



## Nursing applicants' reasoning skills and factors related to them: A cross-sectional study

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### ABSTRACT

**Background:** The assessment of reasoning skills is recommended in undergraduate nursing student selection. Reasoning skills are crucial for sound decision-making, improving patient safety and are necessary from the very beginning of studies. Nursing applicants' reasoning skills based on the reasoning process have not been previously measured.

**Objectives:** To assess undergraduate nursing applicants' reasoning skills and factors related to them.

**Design:** A cross-sectional study.

**Setting and participants:** Undergraduate nursing applicants (n = 1056, response rate 55.4%), who consented to the study and performed a joint electronic entrance examination to six Finnish Universities of Applied Sciences in spring 2019, participated in the study.

**Methods:** The Reasoning Skills (ReSki) test, based on the steps of the reasoning process, was used, comprising three question sections (collecting information, processing information, and identifying the problem and establishing goals). Background variables were collected through a questionnaire and the Positive System Usability Scale (P-SUS). The data were analysed with descriptive statistics, Pearson correlation coefficients and analysis of covariance with Tukey's test in post-hoc multiple group comparisons.

**Results:** Applicants' total reasoning skills mean scores were above the centre of the range of possible scores (2.72/4.5, SD = 0.80). The applicants scored higher in collecting and processing information than in identifying the problem and establishing goals. Standard deviations demonstrated variance between the applicants' ability. Age, gender, and previous education were statistically significantly related to applicants' reasoning skills. Previous work experience was statistically significantly related to success only in the step of identifying the problem and establishing goals.

**Conclusions:** Nursing applicants' reasoning skills vary in the student selection phase. Applicants are less able to identify the problem and establish goals than to collect and process information. Vocational education does not necessarily develop adequate reasoning skills and thus prepare students for higher education studies. The results have implications for educational institutions and further research.

### 1. Introduction

The assessment of reasoning skills is recommended in undergraduate nursing student selection (Haavisto et al., 2019; Vierula et al., 2020a, 2020b). Reasoning skills are cognitive skills that are needed both in

theoretical (McNelis et al., 2010) and clinical (Timer and Clauson, 2011) nursing studies for academic progress (Perkins et al., 2013). Most importantly, nurses need good reasoning skills to make sound decisions that improve patient safety (Levett-Jones et al., 2010; Simmons, 2010). Nowadays, there is increased pressure on nursing programmes to select

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students from the pool of applicants who are most likely to succeed in their studies, graduate on time and join the workforce while delivering appropriate care to service users (Talman et al., 2018; Wambuguh et al., 2016). Therefore, there is a need for admission criteria that support the aforementioned aims. The assessment of applicants should focus on a variety of cognitive and non-cognitive skills that comprehensively reflect the requirements of their professional education (Schmidt and MacWilliams, 2011; Talman et al., 2018; Wambuguh et al., 2016). Cognitive skills, such as language and mathematical skills, have commonly been assessed in nursing student selection based on entrance examination results and/or previous academic achievement (Vierula et al., 2020a; Wolkowitz and Kelley, 2010). Recently, the role of other cognitive skills, such as reasoning skills, has been identified in the assessment processes of healthcare applicants (Lievens et al., 2016; Vierula et al., 2020a). However, compared to more commonly assessed cognitive skills (e.g., language and mathematical skills), reasoning skills are less often assessed in nursing student selection and more evidence of such skills is needed (Vierula et al., 2020a).

The concept of reasoning is used interchangeably with the concepts of critical thinking, decision-making, problem-solving and clinical judgement (Carbogim et al., 2016; Simmons, 2010). Reasoning refers to the thinking process preceding a decision, whereas decision-making, problem-solving and clinical judgement focus on the endpoint of the reasoning process (Simmons, 2010). Critical thinking facilitates reasoning, but refers to a broader concept including knowledge, experiences, dispositions (attitudes or habits of mind) and intellectual abilities (Carbogim et al., 2016; Simmons, 2010). Despite the conceptual differences, all these concepts propose that certain cognitive processes such as reasoning are required to solve problems or to arrive at a solution. According to previous literature, few studies have focused on measuring these concepts in the context of nursing student selection. Previously, critical thinking instruments (Health Sciences Reasoning Test, Watson–Glaser Critical Thinking Appraisal) and the Multiple Mini-Interview (MMI) have been used to assess nursing applicants' critical thinking, decision-making and problem-solving skills (Vierula et al., 2020a). Critical thinking scores in the selection/entry phase have predicted success in nursing programmes (Crouch, 2015; Pitt et al., 2015), risk of course failure and ability to graduate on time (Pitt et al., 2015). The overall MMI scores (including decision-making and problem-solving) have predicted academic success (Gale et al., 2016). In addition, Pitt et al. (2015) have reported that critical thinking mean scores at entry were slightly above the centre of the range of possible scores and approximately 9% of the applicants' scores were extremely weak. They also found statistically significant relationships between critical thinking entry scores, age, and previous nursing-related experience (Pitt et al., 2015).

Nursing student selection and selection decisions have a major individual and institutional impact because of the large number of applications processed on an annual basis. The magnitude of the nursing profession is reflected in student selection affecting thousands of applicants and higher education institutions (HEIs) every year. In 2017, there were 121,000 nursing graduates in the European Union (Eurostat, 2019) out of an estimated 7.3 million European nurses and midwives (World Health Organization [WHO], 2020a). Globally, approximately 20.7 million nurses and midwives account for nearly 50% of the health workforce (WHO, 2020b). Currently, student selection methods are evolving internationally, and evidence is needed for the justification of best practices (Taylor et al., 2014). HEIs are responsible for using valid and reliable selection methods (Perkins et al., 2013) that will enable the equal treatment of the applicants (Haavisto et al., 2019; Shulruf et al., 2018). In the assessment of nursing applicants' reasoning skills, the use of synonymous concepts of reasoning has led to challenges in operationalisation of the concept when establishing what exactly is being measured (Vierula et al., 2020a). Vierula et al. (2020b) identified reasoning skills for the student selection phase according to the clinical reasoning process (Levett-Jones et al., 2010) which is widely used in

clinical contexts to describe a cognitive process where nurses analyse patient information, evaluate its significance and weigh up alternative actions (Levett-Jones et al., 2010; Simmons, 2010). In nursing student selection, reasoning skills refer to generic skills that do not involve nursing-specific knowledge. Nursing applicants' reasoning skills involve collecting information, processing the collected information, and using that information for making decisions by identifying the problem and establishing goals (Vierula et al., 2020b). Studies have been done to assess nursing students' reasoning skills during their education (Georg et al., 2018; Koivisto et al., 2016). Absent from the literature, nursing applicants' reasoning skills based on the reasoning process have not been previously measured.

To conclude, the assessment of nursing applicants' reasoning skills is recommended, but more evidence is needed for the justification of best selection practices. Based on previous literature, very few studies have focused on this field; the assessment has mainly focused on applicants' critical thinking skills (Vierula et al., 2020a) and only one study (Pitt et al., 2015) reported factors explaining test-takers' success. In this study, we focus on nursing applicants' reasoning skills and related factors, measured with the new validated electronic Reasoning Skills (ReSki) test (Vierula et al., 2021).

## 2. Methods

### 2.1. Aim

The aim of the study was to assess undergraduate nursing applicants' reasoning skills and factors related to them. The ultimate goal is to develop undergraduate nursing student selection processes to be more valid and objective. The study is part of the Reforming Student Selection in Nursing Education (ReSSNE) project in Finland (Haavisto et al., 2019).

### 2.2. Design

A cross-sectional design was used to obtain data from undergraduate nursing applicants at a single time-point.

### 2.3. Sample and participants

A purposive sample of undergraduate (bachelor level) nursing applicants was recruited. Altogether 1906 nursing applicants took the Reasoning Skills (ReSki) test as part of the joint electronic entrance examination to six Finnish Universities of Applied Sciences (UASs) in May 2019. Only the data collected from the applicants ( $n = 1056$ , response rate 55.4%) who consented to the study were included.

### 2.4. Data collection

The data were collected through the validated ReSki test (Vierula et al., 2021). The ReSki test is part of the joint electronic entrance examination measuring undergraduate nursing applicants' learning skills (including reasoning, language and mathematical skills), emotional intelligence and certainty of career choice (Haavisto et al., 2019). The time limit for the joint entrance examination is two and a half hours and the selection decisions are based on overall test performance, not on individual test domain scores. The exam is taken under supervision in computer classrooms.

The ReSki test is a case-based test following a reasoning process (Levett-Jones et al., 2010; Vierula et al., 2020b, 2021). The development process of the ReSki test has been reported in a previous study (Vierula et al., 2021). The test was developed by researchers and the content of the test (i.e. relevance and clarity of the items) was evaluated by expert panels. The ReSki test includes three question sections based on the steps of the reasoning process: 1) collecting information, 2) processing information and 3) identifying the problem and establishing goals (Fig. 1).

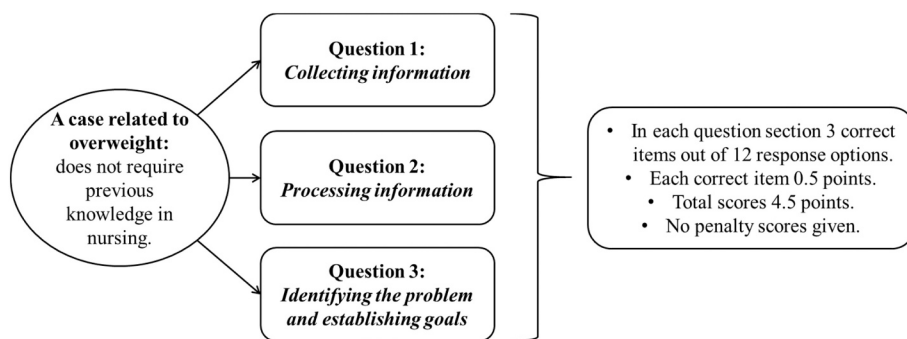


Fig. 1. Reasoning skills (ReSki) test for undergraduate nursing student selection: structure and scoring technique.

The question sections follow the case, each including three correct items out of 12 response options. The case in the ReSki test is related to overweight, a generic phenomenon that the applicants would be familiar with, but for which no previous nursing knowledge is required. The total scores of the ReSki test are allocated as part of the joint entrance exam score and thus the subscores are selected to reach the total scores of the ReSki test. As in other standardised tests, the aim of the ReSki test is to enable examiners to discriminate between the applicants and it is not expected that most applicants will receive the maximum score in the test (Ramsay et al., 2020).

In addition to the ReSki test responses, demographic details, and information about the perceived usability of the ReSki test were collected. The background variables of age, gender, previous education (high school/vocational school), previous Finnish higher education degree, previous application to nursing studies (yes = 1, >1/no), study programme choice (nursing as 1. or >1.), work experience in the field prior to application (yes/no) and the mean value of the Finnish version of the Positive System Usability Scale (P-SUS) (Brooke, 1996; Jokela, 2019) were included in the study.

2.5. Ethical considerations

The participating UASs were partners of the ReSSNE project and gave permission to conduct the study. The applicants received the invitation to participate in the study together with the entrance examination invitation letter. Informed consent was requested electronically before the applicants started the exam. The UASs did not receive the information about which applicants consented/did not consent to participate in the study. The data were pseudonymised before the data analysis and the original data, including identification details, were stored behind the password with limited access. The data will be destroyed after the completion of the study. The ethics committee approval was obtained from the Human Sciences Ethics Committee in the Satakunta region (14/04/2019). Selection results regarding either individual participants or UASs were not reported, protecting the anonymity of the individual applicants. The study was conducted by following responsible conduct of research and protection of the data integrity (General Data Protection Regulation, 2016; The Finnish Advisory Board on Research Integrity, 2012).

2.6. Data analysis

The data were analysed using Statistical Analysis Software (SAS 9.4®) (SAS Institute Inc., 2015). Descriptive statistics (frequencies, percentages, and measures of central tendency) were calculated to describe the participants' demographic characteristics and summarise the ReSki test scores. Nursing applicants' reasoning skills were assessed on the level of above or below the centre of the range of possible subscores and total scores, because a mean value close to the centre of the range of possible scores is considered desirable (DeVellis, 2017). Pearson correlation coefficient was computed to assess the relationships

among subscores to assess if high-achieving applicants demonstrated reasoning skills according to the reasoning process. Analysis of covariance (ANCOVA) with Tukey's test in post-hoc multiple group comparisons was used to examine the factors related to nursing applicants' reasoning skills. The level of statistical significance was set at 0.05.

3. Results

3.1. Participant demographic characteristics

The mean age of the applicants (n = 1056) was 24.56 (SD = 7.22, range = 18–55), most being female (86.0%, n = 904). Slightly over half of the applicants were high school graduates (54.0%, n = 568), whereas 46.0% (n = 484) had a vocational diploma. In addition, 8.9% (n = 93) of the applicants had a previous degree in higher education. Most were first-time applicants (59.5%, n = 625) and approximately half of the applicants had nursing as their first study programme choice (51.5%, n = 485). Approximately half of the participants had work experience in the field prior to application (49.6%, n = 520). All in all, the applicants represented typical Finnish nursing applicant characteristics.

3.2. Nursing applicants' reasoning skills

Nursing applicants' total reasoning skills were slightly above the

Table 1 Undergraduate nursing applicants' (n = 1056) reasoning skills: ReSki test scores, number of correct answers and proportions of correct answers.

| Reasoning skills                               | Mean | SD   | Range | %     |
|--|------|------|-------|-------|
| Collecting information                         |      |      |       |       |
| Subscores <sup>a</sup>                         | 1.02 | 0.37 | 0–1.5 | –     |
| Number of correct answers <sup>c</sup>         | 2.04 | 0.75 | 0–3   | –     |
| Proportion of correct answers                  | –    | –    | –     | 67.8% |
| Processing information                         |      |      |       |       |
| Subscores <sup>a</sup>                         | 1.10 | 0.37 | 0–1.5 | –     |
| Number of correct answers <sup>c</sup>         | 2.21 | 0.74 | 0–3   | –     |
| Proportion of correct answers                  | –    | –    | –     | 73.6% |
| Identifying the problem and establishing goals |      |      |       |       |
| Subscores <sup>a</sup>                         | 0.60 | 0.35 | 0–1.5 | –     |
| Number of correct answers <sup>c</sup>         | 1.20 | 0.70 | 0–3   | –     |
| Proportion of correct answers                  | –    | –    | –     | 40.1% |
| Total  |      |      |       |       |
| Total scores <sup>b</sup>                      | 2.72 | 0.80 | 0–4.5 | –     |
| Number of correct answers <sup>c</sup>         | 5.45 | 1.59 | 0–9   | –     |
| Proportion of correct answers <sup>d</sup>     | –    | –    | –     | 60.5% |

<sup>a</sup> Correct answer = 0.5 pt., maximum subscores = 1.5 pt., centre of the range of subscores 0.75 pt.

<sup>b</sup> Correct answer = 0.5 pt., maximum total scores = 4.5 pt., centre of the range of total scores 2.25 pt.

<sup>c</sup> Three correct items out of 12 options.

<sup>d</sup> Nine correct items out of 36 options in total.

centre of the range of total scores (M = 2.72, SD = 0.80) (Table 1). The applicants scored highest in processing information and lowest in identifying the problem and establishing goals, evidenced by the subscores and the number and proportions of correct answers. More specifically, the applicants' reasoning skills were above the centre of the range of subscores in collecting information (M = 1.02, SD = 0.37) and processing information (M = 1.10, SD = 0.37), whereas their skills were below the centre of the range of subscores in identifying the problem and establishing goals (M = 0.60, SD = 0.35). Nursing applicants' reasoning skills varied as the standard deviations demonstrated variance between the applicants' ability (subscores SD = 0.35–0.37, total scores SD = 0.80) (Table 1). High achieving applicants' reasoning skills seemed to follow the reasoning process supported by the statistically significant correlations among the subscores (Table 2). If the applicants demonstrated reasoning skills in one step of the reasoning process, they also demonstrated reasoning skills in another step of the process.

### 3.3. Factors related to nursing applicants' reasoning skills

The demographic factors of age, gender and previous education (high school or vocational school) were statistically significantly related to the reasoning skills of nursing applicants (Table 3). Specifically, these demographic factors were related both to applicants' total scores and subscores. In addition, work experience in the field prior to application was statistically significantly related to applicants' success in identifying the problem and establishing goals. Other background variables did not reveal statistically significant results, and thus did not explain applicants' success in reasoning skills (Table 3).

Age was related to nursing applicants' total reasoning skills and to all the subscores (Table 3). Based on the slope estimates (Table 3), more mature applicants scored better in reasoning skills. Gender was related to higher mean scores in total scores and in two subscores (collecting information, and identifying the problem and establishing goals), indicating that male applicants scored better than female applicants. Previous education was related to nursing applicants' total reasoning skills and to all the subscores, suggesting that high school graduates scored better than applicants with vocational diplomas. Nursing applicants with previous work experience in the field had slightly higher mean scores in identifying the problem and establishing goals compared to the applicants with no previous work experience in the field (Table 3).

A further descriptive analysis was conducted to examine more specifically work experience in the field prior to application (Table 4). Applicants with previous work experience in the field (49.6%, n = 520) had the same age range (18–55) as the whole sample and were mostly women. Their mean age was 26.22 (SD = 7.50) whereas the applicants without previous work experience were substantially younger (M = 22.87, SD = 6.47). Most of the applicants with work experience had a vocational diploma. In sum, the applicants with work experience were slightly older than the applicants without work experience.

**Table 2**  
Relationships between undergraduate nursing applicants' (n = 1056) reasoning skills.<sup>a</sup>

| Reasoning skills subscores  | r    | p-Value |
|---|------|---------|
| Collecting information and Processing information                         | 0.32 | <0.001  |
| Collecting information and Identifying the problem and establishing goals | 0.27 | <0.001  |
| Processing information and Identifying the problem and establishing goals | 0.29 | <0.001  |

<sup>a</sup> Pearson correlation coefficients (r) for subscores.

## 4. Discussion

### 4.1. Discussion of the results

Reasoning skills are essential for nursing professionals and thus the assessment of reasoning skills is recommended in undergraduate nursing student selection (Haavisto et al., 2019; Vierula et al., 2020a, 2020b). However, absent from the literature, nursing applicants' reasoning skills based on the reasoning process have not been previously measured. The overarching aim of this study was to assess undergraduate nursing applicants' reasoning skills and factors related to them.

The results of the present study indicated that nursing applicants' total reasoning skills were quite good, supported by the result of the applicants' total scores being slightly above the centre of the range. This result is in accordance with previous literature, since test-takers' critical thinking scores at entry to nursing programme have been reported to be slightly above the centre of the range of possible scores (Pitt et al., 2015). However, the results of the present study suggested that nursing applicants' reasoning skills vary between the test-takers and may indicate that some nursing applicants are entering the nursing programme with better reasoning skills than others. The highest achieving applicants demonstrated reasoning skills throughout the ReSki test and were able to collect and process the information and finally make the decision by identifying the problem and establishing goals supported by the results of the correlations. In addition, most nursing applicants were able to collect and process the collected information. However, nursing applicants were less able to identify the problem and establish goals. In prior literature, it has been easier for nursing students to collect information than establish the goals in clinical scenarios (Koivisto et al., 2016). Reasoning is a step-by-step process where collecting and processing information are the basis for identifying the problem and establishing goals (Levett-Jones et al., 2010; Vierula et al., 2020b). It is possible that identifying the problem and establishing goals was difficult for the applicants because it was the final step of the reasoning process, where the test-taker finally makes the decision and comes up with a solution. Therefore, it required comprehensive thinking and the correct choices needed to have already been made in the previous steps of the reasoning process.

Based on the results, reasoning skills in the selection phase are related particularly to age, gender, and previous education. Work experience in the field prior to application was related to reasoning skills in this study, but only in identifying the problem and establishing goals. However, age, educational background and work experience have not been significantly associated with nursing students' learning of the clinical reasoning process during the education (Koivisto et al., 2016). It is likely that reasoning skills are more dependent on the background factors in the selection phase because of the heterogenous group of applicants. In this study, more mature applicants had better reasoning skills in the selection phase. This result aligns with previous studies related to student selection in which statistically significant relationships between test-takers' scores and ages have been found (Pitt et al., 2015; Stage and Ögren, 2004). Gender differences in reasoning skills were found in this study, which is typical for standardised tests, indicating that tests with quantitative elements more often work to men's advantage (Stage and Ögren, 2004). Moreover, significant differences in reasoning skills were found between high-school and vocational school graduates. Secondary education should prepare students for higher education but, based on these results, high-school graduates had better reasoning skills and possibly a better basis for entering the nursing programme. Work experience in the field prior to application was related to only one subscore of reasoning skills and was possibly related to higher age rather than the work experience itself. In a previous study, it was reported that students with prior nursing-related experience had significantly lower entry critical thinking scores, indicating that assistant or helper roles did not develop higher-level thinking skills (Pitt et al., 2015). In this study, participants with a vocational education and

**Table 3**  
Factors related to undergraduate nursing applicants' (n = 1056) reasoning skills.<sup>a</sup>

|  | Collecting information subscores | Processing information subscores | Identifying the problem and establishing goals subscores | Reasoning skills Total scores |
|--|----------------------------------|----------------------------------|--|-------------------------------|
| <b>Independent variables</b>   |                                  |                                  |  |                               |
| Difference between means (95% confidence interval), p-value/NS = not significant |                                  |                                  |  |                               |
| <b>Gender</b>  |                                  |                                  |  |                               |
| Male vs female   | 0.11 (0.03–0.18), 0.004          | −0.01 (−0.08–0.07), NS           | 0.11 (0.04–0.18), 0.003                                  | 0.21 (0.05–0.36), 0.008       |
| <b>Previous education</b>  |                                  |                                  |  |                               |
| High school vs vocational school   | 0.11 (0.05–0.17), 0.001          | 0.10 (0.04–0.16), 0.001          | 0.13 (0.07–0.19), <0.001                                 | 0.34 (0.21–0.47), <0.001      |
| <b>Previous Finnish higher education degree</b>                                  |                                  |                                  |  |                               |
| Yes vs no  | 0.04 (−0.06–0.14), NS            | −0.08 (−0.18–0.02), NS           | −0.01 (−0.11–0.09), NS                                   | −0.05 (−0.26–0.16), NS        |
| <b>Previous application to nursing studies</b>                                   |                                  |                                  |  |                               |
| First-time applicant vs second-time applicant                                    | 0.06 (−0.01–0.13), NS            | 0.05 (−0.02–0.12), NS            | −0.02 (−0.09–0.05), NS                                   | 0.09 (−0.06–0.24), NS         |
| First-time applicant vs third-time applicant or more                             | 0.02 (−0.07–0.10), NS            | −0.00 (−0.09–0.08), NS           | 0.01 (−0.07–0.09), NS                                    | 0.03 (−0.15–0.20), NS         |
| Second-time applicant vs third-time applicant or more                            | −0.05 (−0.14–0.05), NS           | −0.05 (−0.15–0.04), NS           | 0.03 (−0.06–0.12), NS                                    | −0.07 (−0.27–0.13), NS        |
| <b>Study programme choice</b>  |                                  |                                  |  |                               |
| Nursing as a primary choice vs nursing not as a primary choice (second or more)  | −0.02 (−0.07–0.03), NS           | −0.00 (−0.05–0.05), NS           | 0.02 (−0.03–0.07), NS                                    | 0.00 (−0.10–0.11), NS         |
| <b>Work experience in the field prior to application</b>                         |                                  |                                  |  |                               |
| Yes vs no  | −0.00 (−0.06–0.06), NS           | 0.02 (−0.04–0.08), NS            | 0.09 (0.03–0.15), 0.005                                  | 0.11 (−0.02–0.24), NS         |
| <b>Slope (standard error), p-value/NS = not significant</b>                      |                                  |                                  |  |                               |
| Age  | 0.01 (0.00), 0.001               | 0.01 (0.00), 0.001               | 0.01 (0.00), <0.001                                      | 0.02 (0.00), <0.001           |
| Mean value of the Finnish version of the Positive System Usability Scale (P-SUS) | 0.01 (0.01), NS                  | 0.01 (0.01), NS                  | −0.01 (0.01), NS   | 0.01 (0.02), NS               |

<sup>a</sup> Subscores (max. 1.5 pt) and total scores (max. 4.5 pt) of the Reasoning Skills (ReSki) test as a dependent variable (analysis of covariance with Tukey's test in post-hoc multiple group comparisons).

**Table 4**  
Demographic factors of the applicants with work experience in the field prior to application (n = 520).

| Demographic factor <sup>a</sup> | n   | %    | Range | Mean (SD)    |
|---------------------------------|-----|------|-------|--------------|
| Age in years                    | 519 |      | 18–55 | 26.22 (7.50) |
| <b>Gender</b>                   |     |      |       |              |
| Male                            | 63  | 12.1 |       |              |
| Female                          | 456 | 87.9 |       |              |
| <b>Previous education</b>       |     |      |       |              |
| High school                     | 130 | 25.0 |       |              |
| Vocational school               | 390 | 75.0 |       |              |

<sup>a</sup> Missing values: Age in years (n = 1), gender (n = 1).

previous work experience were most likely practical nurses, being typical for the Finnish nursing applicant population. It seems that a vocational education or practical nursing role does not necessarily include complex decision-making or develop reasoning skills. The background variables of a previous Finnish higher education degree, previous application to nursing studies, study programme choice and the mean value of the Finnish version of the P-SUS did not explain applicants' success in reasoning skills. An interesting result is that the perceived usability of the electronic ReSki test (P-SUS mean value) was not related to applicants' reasoning skills, although the use of electronic entrance examinations has been uncommon. This result suggests either that the applicants are familiar with using digital applications or the electronic test was intuitive to use.

Overall, HEIs are responsible for using valid and fair selection practices (Haavisto et al., 2019; Perkins et al., 2013). Understanding the role of demographic factors related to the success in student selection may help HEIs in developing their student selection practices. The results of this study indicate that nursing applicants' reasoning skills vary, especially between high-school and vocational school graduates. This suggests that secondary education (particularly vocational education) institutions critically appraise their courses and their potential to

prepare students for higher education studies. In addition, applicants with a vocational background entering the nursing programme may need more support at the beginning of their studies. Previously, work experience in the field has been used as an admission criterion for higher education (Schmidt and MacWilliams, 2011). In this study, previous work experience in the field did not explain applicants' success in total reasoning skills and thus may not support the use of work experience as an admission criterion. All in all, it is recommended that nursing applicants' reasoning skills are assessed along with other cognitive skills to support the aims of student selection (Vierula et al., 2020a; Wambuguh et al., 2016). It is important to select the applicants who are most likely to succeed in their studies, since in many countries there are more applicants than places for nursing courses (Talman et al., 2018; Wambuguh et al., 2016). The results of this study suggest that reasoning skills could be one area of assessment in the selection phase. In addition, it is important not only to assess reasoning skills in the selection phase, but also to support the development of nursing students' reasoning skills throughout their degree. Further research should acknowledge how nursing education may support nursing students' learning in reasoning skills from the very beginning of their studies.

#### 4.2. Strengths and limitations

Absent from the previous literature, this study was the first to assess nursing applicants' reasoning skills according to the reasoning process. The novelty of the study can be considered its major strength. The response rate was 55.4%, which is considered good. The sample size was large enough to conduct the statistical analysis and large in comparison with sample sizes in other studies focusing on nursing student selection (Vierula et al., 2020a). The sample was representative, since the participants represented typical nursing applicant characteristics and the data were collected nationwide from six large UASs. The results are generalisable to the Finnish population. Internationally, the applicant characteristics may vary slightly, but overall, we consider the results to

be generalisable because nursing competencies are fairly universal and registration into the profession requires formal studies in higher education. The ReSki test used in this study is a valid objective assessment of undergraduate nursing applicants' reasoning skills, but it has been stated that further improvement of the test is needed for the desired adjustment of the item-level difficulty (Vierula et al., 2021). It is noteworthy that cross-sectional design does not allow the drawing of conclusions about any causality of the associations between the variables studied.

## 5. Conclusions

This study produced new knowledge about undergraduate nursing applicants' reasoning skills and factors related to them. Nursing applicants' reasoning skills vary in the student selection phase, which may indicate that some nursing applicants are entering the nursing programme with better reasoning skills than others. In the reasoning process, nursing applicants are less able to identify the problem and establish goals than they are to collect and process the information. Moreover, vocational education is not necessarily developing adequate reasoning skills and thus preparing students for higher education studies. In the future, HEIs should consider that students entering the programme have different abilities to develop their reasoning skills and some students may need more support than others. Vocational education institutions are encouraged to critically appraise their courses and their potential to prepare students for higher education studies. Further research should focus on the development of reasoning skills during the degree and how reasoning skills in the selection phase predict academic success.

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## Author contribution

JV, MH, KT and EH made substantial contributions to study conception and study design, acquisition of data, and interpretation of data and results. JE was responsible for the data analysis and participated to interpretation of data and results. EL contributed to the analysis and interpretation of data and results. JV was responsible for the drafting of the manuscript. All authors participated in commenting and revising the article critically for important intellectual content finally approving the version to be submitted.

## Declaration of competing interest

None.

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