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Critical thinking ability and its associated factors among preclinical students in Yazd Shaheed Sadoughi University of Medical Sciences (Iran)

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Abstract

Background: The aim of this study was to investigate the ability of Iranian medical and dental students in thinking critically and to assess their ability in using definite components of critical thinking (CT).

Methods: Multistage cluster sampling was utilized to recruit 125 preclinical (1st, 2nd and 3rd year of study) students in Yazd Shaheed Sadoughi University of Medical Sciences in Yazd, Iran. The Watson-Glaser Critical Thinking Appraisal (WGCTA) was applied to collect data. The statistical analysis of the data included One-way analysis of variance (ANOVA), t-test and bivariate correlations.

Results: The mean total score for this sample was 45.33±5.4. Significant differences were found in total critical thinking score by gender (p= 0.022), residency (p= 0.026) and the year of education (p= 0.01). A significant correlation was found between the total CT score and the student's number of passed credits (r= 0.297, p= 0.003). Also, a significant difference was found in the students' scores on the WGCTA evaluation subtest by passing any research method courses (p= 0.04).

Conclusion: The CT ability in medical and dental students in the present study was weak overall. Medical educators and clinical instructors should try to develop the ability of CT by teaching methods and techniques like purposeful planning and problem-based teaching to promote the components of CT in their students. The improving of CT in medical students has implications for medical education and promotion of medical profession.

Keywords: Watson-Glaser Critical Thinking Appraisal, Higher education, Medical and dental students.

Introduction

A great number of definitions have been suggested for critical thinking (CT) from educational, philosophical, and psychological view (1). Levy defined critical thinking as: "an active and systematic cognitive strategy to examine, evaluate, and understand events, solve problems, and make decisions on the basis of sound reasoning and valid evidence" (p. 236) (2). Another definition of CT comprises the cognitive master plans applied for decision-making, task analysis, and problem solving which comes from a combination o f operational skills and metacognitive ability (3).

For the past 3 decades, CT has been an important subject in higher education (4). It was noted in Goals 2000 that in the 21st century, CT abilities were essential for produc-

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tive employment occasions and also a necessary component of a quality education (5). Moreover, through the years, educators, investigators, and psychologists have stressed the importance of CT as a high priority in a college education (6) and we can find multiple critical thinking investigations on college students; medicine (7-8), dentistry (9), pharmacy (10) and nursing (11).

Shepard (12) noted that CT is an important skill for today's graduate (13). Also, previous studies have mentioned CT as a necessary skill for medical students and professionals (7-8). That is why physicians who think in a critical manner will be better able to solve problems and make sound decisions due to the common supposition. . Also, CT is known as an essential part for training of many medical and healthcare professionals. As an example, CT is a very controversial subject in physician education. Scott and Market (14) investigated CT skills in medical students applying the Watson-Glaser Critical Thinking Appraisal (WGCTA) and found a positive relationship between CT skills and student academic success in the first two years of medical school. They concluded that CT skills predict academic success, moderately, throughout the preclinical years of medical education (14). In another study, the CT abilities of 123 major students in their final year of educations were assessed using the WGCTA and the total CT scores for this group was found under the national patterns (15).

In recent years, several studies have done on medical students in different Iranian universities and around the world (16-18). CT may influence professional decision-making processes and may has direct and indirect implications for the quality of medical care. Obviously, medicine is characterized by the need for inferences, interpretation, intellectual reasoning and creativity. Nowadays, the ability to find the best solutions, adaptation with new situations and making novel decisions are important for medical and dental students who will play an important role in the future medical and health care. Medical students who are skillful and able to think critically will make their efforts in today's complex workplace environments. Performing such studies will help medical educators in considering the effects of their education on CT ability of their students. Also, it may help them to take into account the CT and its domains in their teaching process and thereby prepare their students to position for career success.

The aim of this study was to apply the WGCTA to investigate the ability of Iranian medical students in CT and to assess their ability in using its definite components. Also, the effect of some selected demographic and educational variables on CT abilities was studied.

Methods

Subject and procedure

In March 2008, a multistage cluster sampling utilized to recruit 150 preclinical (1st, 2nd and 3rd year of study) students in Yazd Shaheed Sadoughi University of Medical Sciences in central Iran. In this descriptive, cross-sectional study, clusters were sampled with probability proportional to the population of each classroom. The purpose of the study, including their rights as human subjects for a research study, was explained to the subjects and all signed consent forms. The testing of participants spanned an academic semester.

At the first days of spring semester, the WGCTA was administered to 150 students before starting the formal classes and they were told about the purpose of examination. It was explained as a tool to help determine pattern related to academic performance, and that the results would be confidential and it is not a part of their academic records or an assessment of knowledge. The students were allowed 40 minutes to complete the assessment. As participating in the study was voluntary, twenty-five students did not take part in the study or did not answer questions completely. Therefore, they were excluded from the study and finally 125 (Male: 42/Female: 83) students from which 68.8% were medical and 31.2% dental students completed WGCTA (response rate=83.3%).

Table 1. Demographic characteristics of students (n=125)

variable	Mean (SD)	Frequency (%)
Gender		
Male		42 (33.6)
Female		83 (66.4)
Age (year)	20.2 (3.5)	
Field of study		
Medicine		86 (68.8)
Dentistry		39 (31.2)
Residency (n=124)		
Native Yazdish		51 (40.8)
Out of Yazd		73 (58.4)
Year of education (n=123)		
First year (freshman)		47 (37.6)
Second year		36 (28.8)
Third year		40 (32)
Number of passed credits	41.8 (27.4)	
Less than 20 credits		27 (21.6)
21-40 credits		21 (16.8)
41-60 credits		12 (9.6)
More than 61 credits		36 (28.8)
Previous semester GPA*(n=86)(out of 20)	15.9 (1.7)	
Under 14.99		20 (16)
15-16.99		49 (39.2)
17-20		17 (13.6)
Cumulative GPA (n=85) (out of 20)	15.86 (1.7)	
Under 14.99		19 (15.2)
15-16.99		49 (39.2)
17-20		17 (13.6)
Passing any research methods courses (n=122)		
Yes		23 (18.4)
No		99 (79.2)

*GPA= Grade Point Average

Demographic characteristics of the students are shown in Table 1.

Watson-Glaser Critical Thinking Appraisal

As the study conducted on preclinical medical and dental students and as some CT abilities like "Recognition of Assumptions" and "Evaluation of Arguments" are considered as having major importance in these students. We chose to use WGCTA. This questionnaire is a generic critical thinking scale (19) and assesses these abilities distinctly among participants. This scale has 5 subscales: (a) Inference, determining the extent to which one can discriminate the veracity of the statements from a given data; (b) Recognition of Assumptions, identifying unstated suppositions or presuppositions in provided statements or claims; (c) Deduction, a skill that inquire one to decide whether certain conclusions necessarily follow the given information; (d) Interpretation, where one take the evidence and implement the information into account; and (e) Evaluation of Arguments, differentiating between claims that are strong and pertinent and those that are weak or impertinent to a particular question under discussion (19).

The WGCTA consists of 80 questions evenly divided among five subtests (a total subtest score=16) designed to assess abovementioned five components of CT (19). Magnusen et al. (20) provided a classification of WGCTA total score: weak (less than 54), moderate (54-59) and strong score (60-80). In dividing the score in a subtest, less than 10, 11 and 12-16 scores considered as weak, moderate and strong scores, respectively. Previous studies have been reported the reliability and validity of the WGCTA (19, 21-22). In Iran, Islami et al. (23) found the internal consistency of the WGCTA satisfactory when they tested the instrument to assess the total CT ability of graduate and

undergraduate nursing students.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS for Windows, Rel. 11.5) was used for the purpose of data entry, manipulation, and analysis. Measures of central tendency and variability were used to summarize and organize the data. One-way analysis of variance (ANOVA), Independent sample t-test and Pearson Product Moment Correlation Coefficient were performed. The level of significance was set, a priori, at 0.05.

Results

Statistically significant differences were found in total CT score by gender (p= 0.022), and place of residency (p =0.026), using Independent sample t-test. The difference favored female gender and native Yazdish. But there were not found significant differences in total CT score by field of study (Fig. 1), and age. Moreover, statistically significant difference was found in the students' scores on the WGCTA evaluation subtest by passing any research method courses (p= 0.048), applying Independent sample t-test. The difference favored those who passed research method courses.

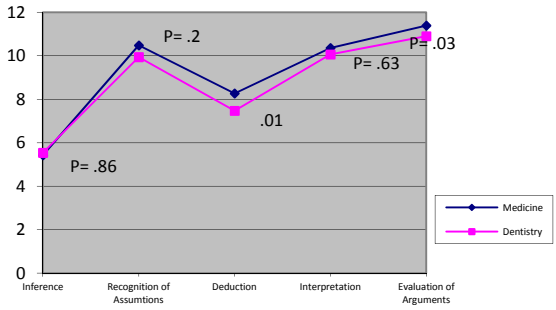

Fig. 1. Mean scores comparison of WGCTA subtests by the students' field of study

The mean scores for each subtest ranged from 5.42±1.9 for inferences to 11.3±1.8 for evaluation of arguments (Table 2). The mean total score for the participants was 45.33±5.4, with a range from 31.2 to 57.

One-way ANOVA showed significant differences between the year of education for the inference ($F_{2, 122} = 3.687$, p= 0.028) subtest and for total score ($F_{2, 122} = 4.775$, p= .010) (Table 2). Both the inference subscale and total CT score difference persisted after post *hoc* tests, with students from third year of education scored significantly higher than those from second and first years of educa-

Table 2. Mean scores comparison of WGCTA subtests by the students' year in Yazd Shaeed Sadoughi University of Medical Sciences*

		Freshmen n=47	Second year n=36	Third year n=40	Total sample n=123
Inference	Mean (SD)	4.97 (1.6)	5.29 (1.9)	6.06 (2.1)	5.42 (1.9)
	Minimum	1	2	2	1
	Maximum	8	10	11	11
Recognition of Assumptions	Mean (SD)	10.2 (1.8)	9.83 (2.0)	10.81 (2.2)	10.3 (2.0)
	Minimum	6	6	6	6
	Maximum	14	14	14	14
Deduction	Mean (SD)	7.81 (2.2)	7.71 (1.9)	8.64 (2.2)	8.05 (2.1)
	Minimum	1	3	4	1
	Maximum	12	12	13	13
Interpretation	Mean (SD)	9.96 (2.3)	10.4 (2.6)	10.43 (2.3)	10.26 (2.4)
	Minimum	4	4	4	4
	Maximum	15	14	15	15
Evaluation of Arguments	Mean (SD)	10.95 (1.9)	11.5 (1.3)	11.43 (2.0)	11.3 (1.8)
	Minimum	4	8	4	4
	Maximum	15	14	15	15
Total score	Mean (SD)	43.96 (5.5)	44.81 (5.1)	47.39 (5.2)	45.33 (5.4)
	Minimum	31	32	34	31
	Maximum	52	53	57	57

*n indicates number of respondents; SD, standard deviation

tion.

Applying Pearson's correlation analysis, a significant correlation was found between the total CT score and the student's number of passed credits (r= 0.297, p= 0.003). Moreover, the student's Number of Passed Credits had statistically significant positive correlations with students scores on the WGCTA recognition of assumptions (r= 0.215, p= 0.03), deduction(r= 0.239, p= 0.019) and evaluation(r= 0.234, p= 0.022) subtests. There was not found any significant correlation between total critical thinking score and the student's previous semester Grade Point Average (GPA) and cumulative GPA.

Discussion

Based on the classification of Magnusen et al. (20) we can see in the results that the sample had a weak critical thinking score. This finding is consistent with the results of previous studies within which WGCTA (15, 24-25) or California Critical Thinking Disposition Inventory (CCTDI) (26-31) were used to investigate CT abilities. Similar to this finding, Barkhordary et al. (28) found that 81.8% of the students had an uncertain CT disposition in a study on nursing students in Yazd city (Iran).

Although the mean score of 45.33±5.4 with the range of 31.2-57 in the present study is in the range that indicates an inclination for CT, it falls close to the lower bounds, showing that the CT ability in these students is weak. The mean score of WGCTA in Scott and Market's study (14) was about 60. In Profetto-McGrath's study (32) using CCTDI on nursing students in Canada, about 98 percent of students had a desired CT ability. These findings showed that CT ability in medical sciences students in Iran is somewhat lower than what it is in developed countries. Therefore, medical teachers and educators should consider this problem while teaching their students and design interventional programs to improve the CT abilities in these students.

As an emphatic recommendation, improving the level of CT in medical and dental students before they go into the work place as a physician will not occur without interventional programs. Therefore, to be allied with Smith and Brownell (33), we also suggest that a considerable part of college preparative coursework should comprise a component of CT. Moreover, a previous study (31) has suggested strengthening selfesteemin the medical sciences students for suitable clinical judging and decision making in different clinical situations.

In the study done in Shiraz, another Iranian city, on two groups of computer sciences students, the mean score for WGCTA was about 36 which was lower than the mean score of CT acquired in the present study (25). In agreement with Leaver-Dunn et al. (34), it seems that the difference in the mean score of CT shows dissimilarity between the general characteristics of universities and the traits of the students attending them. In general, students attending larger universities have interactions with a more varied portion of people and come across a wider range of contend opinions (34). Therefore, they would be expected to have higher CT scores.

The WGCTA is composed of five subtests of 16 questions. Due to the small numbers of questions for each subtest, using subtest score is not suggested to analyze which components of an individual's CT skills are weak or strong (35). However, similar to the findings in our study, the CT abilities of the students are the strongest in the *recognition of assumptions subtest* and the weakest in the *inferences* in previous studies (14, 25). We noted this comment only to remind the educators about the importance of this matter. As it was defined before, inference is determining the extent to which one can discriminate the veracity of the statements from a given data. So, if the ability of medical students in inferences is weak, in real, will not they be confronted with problems while discriminating between clinical statements in real situations of workplace environments?

In the present study, an statistically significant difference was found between the students' scores on the WGCTA evaluation subtest by passing any research method

courses. In a study conducted to compare the CT skills in doctoral and master's level students, Onwueguzie found that there may be a mutual relationship between CT and research skills (36). In other words, CT skills increase as the student's research skills promote. Therefore, persuading medical and dental students to participate in research method courses and research projects may be another way of raising CT in these students.

In consistence with the findings of a previous study on nursing students (37), in the present study there was not any significant correlation between total CT score and the student's previous semester and cumulative GPA. This finding is supported by Scott and Markert (14) and also Facione et al. (27) who noted that it is possible to increase CT score althoughdisposition toward CT seems to be stable over a period of years.

Results indicated significant difference between the years of education for total CT score and furthermore, a good correlation was found between total CT score and the student's number of passed credits. Similar with these findings, in a previous research an increase was observed in CT skills, remarkably after entrance into clinical practice (38). Even though some evidences also suggest that CT skills increase over time (39-40) but we found that the CT ability in medical and dental students in the present study was weak overall. The CT ability of third year students who are going to start the clinical stage was only 47.39 and it shows that they will start the clinical stage with a weak ability of CT and, probably, they would be confronted with some difficulties in clinical environments.

Despite the strengths of the present study, there were some limitations, as well. A main limitation for our work was the large number of questions in WGCTA which is really time-consuming and maybe the reason why some of the students did not participate in the study or did not answer all questions resulting in their exclusion, consequently. Moreover, we did not consider the education level and socioeconomic status of students' parents as demographic and baseline characteristics of the respondents which should be take into account in future studies. As another limitation, although previous studies (19, 21-23) have reported the reliability and validity of the WGCTA, this questionnaire assesses the CT ability of respondents in general. However, for some specific respondents like medical and dental students, applying such a questionnaire may not assess their real ability in some profession-related CT components like interpretation of patients' test results. Therefore, it is suggested to consider some more specific questionnaires for future studies on these populations.

Conclusion

Medical and dental educators and nonclinical instructors must try to develop the ability of CT, especially *inference* and *deduction* domains, in their students. Goal-centered planning, problem-based teaching and using multimedia instructions may help educators in obtaining these objectives. Further research is recommended to appraise the CT abilities of medical sciences students, especially in developing countries, minorities and also disadvantaged areas. Also, studying the changes in CT measures through the progression from preclinical to clinical level is suggested. Moreover, investigating the association between CT abilities and performance-based indices of clinical competence in clinical students is recommended. Finally, more researches are necessary to define factors like clinical judgment in the clinical environment and their relationship with CT in the performance of medical and dental students.

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