Analysis of factors potentially associated with nursing students' academic outcomes: A thirteen-year retrospective multi-cohort study

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A B S T R A C T

Background: Low academic success rates lead to fewer than the required number of nurses entering the national health systems, impacting on the supply of nurses and with negative consequences for global health care since low nurse-to-patient ratios are associated with an increase of patients' adverse outcomes.
Objectives: This study was mainly aimed at documenting any of the academic outcomes' potential predictors among Nursing Degree Program (NDP) students' characteristics.
Design: A retrospective multi-cohort study was conducted.
Participants and Setting: Ten cohorts of nursing students enrolled in a central Italy university were involved.
Methods: Qualitative and quantitative data on entry characteristics and academic outcomes were retrieved, observing retrospectively 10 cohorts of Italian nursing students for 13 academic years (2004–2017).
  Multiple regression analyses were conducted to assess if potential predictors reporting a p-value < 0.05 in univariate analyses were independently related to academic outcomes.
Results: A total of 2278 students were enrolled in this study. Multivariate analyses showed that 'female gender', 'having attended classical or scientific upper-secondary school', and 'having higher upper-secondary diploma grade' were associated both with the qualitative outcomes (graduation within the legal duration of NDP) and the quantitative ones (final degree exam grade). The weight of the 'admission-test score' in explaining the variance of academic performances was very low ($\beta = 0.03$, 95% CI = 0.01 to 0.05) compared to the 'upper-secondary diploma grade' ($\beta = 0.14$, 95% CI = 0.12 to 0.16).
Conclusions: This evidence should lead to a reflection on the entry-selection methods for NDP, especially in those countries such as Italy, where these methods are essentially based on the entry-test, which in this study was shown to have a very low predictive power for academic outcomes.

1. Introduction

Research concerning nursing students' academic outcomes such as success or failure has been continuing for over half a century (Merkley, 2015; Urwin et al., 2010), and it has long been known that outcome rates could depend on the assumed definitions and the features of nursing education programs in each country (Salamonson and Andrew, 2006). Nevertheless, it is widely accepted that the ideal academic progression of nursing students should lead to attaining graduation within the legal duration of the degree program, which in the literature is defined as academic success (Dante et al., 2013a; Dante et al., 2015; Lancia et al., 2013). However, due to the dynamic, complex, and multidimensional nature of the interactions between students' characteristics and Higher Education Institutions (HEIs), not all students experience academic success (Jeffreys, 2015; Urwin et al., 2010), resulting in a rate of academic failure varying from 9.0% to 46.3% across the world (Bulfone et al., 2011; Seago et al., 2012). In fact, many students voluntarily or involuntarily drop out the Nursing Degree Program (NDP) (Pitt et al., 2012; Ten Hoeve et al., 2017; Wray et al., 2017), while others are retained to either re-sit their failed exams or for personal reasons (e.g. family, work or heath) until they graduate or definitely withdraw (Cameron et al., 2011a, 2011b).

Low academic success rates lead to fewer nurses than required entering the national workforce (Cameron et al., 2011a; Gaynor et al., 2006), with negative impact on the supply of nurses (World Health Organization, 2013) and consequences for global health care (World

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Health Organization, 2006) since low nurse-to-patient ratios are associated with an increase of patients' adverse outcomes (Aiken et al., 2002; Aiken et al., 2014; Needleman et al., 2002; Petrucci et al., 2015). Moreover, when students fail, universities lose financial resources, with a negative impact on their economic efficiency (Pub. L. No. 240, 2010; Raisman, 2013). Therefore, documenting students' academic outcomes and their potential determinants could be the first step for universities to face students' difficulties and consequently facilitate the nursing students' academic success, promoting their own economic sustainability and contributing to satisfy the community's health needs (Jeffreys, 2015). However, even though much evidence showed that students' profile, including gender, age, and pre-entry qualification, could be associated with academic outcomes, such results do not allow the adoption of effective strategies to reduce academic failure since they were often conflicting or focused on non-modifiable students' characteristics (Cameron et al., 2011b; Dante et al., 2013b; Gaynor et al., 2006; Urwin et al., 2010). Nevertheless, the entry-test scores and upper-secondary school grades have often been identified as good criteria to select the best candidates (Lancia et al., 2013; Newton et al., 2007) even though in the nursing field the contrasting evidence highlights the need to deeply understand the role of these predictors (Dante et al., 2013b).

Since the contemporary society needs nurses that fit with the modern health paradigm, the academic education is requested to provide nursing students both with appropriate theoretical knowledge and practical skills (York et al., 2015). Therefore, taking into account these peculiar aspects of nursing education, research should not be limited to evaluating academic success just as a dichotomous outcome (success or failure), which refers to the ability or inability to attain graduation within the legal duration of the NDP. It should also be focused on a quantitative analysis of students' performances, such as the 'mean grade of intermediate exams' and the 'final degree exam grade', that are considered proxy measurements of the achievement of theoretical and practical learning objectives (York et al., 2015).

The only way to provide universities with effective entry-selection methods to offer the best-educated professionals to the community is to deeply detect the relationship between all possible academic outcomes and entry characteristics of nursing students in the current systems as well as their trends over time.

For these reasons, this study aimed to retrospectively investigate any relationship between nursing students' academic outcomes and their potential predictors through a thirteen-year observational study.

2. Methods

2.1. Study Design

A retrospective multi-cohort study was conducted and reported according to STROBE recommendations (von Elm et al., 2008). Ten cohorts of students admitted to the NDP first years from 2004 to 2013 were observed for an overall period of thirteen years. The study ended in May 2017 when the observation period of the last cohort (2013) was concluded.

2.2. Population and Setting

The study was performed into the NDP of a university in central Italy. Since 1992, Italian nursing education takes place at the university level only (Pub. L. No. 502, 1992), and according to the Bologna Declaration (1999) the programs became homogeneous throughout the national territory with the exception of small differences permitted by law (Zabalegui et al., 2006).

In Italy only students with at least 12 years of prior formal education are allowed to be admitted to university courses and admission into the NDP depends on passing an entry-test based on multiple-choice questions about the following topics: 'logic and general education',

'mathematics and physics', 'biology', and 'chemistry' (Pub. L. No. 477, 2017). The NDP lasts 3 years and requires students to obtain 180 credits (5400 h), passing exams in theoretical activities (at least 96 credits), clinical training activities (at least 60 credits), and other activities (approximately 24 credits) (Pub. L. No. 128, 2001). Grades of intermediate exams range from 18 to 31 (i.e. the maximum grade with honours), while the final exam ranges from 66 to 111 (i.e. the maximum grade with honours).

2.3. Data Collection

For all students admitted to the NDP first years from 2004 to 2013, the following data were retrieved from multiple administrative electronic records: 1) personal data, 2) type of upper-secondary school attended, 3) grade of upper-secondary diploma, 4) score in entry-test, 5) mean grade of intermediate exams, 6) grade of final degree exam, and 7) graduation within the legal duration of NDP (yes/no).

Academic outcomes were defined both through a qualitative measurement (success or failure), which refers to the ability to attain graduation within the legal duration of the NDP course, and quantitative ones (academic performances), such as the 'mean grade of intermediate exams' and the 'final degree exam grade'.

Upper-secondary school attended was dichotomized into two main categories: 'classical and science education' and 'technical and professional education'.

2.4. Data Analysis

Data analysis was performed in the second half of 2017, after the conclusion of the observation period of the last cohort enrolled in the 2013/2014 academic year.

In order to avoid information bias, the building of final dataset, obtained through the merging of data from multiple administrative electronic records, was performed independently by two researchers.

Descriptive analyses were used to illustrate the characteristics of the sample. Categorical variables, such as 'gender', 'upper-secondary school attended', and 'graduation within the legal duration of course', were described through frequencies and percentages, and their trends over the period 2004–2017 were tested using the Royston's test (Sribney, n.d.).

Continuous variables, such as 'age', 'upper-secondary diploma grade', 'admission test score', 'mean grade of intermediate exams', and 'final degree exam grade' were expressed as mean and standard deviations, and their trends over time were analyzed using the slopes regression analysis (β) (Remy et al., 2005).

Univariate logistic or linear regression analyses, as appropriate, were performed to document the potential predictors of academic outcomes, which in this study were identified both as quantitative variables ('mean grade of intermediate exams' and 'final degree exam grade') and qualitative ones (graduation within the legal duration of course). The predictive power was expressed as odds ratio (OR) with 95% confidence interval (95% CI), or linear regression coefficient (β). Next, multiple regression analyses were conducted to assess if predictors reporting a p-value < 0.05 in univariate analyses were independently related to academic outcomes, adjusting for all other independent variables.

The Pearson coefficient was calculated to examine the degree of correlation between 'mean grade of intermediate exams' and 'final degree exam grade'.

A p-value < 0.05 was the criterion for statistical significance. The data were processed using the STATA/IC 15.0 statistical package.

3. Results

Among 2402 eligible students, a total of 2278 (94.8%) students were enrolled in this study (Fig. 1). Table 1 shows the participants'