achieve statistical significance.

Pitt et al. (2015) reported significant correlations between the Health Sciences Reasoning Test (HSRT) Critical Thinking cumulative and sub-scores, academic performance and completing the
course on time. They found no correlation between Critical Thinking scores and clinical practice performance. Elkins (2015) investigated The American College Test (ACT) and found a significant correlation between the ACT scores and on time completion of the nursing programme, although the exact results are not reported within the paper. Lancia et al. (2013) found that a cumulative score on the Nursing Degree Programme Admission Test did not correlate significantly with final degree grade or average value of examinations score throughout the programme.

Gale et al. (2016) carried out a study to discern the predictive validity of in-house selection tests in numeracy and literacy. The results show that there is a statistically significant correlation between numeracy testing and academic outcomes in years 1, 2 and 3. There is a small correlation between literacy and the same outcomes, but it is not statistically significant. Donaldson et al. (2010) designed an interview score sheet that included admissions tests in arithmetic, subject knowledge, role of the nurse, standard of written work and content of written work. The results indicate that participants who were successful in passing all year one modules and completing the CFP had significantly higher scores in standard of written work, content of written work and subject knowledge than those who were unsuccessful.

Essay scores were listed as a variable to predict on time graduation by Tartavoulle et al. (2018) but no findings on this variable were reported in the paper. Personal communication with the authors confirmed that this was because no statistically significant relationship was found.

Non-Cognitive Screening

Individual Face-to-face Interviews

Individual face-to-face interviews are defined as traditional panel interviews comprising 2-3 interviewers and one applicant who is answering a series of predetermined questions and being scored according to the answers they give. Four studies reported results on interviews. Traynor et al. (2016) reported that interview scores did not correlate with first year academic module results. Timer and Clauson (2011) found that interview scores were not significantly correlated with participants’ final GPA at course completion. Donaldson et al. (2010) found a small significant correlation between interview score and participants who successfully completed the CFP, but only reported the score awarded for the communication aspect of the interview, rather than the overall interview score. Interview scores were listed as a variable to predict on time graduation by Tartavoulle et al. (2018) but no findings on this variable were reported in their paper. Personal communication with the authors confirmed that this was because no statistically significant result was found between scores and on time graduation. No studies support the use of interviews as a valid predictor of early or continued success in either academic or clinical outcomes.

Multiple Mini Interviews

Multiple Mini Interviews (MMI) are defined as interviews where candidates rotate around multiple interview stations, typically 6-7, each with a different examiner testing one specific attribute or competency through scenario or situational judgement-based questions (Traynor et al. 2016). Four studies reported correlations between MMI scores and course outcomes. Traynor et al. (2016) and Callwood et al. (2018) investigated the relationship between MMI scores and participants’ early academic success and clinical outcomes at the end of first year. Neither study found any correlation. Callwood et al. (2020) followed the same group of participants into final year and reported a
statistically significant positive correlation between MMI scores and participants’ clinical outcomes, but no correlation was found with academic outcomes. Gale et al. (2016) found in favour of using MMIs, stating a significant correlation between MMI scores in both early and continued academic outcomes in years 1, 2 and 3. This MMI score was a cumulative score comprising a combination of skills stations which included a numeracy and a literacy skills station.

**Emotional Intelligence Tests**

Emotional intelligence (EI) tests are defined as any test or self-reporting scale that measures participants’ ability to recognise and manage their own emotions and the emotions of others (Rankin 2013). There is no indication in the literature that EI tests are currently being used as a selection method for baccalaureate nursing programmes. As a potentially emerging selection method with a growing body of evidence into their ability to predict nursing programme outcomes, the results are included in this review.

Four studies reported results on EI tests. Sharon and Grinberg (2018) found a positive correlation between EI scores and the grade average of first year and second year participants using the Schutte Self-Report Emotional Intelligence Test (SSEIT), administered at the beginning of each academic year. Rankin (2013) also found a significant relationship between EI scores and academic attainment, clinical performance and retention at the end of year one as measured by the Assessing Emotions Scale (AES) (this is the same scale as the SSEIT) adding that EI is a powerful predictor of clinical practice performance.

Cheshire et al. (2015) found no statistical difference between groups of participants whose cumulative scores ranked low, medium or high in the Mayer-Salovey-Caruso EI Test (MSCEIT) on final academic grades. When the four sub-scales were examined, Facilitation of Emotion was the only sub-scale to achieve statistical significance for those with higher scores on final academic grades. Strickland and Cheshire (2017) found that EI scores on the MSCEIT did not correlate with any early success on examinations in semester one or continued success in the participants’ final examinations.

**Psychometric Tests**

The Psychometric Entrance Test (PET) is a psychometric selection test administered to students in Israel and is thought to have the ability to predict participants’ academic performance at university. As part of their investigation into EI scores, Sharon and Grinberg (2018) compared the effect that PET scores would have on participants’ academic grades. They concluded that high PET scores had less predictive power on participants’ grades than EI scores, although the exact figures were not presented within their paper. This was the only study to report on psychometric tests.

**Personal Statements, Résumés and References**

Three studies reported on personal statements (which are autobiographical essays), résumés or references from school or work placements. Traynor et al. (2016) found a positive correlation between personal statement scores and early academic outcomes in first year in 3 out of 4 modules taken by the participants. The only correlation that did not achieve statistical significance was with the Practice Module. Timer and Clauson (2011) combined the participants’ personal statement and
résumé scores and stated that the total score was not predictive of final GPA at graduation. They add that inter-rater reliability between scorers in both segments was poor and that they had used graduate nursing students to screen these as opposed to admissions staff or nursing faculty staff. Donaldson et al. (2010) found no statistically significant correlation between participants’ supporting application statements and completion of the CFP. They found a significant correlation between the reference scores of those who completed and those who did not. Participants with higher scores were more likely to complete.

**Previous Healthcare Experience**

Previous healthcare experience is defined as any prior experience working or volunteering in healthcare environments prior to commencing the nursing programme. Two studies considered the predictive validity of previous healthcare experience. Whambuguh et al. (2016) concluded that previous healthcare experience did not increase the likelihood of a student graduating, nor did it correlate to final GPA scores. Donaldson et al. (2010) tested previous healthcare work experience for participant success on the CFP but found no statistically significant correlation.

**Combined Screening**

Two studies reported on the combined selection scores of participants. Hinderer et al. (2014) looked at HESI-A2 examination scores and pre-programme science GPA in combination as a predictor of timely progression through the nursing programme. They stated that the combined selection method was significant and that the full model was able to predict 84% of successful cases. They also combined HESI-A2 scores and prior GPA and found that the full model was able to predict timely progression in 83% of cases.

Cunningham et al. (2014) combined their four most predictive variables (overall GPA at entry, science GPA at entry, TEAS score and number of completed pre-requisite courses) from their analysis. This combination was able to explain a statistically significant proportion of the variance in each of the outcome variables, all of which were examinations. This was in comparison to their points-based system which allocated each participant an admission score from a combination of criteria that was weighted by the expert opinion of the educators at the university. Both models were measured against participant performance outcomes and the statistically derived model explained more of the variance than the points-based system.

**4. Discussion**

The aim of this review was to gather and synthesise evidence from published studies that have reported on the predictive validity of selection methods used to admit candidates into pre-registration nursing programmes. The lack of standardisation of entry requirements across nursing programmes, with different universities employing a wide variety of selection methods, made comparison between studies difficult. Once the independent variables were categorised, distinct themes emerged.

Cognitive screening methods such as prior academic achievement, prior academic achievement in science and admissions tests were the most consistently cited methods that had the ability to predict continued success in nursing programmes. These methods were shown to be predictive of
academic achievement throughout the course as well as predictive of successful programme completion. There was insufficient evidence to conclude that non-cognitive screening methods such as interviews, psychometric tests, personal statements or previous healthcare experience were predictive of clinical or academic success. The exception to this was MMI and EI scores, which were the only non-cognitive screening methods to correlate with clinical competence and academic achievements, but the results were conflicting. Using regression analysis, Cunningham et al. (2014) and Hinderer et al. (2014) combined several selection methods into an overall selection model, which appeared to demonstrate high levels of reliability in selecting students who were most likely to succeed.

The merits of academic selection through prior academic achievement or admissions tests are well established as a reliable indicator of future academic achievement in healthcare programmes in higher education (Schmidt and MacWilliams 2011, Patterson et al. 2018). Our systematic review further corroborates this. Achieving a certain level of academic achievement prior to commencing university education is seen as a necessary criterion, but insufficient on its own (McNelis et al. 2010, Lancia et al. 2013, Jones-Schenk and Harper 2014). The temptation for university selectors could be to simply raise the academic entry requirements so that only those most likely to succeed, based on evidence from prior academic achievement, would be accepted onto nursing programmes. This is replete with difficulties such as grade inflation (Timer and Clauson 2011, Underwood et al. 2013) and can be seen as a barrier to admission by some applicants from minority groups (Kelly, Patterson, O’Flynn, Mulligan and Murphy 2018).

Interviews are often seen as a way of diversifying and enhancing applications and allow candidates to explain and expand on their written application form. This method can be popular with applicants as they believe it gives them the opportunity to portray their non-academic attributes such as communication skills or their ‘desire’ to be a nurse (House, Sturgeon, Garrett-Wright and Blackburn 2015). The evidence identified in our review indicates that traditional face-to-face interviews do not correlate with nursing students’ academic or clinical practice outcomes and are therefore not predictive of student success (Timer and Clauson 2011, Traynor et al. 2016, Tartavoulle et al. 2018). Similar non-significant results were reported for psychometric tests, personal statements, résumés and previous healthcare experience (Timer and Clauson 2011, Traynor et al. 2016, Whambuguh et al. 2016, Sharon and Grinberg 2018). However, the body of evidence available from investigating these methods is small and few certain conclusions can be reached about their effectiveness at predicting academic or clinical outcomes at present. More research is required to validate their continued use as selection methods.

MMIs are seen as an alternative to traditional face-to-face interviews. This method of interview is common in healthcare selection (Callwood et al. 2018). Although resource intensive, this method has been shown to be predictive of some student outcomes and has the added benefit of reducing interviewer bias which is sometimes encountered by applicants on face-to-face interview panels (Pau et al. 2013). MMIs were one of only two non-cognitive screening methods to report any positive and significant correlations between selection scores and clinical and academic outcomes (Gale et al. 2016, Callwood et al. 2020), although not in every case (Traynor et al. 2016, Callwood et al. 2018). The differences in findings could be explained by any number of factors including differences in station design, interviewer skill or experience and course content or structure. It must also be factored in that some participants had already been given a place on the course and that their voluntary participation in the study happened after the initial interview process (Traynor et al. 2016). This may have influenced the results as the participants had already embarked on the nursing
programme, and there may have been less preparation undertaken prior to the interviews as the scores did not count towards any outcomes.

There was a positive correlation between EI scores and student outcomes found in two of the studies using the AES score and the SSEIT scale (which is essentially the same 5-point Likert self-reporting scale). It is a valid measurement tool with a high internal consistency and a Cronbach’s alpha of 0.90 (Schutte, Malouff, Thorsteinsson, Bhullar and Rooke 2007). Rankin (2013) acknowledges the limitation of using self-reporting scales as selection methods as these may discourage applicants from providing honest responses in fear of being penalised by giving unfavourable answers. Rankin (2013) suggested that rather than it being used as a selection tool by a university, it could be used by applicants as a self-assessment tool to evaluate their own emotional readiness to undertake a pre-registration nursing course. Caution must be used when selecting the type of EI scale as the MSCEIT (which is not considered a self-reporting scale) showed no correlations with student outcomes (Cheshire et al. 2015, Strickland and Cheshire 2017).

When several selection methods are combined into a selection model, the ability to predict successful students appears to increase, and this has been cited as a more effective method of predicting nursing student success (Schmidt and MacWilliams 2011, Al-Alawi, Oliver and Donaldson 2020). Selection formulas comprising the most predictive selection methods, based on statistical tests that assign the comparative weight of each method, is more successful than using experience or expertise to judge which selection criteria should be allocated more weight (Cunningham et al. 2014). However, these models were tested on retrospective student cohorts and were not verified for use with real time participants.

There were clear limitations in the designs of the studies reviewed, notably that several failed to follow the participants through to completion of the programme. Had a complete follow-up been undertaken this would have allowed for greater exploration of how the selection variables influenced students’ long-term outcomes. This is observed in the studies of Callwood et al. (2018) and Callwood et al. (2020), where significant findings were reported in the second study but not the first. The shorter follow-up times were justified by the authors due to the large percentage of attrition seen within the first year of study in nursing programmes. These results, however, are useful in identifying students at risk of failure early in the programme and will help educators plan and implement strategies that support students as they progress through the course (Donaldson et al. 2010, Tartavoule et al. 2018, Hofwegen et al. 2019).

Wolkowitz and Kelley (2010) and Lui et al. (2018) were the only studies to use a multi-centre design across 204 and 64 sites respectively, adding to the rigour, validity and transferability of their results. The remaining studies were carried out using a single cohort or institution. Investigating multiple cohorts and institutions would have led to greater reliability of the results and could have demonstrated greater consistencies across cohorts.

The last limitation of note was that many studies did not report non-significant findings, and this was verified by the authors who responded to our personal communications. To enable a full comprehension of findings, it is well recognised in research that non-significant results as well as significant results should be reported as this helps to inform future practice and research.

5. Recommendations
This review has shown that universities have a valuable resource of student data on admission and progression. This can be used to identify and report on selection methods that are more effective in predicting students who are likely to be successful in programme outcomes. Future research could track students from the beginning to the end of the course to determine a more accurate picture of the undergraduate journey, and how the selection methods predict a range of academic and clinical outcomes. There was little information contained in these studies to indicate why students were failing or dropping out in the early stages of study (e.g. academic, clinical, social or economic reasons). This could be a focus for future research.

More evidence is needed to justify the continued use of non-cognitive screening methods such as face-to-face interviews, psychometric tests, personal statements and previous healthcare experience. These methods may add value in combined selection models or have merit in other ways, but their use as predictive methods of selection is not warranted on the basis of existing evidence. There is also a need for more evidence into selection methods that predict students’ clinical outcomes, considering that the clinical element accounts for a large proportion of their course. Any research into this topic would have to consider the well-known difficulties associated with clinical practice grading, such as a lack of grading consistency and bias on behalf of the clinical assessor (Bradshaw et al. 2013, Callwood et al. 2018).

6. Relevance to Clinical Practice

Identifying selection methods that are predictive of student success is clearly valuable in promoting high standards of patient care. Selecting students who are likely to complete the programme and have successful clinical and academic outcomes increases the availability of the graduate nursing work force and enhances the quality of care provided to patients.

Combined selection models that comprise multiple selection methods appear to increase the probability of selecting students that will have successful outcomes. Due to differences in assessments, course structures and school ethos, it would be difficult to identify one model that would fit all institutions. It may be more appropriate for institutions to design their own combined selection models with the weighting of each criterion based on statistical testing as opposed to expert judgement.

Identifying selection methods that can predict successful students does not remove the responsibility of universities to champion applications from diverse populations of people from different backgrounds and ethnic groups. University selection scores can also be used in a commitment to identify and support students who are at-risk of failure as well as success. This reduces the temptation for universities to simply raise the minimum academic entry requirements so that only those more likely to succeed, based on these methods, are encouraged to apply (Seidman 2012).

7. Limitations

This systematic review was limited to studies published in peer-reviewed journals, within a specific timeframe potentially excluding other relevant literature. Every effort was made to ensure that all relevant literature was identified and included in this review, but it is possible that some may have been missed, such as studies published in non-English languages. Although a stringent checking
method was used to ensure the accuracy of the data extraction and reporting, it is possible that errors were made during manual transfer of information.

Due to the differences in population and location of the samples, caution should be used when considering the transferability of the results between schools of nursing.

8. Conclusion

Undertaking the selection of individuals with the appropriate knowledge, interpersonal skills and personal qualities needed to complete an undergraduate nursing programme is an important part of the role of nurse educators. This review shows that a wide variety of selection methods are used across different institutions, some of which are more effective than others in predicting student outcomes. The evidence suggests that prior academic achievement and admissions tests are the most predictive methods of student success when compared with other selection methods such as interviews, psychometric testing, personal statements and previous healthcare experience. Further research into selection methods using larger samples sizes across multiple institutions will add to the body of evidence on how higher education institutions can best select the individuals that will successfully complete the nursing programme.

What does this paper contribute to the wider global clinical community?

The findings of this paper suggest that prior academic achievement and admissions tests are the best indicators of nursing student success in pre-registration nursing programmes. More evidence is required to justify the continued use of non-cognitive screening methods such as interviews, psychometric tests and personal statements.

Continued efforts should be made by nursing educators to encourage applications from a wide variety of people including those from underrepresented groups.

Sources of Funding

None.
References


**Population**
Applicants for and students selected for an undergraduate (pre-registration) degree in nursing, regardless of age, gender, ethnicity or location.

**Intervention**
Selection methods used to determine admission onto nursing degree programmes including prior academic achievement, admissions examinations, psychometric profiling, interviews and previous health care experience.

**Comparison**
Student outcomes measured at any point of the degree programme including academic assessment, clinical assessment and course completion rates.

**Outcome**
Selection methods that have the predictive power to determine which students will be successful throughout the nursing programme.
nurs* student* or nurs* pupil* or nurs* education or nurs* undergrad* or preregistr* AND undergrad* or degree* or baccalaureate or BSc or bachelors or ‘higher education’ AND (select* or admission or admitted or entr*) AND (philisoph* or polic* or criteria or process*)
Records identified through database searching (n = 3980)

- EBSCO CINAHL – n = 530
- OVID MEDLINE – n = 546
- OVID EMBASE – n = 718
- PROQUEST Health and Medical – n = 435
- PROQUEST Education – n = 293
- Cochrane – n = 147
- Web of Science – Core Collection – n = 737
- ASSIA – n = 334
- SCOPUS – n = 204
- PROSPERO n = 36

Additional records identified through other sources (n = 22)

- Reference lists – n = 21
- Hand searching of journals – n = 0
- Google Scholar – n = 0
- Database alerts – n = 1

Records after duplicates removed (n = 2512)

Records screened by title (n = 2512)

Records excluded (n = 2314)

Records screened by abstract (n = 198)

Records excluded (n = 121)

Full-text articles assessed for eligibility (n = 77)

Full-text articles excluded with reasons (n = 52)

Not all nursing students (n=1).
Not degree level education (n=16).
No selection methods investigated (n=14).
No programme outcomes investigated (n=22).
Published before 2008 (n=0).
No English translation available (n=0).
Not peer reviewed in academic journal (n=14).
Not original research (n=4).

Studies included in quantitative synthesis (systematic review) (n = 25)
Figure 4. Selection Method Categories

Prior Academic Achievement:
High school grade (Ahmad and Safadi 2009)
Nursing admission GPA (Newton and Moore 2009)
Prerequisite GPA (Díaz et al. 2012)
Pre-programme GPA (Elkins et al. 2015)
GPA at entry (Cunningham et al. 2014)
Upper secondary diploma grades (Lancia et al. 2013)
Total NCEA credits attempted (Shulruf et al. 2011)
Total number of NCEA gained (Shulruf et al. 2011)
NCEA GPA used for admission (Shulruf et al. 2011)
Total credits gained from credits attempted (Shulruf et al. 2011)
NCEA university ranking (Shulruf et al. 2011)
Overall pre-requisite GPA (Tartavoule et al. 2018)
Prior academic attainment (Rankin 2013)
Previous degree qualification (Whambuguh et al. 2016)

Prior Academic Achievement in Science:
Pre-admission cumulative science GPA (Wambuguh et al. 2016, Van Hofwegan et al. 2019)
Pre-requisite science GPA (Tartavoule et al. 2018)

Admissions Tests:
ATI-TEAS score (Díaz et al. 2012, Cunningham et al. 2014)
ATI-TEAS sub-scores in English, mathematics, science and reading (Díaz et al. 2012)
ATI Critical Thinking (Díaz et al. 2012)
ACT scores (Elkins 2015)
HESI-A2 examination score (Hinderer et al. 2014)
HESI-A2 composite score (Underwood et al. 2013, Tartavoule et al. 2018)
HESI-A2 Anatomy and Physiology score (Underwood et al. 2013)
HESI-A2 Mathematics score (Underwood et al. 2013)
HESI-A2 English score (Underwood et al. 2013)
TEAS V sub scores in reading, mathematics, science and English (Wolkowitz and Kelley 2010, Lui et al. 2018)
HESI Critical Thinking (CT) total score (Strickland and Cheshire 2017)
HSRT CT and sub scores (Analysis, Inference, Evaluation, Inductive Reasoning, Deductive Reasoning) (Pitt et al. 2015)
Nursing Degree Programme Admission test score (Lancia et al. 2013)
Essay score (Tartavoule et al. 2018)
Admissions test elements of the Interview Score Sheet (arithmetic score, subject knowledge, understanding the role of the nurse, standard of written work and content of written work) (Donaldson et al. 2010)
Admissions test elements of the overall MMI score (Literacy and Mathematics) (Gale et al. 2016)

Individual Face-to-face Interviews:
Interview score (Donaldson et al. 2010, Timer and Clauson 2011, Traynor et al. 2016, Tartavoule et al. 2018)

Multiple Mini Interviews:
MMI Cumulative score (Traynor et al. 2016, Callwood et al. 2018, Callwood et al. 2020)
MMI data (numeracy exam, literacy exam and interview score) (Gale et al. 2016)

Emotional Intelligence Tests:
Mayer-Salovey-Caruso EI Test (MSCEIT) branch scores (Cheshire et al. 2015)
Mayer-Salovey-Caruso EI Test cumulative score (MSCEIT) (Cheshire et al. 2015, Strickland and Cheshire 2017)
Assessing Emotions Scale (AES) (Rankin 2013)
Schutte Self-Report Emotional Intelligence Test (SSEIT) (Sharon and Grinberg 2018)
**Psychometric Tests:**
Psychometric Entry Test score (Sharon and Grinberg 2018)

**Personal Statements, Résumés and References:**
Sum of personal statement and resume scores (Timer and Clauson 2011)
Applicant statement and work/school reference (Donaldson et al. 2010)
Personal statement score Traynor et al. (2016)

**Previous Health Care Experience:**
Health care experience (Wambuguh et al. 2016)
Previous health care work experience (Donaldson et al. 2010)

**Combined Screening:**
HESI-A2 examination scores and prior GPA/science GPA (Hinderer et al. 2014)
GPA and ATI-TEAS (Cunningham et al. 2014)
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<tr>
<td>Primary research that used a qualitative design.</td>
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<th>Outcome</th>
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All studies must be published in a peer reviewed journal.
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<th>Have they taken account of the confounding factors in the design and/or analysis?</th>
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<td>Yes</td>
<td>Yes</td>
<td>Clearly displayed</td>
<td>Yes</td>
<td>No – veteran students only.</td>
</tr>
<tr>
<td>Wambuguh et al. 2016</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
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<tr>
<td>Wolkowitz and Kelley 2010</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Clearly displayed</td>
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<td>Yes</td>
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</tbody>
</table>

Note - The questions pertaining to results, fit with other available evidence, and implications for practice are discussed throughout the paper.
<table>
<thead>
<tr>
<th>Authors, Year and location</th>
<th>Study</th>
<th>Variables</th>
<th>Population and sample</th>
<th>Results</th>
<th>Key findings</th>
</tr>
</thead>
</table>
| Ahmad and Safadi 2009 (Jordan)  | **Aim:** To examine if admission criteria can predict chances of success  
 **Design:** Cross-sectional design  
 **Data collection tools:** Student records  
 **Data collection period:** Not reported  
 **Data analysis methods:** Regression analysis | **Independent variables:**  
 High school grade  
 **Outcome variables:**  
 Grade Point Average (GPA)  
 **Population and sample:**  
 Nursing degree students in fourth year of study one cohort  
 (n=224)  
 Convenience sample  
 Age: mean 21.37  
 Gender: female 41.5%, male 58.5%  
 Ethnicity: not reported  | **Results:** Prediction of high school grade on GPA  
 (B=0.3, Beta=0.54, t=9.51, p=<0.001)  
 **Key findings:** Student high school grades were a significant predictor of final year GPA. |                                                |
| Callwood, Cooke, Bolger, Lemanska and Allan 2018 (UK) | **Aim:** To examine the reliability and predictive validity of Multiple Mini Interviews (MMI) using the year one practice outcomes of undergraduate nursing students  
 **Design:** Cross discipline cohort study  
 **Data collection tools:** Six MMI stations and student assessment scores  
 **Data collection period:** 2015  
 **Data analysis methods:** Pearson’s correlation | **Independent variables:**  
 MMI cumulative score  
 **Outcome variables:**  
 Year one clinical performance (mentor grading)  
 **Population and sample:**  
 Undergraduate pre-registration nursing students one cohort  
 (n=247)  
 Non-probability consecutive sampling  
 Age: mean 23  
 Gender: not reported  
 Ethnicity: 71% of adult, 75% of child, 55% of mental health nursing students were Caucasian British  | **Results:** Correlations between MMI scores and clinical performance: adult  
 (r=0.266 p=0.053), mental health  
 (r=0.301 p=0.119), child  
 (r=0.083 p=0.693)  
 **Key findings:** There were no significant associations between MMI scores and end of year one clinical practice outcomes. |                                                |
| Callwood, Groothuizen, Lemanska and Allan 2020 (UK) | **Aim:** To examine the predictive validity of MMIs using the end of programme and practice outcomes of undergraduate nursing students  
 **Design:** Cross-sectional cohort study  
 **Data collection tools:** Six MMI stations, student assessment scores  
 **Data collection period:** 2015  
 **Data analysis methods:** Pearson’s correlation | **Independent variables:**  
 MMI cumulative score  
 **Outcome variables:**  
 Year three clinical performance (mentor grading)  
 Year three academic performance (dissertation grade)  
 **Population and sample:**  
 Undergraduate pre-registration nursing students one cohort  
 (n=182)  
 Non-probability consecutive sampling  
 Age: median 20  
 Gender: not reported  
 Ethnicity: 71% of adult, 75% of child, 55% of mental health nursing students were Caucasian British  | **Results:** Correlations between MMI scores and clinical performance: adult  
 (r=0.27 p=0.003), mental health  
 (r=0.43 p=0.01) and child  
 (r=0.14 p=0.441)  
 Correlations between MMI scores and academic attainment: adult  
 (r=0.18 p=0.055), mental health  
 (r=-0.11 p=0.578) and child  
 (r=-0.10 p=0.595)  
 **Key findings:** There were significant correlations between MMI scores and clinical practice outcomes in the adult and mental health branches, but not with children’s nursing. There were no significant associations between MMI scores and academic outcomes. |                                                |
<table>
<thead>
<tr>
<th>Study</th>
<th>Aim</th>
<th>Independent variables</th>
<th>Outcome variables</th>
<th>Results</th>
<th>Key findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheshire, Strickland and Carter 2015 (USA)</td>
<td>To compare emotional intelligence (EI) test scores to nursing degree outcomes</td>
<td>Baccalaureate nursing students in eight cohorts (n= 90-283)</td>
<td>Final grades for Fundamentals of Professional Nursing Practice</td>
<td>GPA at entry and ATI composite scores (r=0.14, p&lt;0.05) and overall GPA (r=0.22, p&lt;0.01)</td>
<td>The only EI score to achieve statistical significance was the branch score Facilitation of Emotion. The rest were non-predictive of student outcomes.</td>
</tr>
<tr>
<td>Cunningham, Manier, Anderson and Sarnosky 2014 (USA)</td>
<td>Compare the predictive validity of a rational vs. empirically derived admission formula</td>
<td>Second semester upper division BSN students one cohort (n=85)</td>
<td>Overall ATI composite score</td>
<td>GPA at entry and ATI composite scores (r=0.32, p&lt;0.01), ATI Fundamentals score (r=0.24, p&lt;0.01), with second semester GPA (r=0.16, p&lt;0.05) and overall GPA (r=0.18, p&lt;0.01)</td>
<td>GPA at entry was significantly associated with overall ATI composite score. Science GPA was predictive of second semester GPA and overall GPA. ATI-TEAS score was significantly associated with ATI composite score, ATI Fundamentals, second semester GPA and overall GPA. There were no other significant correlations between independent and outcome variables. All selection criteria were combined using regression-based methods to identify a formula for admission. The empirical admission formula was more successful in predicting outcomes than the traditional rational points-based system and explained a higher proportion of the variance across many programme outcomes.</td>
</tr>
<tr>
<td>Authors</td>
<td>Year</td>
<td>Country</td>
<td>Study Type</td>
<td>Aim</td>
<td>Independent variables</td>
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<tr>
<td>Diaz, Sanchez and Tanguma</td>
<td>2012</td>
<td>USA</td>
<td>Exploratory study</td>
<td>To explore patterns of retention and attrition for nursing students</td>
<td>Interview score sheet sub-scores; arithmetic score; subject knowledge; role of the nurse (p=0.056), communication (p=0.026), reference (p=0.039), standard of written work (p=0.01), content of written work (p=0.001), application statement (p=0.320), educational qualifications (p=0.906) and health care work experience (p=0.278)</td>
</tr>
<tr>
<td>Donaldson, McCallum and Lafferty</td>
<td>2010</td>
<td>UK</td>
<td>Exploratory study</td>
<td>To assess the predictiveness of CEP and ATI-TEAS on success</td>
<td>Pre-programme GPA; American College Test (ACT) scores; TEAS composite score; composite TEAS score</td>
</tr>
<tr>
<td>Elkins</td>
<td>2015</td>
<td>USA</td>
<td>Retrospective correlation study</td>
<td>To investigate the predictors of success</td>
<td>Pre-programme GPA; American College Test (ACT) scores</td>
</tr>
<tr>
<td>Gale, Onms, Grant, Paget, Marks-Marsh</td>
<td>2016</td>
<td>USA</td>
<td>Longitudinal retrospective analysis</td>
<td>To determine the extent to which the MMI is predictive of academic success in nursing</td>
<td>MMI data (numeracy exam, literacy exam and interview score)</td>
</tr>
<tr>
<td>Year</td>
<td>Country</td>
<td>Aim</td>
<td>Design</td>
<td>Data collection tools</td>
<td>Data collection period</td>
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<tr>
<td>2013</td>
<td>Italy</td>
<td>To investigate the role in predicting nursing student academic success</td>
<td>Retrospective observation study</td>
<td>Existing student records</td>
<td>2004 – 2008</td>
</tr>
<tr>
<td>2014</td>
<td>USA</td>
<td>To examine the extent to which standardised HESI-A2 exam scores and pre-admission cumulative GPA predict timely progression in the nursing programme</td>
<td>Exploratory retrospective descriptive design</td>
<td>Existing student database</td>
<td>2008 – 2010</td>
</tr>
<tr>
<td>2013</td>
<td>Italy</td>
<td>To investigate the role in predicting nursing student academic success</td>
<td>Retrospective observation study</td>
<td>Existing student records</td>
<td>2004 – 2008</td>
</tr>
</tbody>
</table>

**Key findings:**
- Students with a higher preadmission GPA and preadmission GPA in science were more likely to have timely progression. Those with higher HESI-A2 scores were no more likely to have timely progression but were more likely to have higher nursing GPA.
- Combined HESI-A2 and preadmission GPA as predictors of timely progression: A test of the full model was significant ($\chi^2=11.450$, $p=0.003$, df=2). $R^2$ showed that the model explained 20.2% of the variance and accurately predicted 83.1% of cases.
- Combined HESI-A2 scores and preadmission science GPA as predictors of timely progression: A test of the full model was significant ($\chi^2=10.526$, $p=0.005$, df=2). $R^2$ showed that the model explained 18.7% of the variance. The model accurately predicted 84.3% of cases.

**Key findings:**
- There was no correlation between the admissions test score and any outcomes.
<table>
<thead>
<tr>
<th>Lui, Codd and Mills</th>
<th>Aim: To identify incremental validity in improving the accuracy of predicting early school success by adding other content areas in addition to science in the admission criteria. Design: Predictive design. Data collection type: Student data collected from 204 institutions. Data collection period: 2013 – 2016. Data analysis methods: Pairwise correlation coefficient and hierarchical regression.</th>
<th>Independent variables: TEAS V sub-score; Science; Reading; Mathematics; English. Outcome variables: RN-Fundamentals exam score taken in semester one.</th>
<th>Baccalaureate nursing students (n= 3253). Age: mean 29. Gender and ethnicity not reported.</th>
<th>Results: Science and RN-Fundamentals (r=0.403, p&lt;0.01). Reading and RN-Fundamentals (r=0.352, p&lt;0.01). Mathematics and RN-Fundamentals (r=0.294, p&lt;0.01). English and RN-Fundamentals (r=0.347, p&lt;0.01). Key findings: All correlations between all subsections of the TEAS test and the RN-Fundamentals exam were significant.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newton and Moore</td>
<td>Aim: To describe relationships among scholastic aptitude, nursing aptitude and BSN student attrition. Design: Exploratory descriptive. Data collection tools: Existing faculty records and ATI website for TEAS scores. Data collection period: 2004. Data analysis methods: Logistic regression.</td>
<td>Independent variables: Scholastic aptitude (GPA); TEAS composite score. Outcome variables: Attrition late in the programme because of one or more academic failures.</td>
<td>Nursing students enrolled on the baccalaureate programme, one cohort (n=107). Age, gender and ethnicity not reported.</td>
<td>Key findings: Neither scholastic aptitude (GPA) or TEAS composite score were predictive of attrition.</td>
</tr>
<tr>
<td>Pitt, Powis, Levett-Jones and Hunter</td>
<td>Aim: Explore CT scores relationship with students’ academic performance, clinical performance and progression. Design: Longitudinal correlational study. Data collection tools: Faculty records and the Health Sciences Reasoning Test (HSRT). Data collection period: 2009 - 2011. Data analysis methods: Correlation analysis, logistic and multinomial regression.</td>
<td>Independent variable: HSRT CT score; HSRT CT sub-scores; Analysis; Inference; Evaluation; Inductive reasoning; Deductive reasoning. Outcome variables: Academic performance (measured by GPA in years 1, 2 and 3); Clinical performance (measured by structured observation and assessment of practice by a university employed assessor in the clinical area); Progress (completion of the programme in three years).</td>
<td>Nursing students enrolled on Bachelor of Nursing programme one cohort (n=51-134). Convenience sample. Age: mean 27. Gender: female 86%. Ethnicity: not reported.</td>
<td>Results and key findings: There were positive correlations between HSRT scores and all academic performance scores which were significant. There was no statistical difference between HSRT scores of students who took and passed or failed their clinical assessment (n=51). HSRT CT score, analysis score and deductive reasoning score predicted programme completion. As the analysis score increased by 1 the chance of completion increased by 42% (p=0.001, odds ratio=0.582). As the deductive reasoning score increased by 1 the chance of completion increased by 27% (p=0.003, odds ratio=0.726). As the total CT score increased by 1 the likelihood of completion increased by 11% (p=0.011, odds ratio=0.888).</td>
</tr>
<tr>
<td>Author(s) and year</td>
<td>Country</td>
<td>Aim</td>
<td>Independent variables</td>
<td>Outcome variables</td>
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<tr>
<td>Strickland and Cheshire</td>
<td>New Zealand</td>
<td>To identify if a correlation exists between admission criteria GPA with the</td>
<td>Undergraduate nursing students one cohort (n=112)</td>
<td>Admission GPA and Fundamentals final grade (r=0.41, p&lt;0.01)</td>
</tr>
<tr>
<td>Rankin</td>
<td>UK</td>
<td>To examine the predictive relationship between EI and clinical practice performance, academic performance and retention</td>
<td>Nursing degree students one cohort (n=178)</td>
<td>Prior academic attainment EI scores</td>
</tr>
<tr>
<td></td>
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<td>Age: mean 22.8</td>
<td>Clinical performance in year one</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data collection period: 2007 – 2009</td>
<td>Gender: female 95%, male 5%</td>
<td>Academic attainment in year one</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data analysis methods: Pearson’s correlation and multiple regression</td>
<td>Ethnicity: Caucasian 99.4%, (95.5% were British)</td>
<td>Registering for year two of the programme (progression)</td>
</tr>
<tr>
<td>Sharon and Grinberg</td>
<td>Israel</td>
<td>To examine the relationship between nursing students’ level of EI and their degree of academic success</td>
<td>Nursing degree students two cohorts (n=110, first year = 64, second year = 46)</td>
<td>EI score</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design: Cross-sectional prospective study</td>
<td>PET score</td>
<td>Convenience sample</td>
</tr>
<tr>
<td></td>
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<td>Data collection tools: Schutte Self-report Inventory, psychometric entrance test (PET) scores and grade transcripts</td>
<td>Academic success measured by annual grade average</td>
<td>Age: mean 21.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data collection period: Not reported</td>
<td>Gender: female 64%, male 36%</td>
<td>PET score</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data analysis methods: Pearson’s correlation</td>
<td>Ethnicity: not reported</td>
<td></td>
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<tr>
<td>Shulruf, Wang, Zhao and Baker</td>
<td>New Zealand</td>
<td>To measure the predictability of undergraduate GPA in the nursing programme with a range of measures based on student NCEA results</td>
<td>Nursing degree students (school leavers) one cohort (n=134)</td>
<td>NCEA credits attempted and GPA in first year (r=-0.64, p&lt;0.05)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design: Not reported</td>
<td>NCEA credits gained</td>
<td>NCEA credits attempted and GPA in first year (r=-0.175, p&lt;0.05)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data collection tools: Faculty database</td>
<td>NCEA GPA</td>
<td>NCEA GPA and GPA in first year (r=0.477, p&lt;0.05)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data collection period: Not reported</td>
<td>NCEA success rate</td>
<td>NCEA success rate and GPA in first year (r=0.262, p&lt;0.05)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data analysis methods: Pearson’s correlation</td>
<td>NCEA university ranking</td>
<td>NCEA university rank GPA in first year (r=0.313, p&lt;0.05)</td>
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<tr>
<td></td>
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<td></td>
<td>GPA in first year</td>
<td></td>
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<tr>
<td>Year</td>
<td>Country</td>
<td>Aim</td>
<td>Design</td>
<td>Data collection tools</td>
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<tr>
<td>2017</td>
<td>USA</td>
<td>To determine the predictors of success in a traditional baccalaureate programme</td>
<td>Retrospective, predictive, correlational design</td>
<td>Retrospective review of student records</td>
</tr>
<tr>
<td>2018</td>
<td>USA</td>
<td>To investigate if supplemental application and interview scores add to the prediction of student’s success</td>
<td>Retrospective correlational study</td>
<td>Student data from faculty records</td>
</tr>
<tr>
<td>2011</td>
<td>Canada</td>
<td>To investigate if supplemental application and interview scores add to the prediction of student’s success</td>
<td>Retrospective correlational study</td>
<td>Student data from faculty records</td>
</tr>
</tbody>
</table>
| **Traynor, Galanouli, Roberts, Leonard and Gale** | **Aim:** To complement existing evidence on the suitability of MMIs as a tool for the selection of nursing candidates onto a BSc nursing programme  
**Design:** Cross-sectional validation study  
**Data collection tools:** Seven MMI stations, retrospective data from original interview scores and end of first year academic results  
**Data collection period:** 2015  
**Data analysis methods:** Pearson’s correlation coefficients | **Independent variables:**  
Personal statement (PS) score  
Original interview score  
MMI score  
**Outcome variables:**  
Academic scores at the end of year one in the following modules:  
1. Health and Wellbeing  
2. Evidence Based Nursing  
3. Professional Nursing Values  
4. Practice Module  
**First year undergraduate nursing students one cohort (n=110)**  
Convenience sample  
Age: mean 24, range 19 – 48  
Gender: female 92%, male 8%  
Ethnicity: not reported | **PS score and Health and Wellbeing (r=0.22, p=0.029)**  
**PS score and Evidence Based Nursing (r=0.31, p=0.002)**  
**PS score and Professional Nursing Values (r=0.24, p=0.019)**  
**PS score and Practice Module (r=0.14, p=0.175)**  
**Interview score and Health and Wellbeing (r=0.02, p=0.824)**  
**Interview score and Evidence Based Nursing (r=0.11, p=0.296)**  
**Interview score and Professional Nursing Values (r=0.04, p=0.705)**  
**Interview score and Practice Module (r=0.06, p=0.598)**  
**MMI score and Health and Wellbeing (r=0.07 p=0.492)**  
**MMI score and Evidence Based Nursing (r=0.03, p=0.757)**  
**MMI score and Professional Nursing Values (r=0.06, p=0.588)**  
**MMI score and Practice Module (r=0.03, p=0.753)**  
**Key findings:** PS scores were associated with all modules aside from the practice module. Interview scores and MMI scores were not associated with any module outcomes. |
| --- | --- | --- | --- |
| **Underwood, Williams, Lee and Brunner** | **Aim:** To investigate the predictive value of HESI-A2 components with nursing student success  
**Design:** Correlational Design  
**Data collection tools:** Student data from faculty records  
**Data collection period:** 2008 – 2010  
**Data analysis methods:** Correlations | **Independent variables:**  
HESI-A2 composite scores  
HESI-A2 sub-scores;  
- Anatomy and Physiology  
- Mathematics  
- English  
**Outcome variables:**  
Final course grades in first semester nursing courses;  
NU301 – Fundamentals of Nursing (inc. skills, clinical practice and drug calculations).  
NU302 – Community Health Nursing (inc. skills and clinical practice).  
NU305 – Health and Physical Assessment (inc. skills).  
**BSN students (n=184)**  
Age, gender and ethnicity not reported | **Results:** Composite scores and NU301 (r=0.564, p<0.01)  
Composite scores and NU302 (r=0.609, p<0.001)  
Composite scores and NU305 (r=0.518, p<0.001)  
Anatomy & Physiology and NU301 (r=0.350, p<0.01)  
Anatomy & Physiology and NU302 (r=0.402, p<0.01)  
Anatomy & Physiology and NU305 (r=0.404, p<0.01)  
Mathematics and NU301 (r=0.297, p<0.01)  
Mathematics and NU302 (r=0.239, p<0.01)  
Mathematics and NU305 (r=0.253, p<0.01)  
English and NU301 (r=0.503, p<0.01)  
English and NU302 (r=0.581, p<0.01)  
English and NU305 (r=0.414, p<0.01)  
**Key findings:** All HESI-A2 composite and sub-scores were positively and significantly correlated with grades in all modules. |
| **Van Hofwegen, Eckfield and Wambugh** | **Aim:** To examine how admission data of veteran nursing students predicted quantitative measures of success at the completion of programme  
**Design:** Not reported  
**Data collection tools:** Student data from faculty records  
**Data collection period:** 2009 – 2013 | **Independent variables:**  
TEAS cumulative score  
Pre-admission science GPA  
**Outcome variables:**  
Graduating GPA  
**Student (veterans) enrolled on the nursing programme five cohorts (n=55)**  
Age: range 22-62  
<25 = 24%,  
26 – 30 = 46%  
31 – 40 = 19%  
>40 = 11%  
**Results:** TEAS and pre-admission science GPA had a non-significant relationship with graduating (chi-square =1.04; df=2, p=0.6).  
**TEAS score of 79 or higher or pre-admission science GPA of 3.43 or higher had no better odds of graduating than those with scores below these values.**  
**Pre-admission science GPA was a significant predictor of a graduation GPA of at least 3.13 (chi-square =9.93; df=2, p=0.007).** |
| Wambughu, Eckfield and Van Hofwegen 2016 (USA) | Gender: female: 43%, male: 57%  
Ethnicity:  
Caucasian: 39%  
African American: 5%  
Latino: 20%  
Filipino: 19%  
Asian: 13%  
Other: 4%  
Students with a pre-admission science GPA of 3.43 or higher increased their odds of graduating with a GPA of 3.13 by a factor of 3.73.  
**Key findings:** Higher preadmission science GPA was predictive of graduating with a score of 3.13. The rest of the results were non-significant. |
|---|---|
| **Aim:** To examine which admission criteria are useful as predictors of nursing programme success  
**Design:** Not reported  
**Data collection tools:** Student data from the nursing programme  
**Data collection period:** 2009 – 2014  
**Data analysis methods:** Logistic regression modelling  
**Independent variables:**  
TEAS cumulative score  
Pre-admission science GPA  
Health care experience  
Previous baccalaureate degree  
**Outcome variables:**  
Graduating  
Overall nursing programme GPA  
Nursing degree students four cohorts (n=513)  
Age, gender and ethnicity not reported  
**Results:** TEAS score was statistically significant (p=0.01) in predicting graduation rates. The rest were not; pre-admission science GPA (p=0.75), health care experience (p=0.77), previous baccalaureate degree (p=0.11).  
TEAS and pre-admission science GPA were statistically significant predictors of obtaining an overall nursing programme graduation GPA of 3.25 or above (p=0.00).  
**Key findings:** Students with higher pre-admission science GPA were more likely to obtain a score of 3.25 or above, and those with higher TEAS were more likely to graduate and obtain a score of 3.25 or above. |
| Wolkowitz and Kelley 2010 (Canada) | BSN students from multiple cohorts (n=2000)  
Age, gender and ethnicity not reported  
**Results:** Reading and RN-Fundamentals (r=0.3, p=0.01)  
Mathematics and RN-Fundamentals (r=0.3, p=0.01)  
Science and RN-Fundamentals (r=0.35, p=0.01)  
English and RN-Fundamentals (r=0.27, p=0.01)  
Relationship between TEAS cumulative sub-scores and RN-Fundamentals score was statistically significant, (R²=0.20, F (4, 4100) =256.467, p<0.01) explaining 20% of the variance.  
**Key findings:** The TEAS sub-scores were all predictive of success with science being the most predictive. The cumulative score is a better indicator of success than the sub-scores. |
| **Aim:** To apply multiple regression model to student test scores to determine the relative strength of science, math, English and reading content areas in predicting early nursing student success  
**Design:** Not reported  
**Data collection tools:** Existing nursing school records collected from 64 institutions via survey  
**Data collection period:** 2005 – 2008  
**Data analysis methods:** Multiple regression analysis  
**Independent variables:**  
TEAS cumulative score  
TEAS sub-score;  
- Reading  
- Mathematics  
- Science  
- English  
**Outcome variables:**  
RN-Fundamentals score (taken within first year of course)  
**Results:** Reading and RN-Fundamentals (r=0.3, p=0.01)  
Mathematics and RN-Fundamentals (r=0.3, p=0.01)  
Science and RN-Fundamentals (r=0.35, p=0.01)  
English and RN-Fundamentals (r=0.27, p=0.01)  
Relationship between TEAS cumulative sub-scores and RN-Fundamentals score was statistically significant, (R²=0.20, F (4, 4100) =256.467, p<0.01) explaining 20% of the variance.  
**Key findings:** The TEAS sub-scores were all predictive of success with science being the most predictive. The cumulative score is a better indicator of success than the sub-scores. |