Critical-Thinking Ability in Respiratory Care Students and Its Correlation With Age, Educational Background, and Performance on National Board Examinations

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BACKGROUND: Critical thinking is an important characteristic to develop in respiratory care students. METHODS: We used the short-form Watson-Glaser Critical Thinking Appraisal instrument to measure critical-thinking ability in 55 senior respiratory care students in a baccalaureate respiratory care program. We calculated the Pearson correlation coefficient to assess the relationships between critical-thinking score, age, and student performance on the clinical-simulation component of the national respiratory care boards examination. We used chi-square analysis to assess the association between critical-thinking score and educational background. RESULTS: There was no significant relationship between critical-thinking score and age, or between critical-thinking score and student performance on the clinical-simulation component. There was a significant (*P* = .04) positive association between a strong science-course background and critical-thinking score, which might be useful in predicting a student's ability to perform in areas where critical thinking is of paramount importance, such as clinical competencies, and to guide candidate-selection for respiratory care programs. *Key words: critical thinking; Watson-Glaser Critical Thinking Appraisal; education.* [Respir Care 2011;56(3):284–289. © 2011 Daedalus Enterprises]

Introduction

The importance of critical thinking is often mentioned in educational and professional presentations and endorsed in the literature. Given the global explosion of knowledge, the suggestion by Facione and Facione[1] that education should not focus on imparting out-of-date data, but must instead foster critical-thinking skills, seems self evident.

Critical thinking has been defined as the "*process of evaluating propositions or hypotheses and making judgments about them on the basis of well supported evidence*."[2] It is difficult to deny but challenging to implement the concept proposed by Barnett,[3] that critical thinking is a process encompassing self-reflection and action as the "center" of the education experience.

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Critical thinking has been used as a single predictor of board examination performance in healthcare professions and has been proposed as a measure of teaching effectiveness.[4] The short-form Watson-Glaser Critical Thinking Appraisal (WGCTA-S) has been widely used in respiratory and nursing research.[5-10]

The complexity of modern healthcare calls for clinicians to make intricate decisions that impact patients' qual-

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ity of life and survival. Thus, healthcare professionals must be expert at gathering pertinent patient information, processing that information, and then making good patient-care decisions. McPeck described critical thinking as the application of discipline-specific knowledge and skills to solve real-life problems.[11]

There has been a growing concern among many employers in the healthcare industry that new recruits lack critical-thinking ability.[12] In healthcare, a critical thinker can think through complex, multifaceted problems, anticipate and recognize needs and potential and actual complications, and expertly communicate with the rest of the healthcare team.[13] The critical thinker possesses the decision-making skills that translate to better patient care.

While good decision-making skills are believed to be strongly tied to critical thinking in respiratory care students and respiratory therapists, the results of studies that attempted to test correlation between critical thinking and decision-making skills have been conflicting.[5,6,14-18] There are also very limited data available that quantifies or describes specific predictors of adequate critical-thinking skills within the respiratory care discipline.

We designed this study to identify factors that predict critical-thinking ability in respiratory care students in a baccalaureate respiratory care program, and to determine if critical-thinking scores predict student performance on the clinical-simulation component of the national respiratory care boards examination. This knowledge could help drive future research on admission criteria for applicants to respiratory care programs, and on senior respiratory care students' readiness for the national boards.

We studied 3 questions:

- Is age of senior respiratory care students correlated with exiting WGCTA-S score?
- Do students with a stronger science-course background have more advanced critical-thinking skills?
- Is WGCTA-S score correlated with student performance on the clinical-simulation component of the National Board for Respiratory Care (NBRC) examination?

Methods

The subject pool consisted of 60 senior students, in 3 cohorts (the graduating classes of 2004, 2005, and 2006), completing a bachelor of science degree in respiratory care at an academic health-science center in the southwestern United States. We excluded 5 subjects from the analysis because of incomplete records at the time of administering the WGCTA-S, resulting in an effective n of 55.

The WGCTA-S has 40 multiple-choice items, with item options ranging from 2 to 5. The WGCTA-S poses 5 scenarios, and the test-taker is asked to judge the potential conclusions to the presented data. The scenarios provide scores (ranging from 0 to 40) for 5 subtests:

- Inference: discriminating among degrees of truth or falsity of inference drawn from given data
- Recognition of assumptions: recognizing unstated assumptions or presuppositions in given statements or assertions
- Deductions: determining whether certain conclusions necessarily follow from information in given statements or premises
- Interpretation: weighing evidence and deciding if generalizations or conclusions based on the given data are warranted
- Evaluation of arguments: distinguishing between arguments that are strong and relevant and those that are weak or irrelevant to a particular question at issue[19]

Our institutional review board approved this study and deemed it exempt on the stipulation that we receive only de-identified data. Personal data such as age is part of the students' permanent files. All the test data were collected by the respiratory care faculty as part of program evaluation. Academic information such as grade point average (GPA) and past course work was obtained from student records by the office administrator.

During the spring semester of their senior year, students took the WGCTA-S, then the NBRC clinical-simulation examination. The WGCTA-S was proctored in a classroom setting, with no time limit. Most subjects completed the WGCTA-S in less than 40 min.

All subject data were labeled by number only (students 1–55) and were provided to us in an electronic spreadsheet (Excel, Microsoft, Redmond, Washington). The WGCTA-S and NBRC clinical-simulation examination results and the students' transcripts were provided in paper form, with only the number as an identifier. Science-course background was determined from each transcript by identifying course designations for biology, chemistry, biochemistry, anatomy, physiology, physics, and microbiology that were in addition to the program prerequisite science courses. The prerequisite science courses are anatomy and physiology I and II with labs, general chemistry with lab, general physics with lab, and microbiology with lab. Subjects were considered to have a strong science-course background if they had completed $\geq$ 10 credits in science. Twenty-four subjects (44%) had a strong science-course background. Twenty-two subjects (40%) had less than 10 science credit hours. Nine subjects (16%) had transfer credits from other schools that listed course numbers but failed to provide a course designation, which made it impossible to determine the specific course content. Therefore, only 46 subjects were included in our analysis of the relation-

Table 1. Short-Form Watson-Glaser Critical Thinking Appraisal Scores*

	Items (no.)	Score (mean ± SD)
Overall score	40	23.7 ± 5.02
Domain scores		
Inference	7	3.6 ± 1.6
Recognition of assumptions	8	4.7 ± 2.4
Deduction	9	5.5 ± 1.9
Interpretation	7	3.5 ± 1.4
Evaluation of arguments	9	6.6 ± 1.5

* n = 55 test-takers.

Table 2. Scores on the Clinical-Simulation Component of the National Board for Respiratory Care Examination*

Sub-component	Mean ± SD	Median	Range
Information gathering	82 ± 5	83	64–90
Decision making	72 ± 7	73	56–90

* n = 55 test-takers.

ship between science-course background and critical-thinking score.

We collected all the data in a spreadsheet (Excel, Microsoft, Redmond, Washington), then imported it into statistics software (SPSS, SPSS, Chicago, Illinois) and calculated descriptive statistics on the WGCTA-S scores. We used Pearson/Spearman correlation to assess the relationship between critical thinking and student age, and between critical thinking and clinical-simulation examination scores. We used chi-square analysis to assess the correlation between critical thinking and educational background. A P of $< .05$ was considered statistically significant.

Results

Age, WGCTA-S scores, and NBRC clinical-simulation examination results were available for 55 students (mean ± SD age 26.4 ± 3.9 y, range 21–41 y). There was no significant relationship between age and critical-thinking ability. The group's mean ± SD prerequisite GPA was 3.20 ± 0.38. Prerequisites are the courses required to obtain a bachelor of science degree in respiratory care in Texas. The group's mean ± SD overall GPA for all course work was 2.91 ± 0.45 (range 1.96–4.00).

Table 1 shows the WGCTA-S scores. The subjects answered at least 50% of the items correctly on all the subsets. Their scores were higher in the evaluation of arguments (73%), deduction (61%), and recognition of assumptions (59%) subsets than in the inference (51%) and interpretation (50%) subsets.

The students took the NBRC clinical-simulation examination within 6 months of the WGCTA-S. The passing score for the clinical-simulation examination is based on a "minimal passing level" established by the NBRC.[20] The candidate must pass the information-gathering and decision-making sections on the same clinical-simulation examination. Table 2 shows the scores from the information-gathering and decision-making sections. There were no significant relationships between age and critical-thinking score (P = .66), critical thinking and information-gathering score (P = .61), or critical thinking and decision-making score (P = .56).

We used chi-square analysis to assess the association between a strong science-course background and critical-thinking ability in 46 subjects. We assigned the subjects into 2 groups: above-average critical-thinking ability, and below-average critical-thinking ability. Since no normative data are available for respiratory care students, it seemed reasonable to evaluate the data with the mean WGCTA-S score of this subject pool (23.7) as the break point for strong versus weaker critical thinking. Chi-square analysis revealed a significant relationship between strong science-course background and critical-thinking score: the chi-square value is 4.22 (P = .04). The students with above-average critical-thinking were 4.3 times more likely to have a strong science background.

Discussion

The lack of a positive correlation between the WGCTA-S score and the NBRC decision-making and information-gathering scores in our findings is consistent with the results from Johnson and Van Scoder.[21] Even at the master's level, the modest gains sometimes obtained in critical-thinking score between starting and finishing the program has led to questioning of the value of this score as a predictor of overall performance on national boards.[22]

In a study by Mishoe et al,[23] the WGCTA forms A and B and the Clinical Simulation Self-Assessment Examination were administered to 60 students prior to graduation from their bachelor of science program in respiratory therapy. They found a significant correlation (r = 0.34) between the WGCTA and decision-making scores, and between GPA and WGCTA score (r = 0.45), and between GPA and decision-making (r = 0.43). However, though significant, the correlation was weak and was based on the WGCTA forms A and B, which contain a total of 80 items. Hill compared decision-making scores from the Clinical Simulation Self-Assessment Examination and the WGCTA-S of 143 respiratory care students graduating from 10 programs, and found a significant but weak correlation between critical thinking and decision-making

($r = 0.32$).[5] In 24 first-year respiratory care students, Shelledy et al found that critical thinking had a weak but significant correlation to decision-making performance on a written clinical-simulation examination ($r = 0.49$), and concluded that critical thinking may have more impact on a student's ability to gain from instruction and practice than the decision-making score itself.[24] The 3 studies mentioned above all examined critical thinking and Clinical Simulation Self-Assessment Examination results. This was in contrast to our study, in which we considered the relationship of critical thinking to performance on the NBRC's clinical-simulation component. This difference in study design may partially explain the difference in findings.

We found a significant association between a strong science-course background and critical-thinking score. Our subjects who had a strong science-course background had completed 60 university credit hours in addition to the core requirements, compared to an average of 38 credit hours in the subjects with ≤ 10 credit hours in science courses. Students with high grades tend to score better on the WGCTA-S.[25] We did not study the correlation between science-course GPA and critical-thinking score. This raises an important question: is a strong science-course GPA (regardless of the number of science credit hours), a better predictor of critical-thinking score?

At first glance the positive correlation that we found between science and critical-thinking score appears to be in contrast with previous studies.[26-32] While Tsui,[33] Brigham,[34] and McCleish[35] found a positive correlation between science courses and critical thinking, Brigham[34] and McCleish[35] essentially found that more college credits was associated with a higher critical-thinking score regardless of course work studied, thus including science courses. Tsui[33] found a significant positive association ($P < .01$) between science and critical thinking, but it was not as strong as that between humanities, honors, and interdisciplinary courses and critical thinking ($P < .001$). Those studies support the theory that critical-thinking ability is proportional to the individual's educational background.

Whereas Hill[5] and others[34-39] found a significant association between age and critical thinking, we found no significant correlation between age and critical-thinking score, which is consistent with other studies of health-sciences students.[40-45] This suggests that critical thinking does not improve simply with age, and that specific academic and professional experiences are needed to develop and improve critical thinking in most individuals.[46]

Shin et al[47] measured critical-thinking in associate, baccalaureate, and bachelor of nursing science senior students and found a negative correlation between age and critical thinking. Their finding was supported by previous studies in nursing.[26,47]

Limitations

Our sample size was small ($n = 55$), only senior students were enrolled, and the sample was from only one baccalaureate program, so our results may not be generalizable to junior and senior respiratory care students or students in other programs. In addition, data available from studies in respiratory care are scarce, which limits the validity and the extrapolation of our findings.

There is conflicting evidence regarding whether the curriculum can improve health-professions students critical-thinking skills enough to improve WGCTA scores.[48] McMillan[49] and Bauwens et al[50] found that the WGCTA was not sensitive to changes in critical thinking of students in professional settings, because it is based on situations in daily life. Recent data indicate that the guessing rate could be as high as 38% with the original WGCTA, and potentially higher with the short-form WGCTA.[51] New critical-thinking evaluation tools with better precision may change the results of future studies on the variables considered in our study. The lack of an association between critical-thinking score and clinical-simulation examination score in our study, and the relatively poor correlation (although statistically significant) in some other studies in respiratory care relating to the Clinical Simulation Self-Assessment Examination may suggest that the WGCTA is useful in measuring critical-thinking skills of the general population but not necessarily the critical-thinking ability of healthcare-professions students.[52]

Conclusions

While there was no correlation between critical-thinking score and performance on the clinical-simulation examination, the significant association between strong science-course background and critical-thinking scores may be useful in predicting a student's ability to perform in areas where critical thinking is of paramount importance, such as clinical competence and response under pressure. When a larger pool of qualified candidates is present, assessing applicants' critical-thinking ability might also be used as a factor in candidate selection for respiratory care programs. The WGCTA, although considered the standard test for critical-thinking ability, may not be the best way to measure critical-thinking ability in healthcare professionals.

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