

A comparison of the Objective Structured Clinical/ Practical Examination (OSCE/OSPE) Scores of the Biochemistry Laboratory Obtained by Male and Female Nursing Students of Shahid Beheshti University of Medical Sciences: 2011-15

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Abstract

Introduction: The Objective Structured Clinical/Practical Examination (OSCE/OSPE) is one of the best assessment methods for measuring the students' realization of their educational goals in cognitive, emotional, and psychomotor domains. Given that gender may influence the evaluation of medical sciences examinations, the present study was conducted to compare the female and male nursing students of Shahid Beheshti University of Medical Sciences during years 2011 to 2015 in terms of their OSCE/OSPE scores for the biochemistry laboratory.

Methods: This study had a comparative descriptive design. All of the students participated in this study from 2011 to 2015 (census). Over these four years, 649 students took this examination and their scores were recorded. The data collection tools included a demographic information questionnaire and a researcher-made checklist. Pearson's Correlation Coefficient was calculated for determining both the criterion validity and the internal consistency ($r = 0.732$). The Pearson correlation coefficient confirmed the test-retest reliability of the test ($r = 0.88$). The data were analyzed using the SPSS-22 software with descriptive statistics, the independent t-test, the one-way Analysis of Variance (ANOVA), and Scheffe's post-hoc test.

Results: The scores of 361 female students and 288 male students were assessed in this study. The mean score was 11.6 ± 1.83 in female students and 11.2 ± 1.75 in male students (out of 14). The difference between the female and male students' OSCE/OSPE scores in biochemistry laboratory skills was significant ($P = 0.02$). Comparing the mean scores of the female and male students in biochemistry laboratory skills according to OSCE/OSPE by year of admission showed a significant difference between the genders in the students admitted to the school during year 2012 ($P = 0.01$). There were also significant differences between the age groups of < 20 and 25-29 and the other age groups in terms of the mean OSCE/OSPE scores ($P < 0.05$).

Conclusions: There was a significant difference between the two genders in the mean crude scores obtained and the female students had slightly higher scores. Future studies are recommended to investigate the students of other disciplines, academic levels, and schools to improve the generalizability of these findings.

INTRODUCTION

A global movement has begun over the last twenty years among researchers and policy-makers to study factors that make educational systems more efficient. Students and teachers constitute the two main pillars of the classroom in every educational system. In the process of education and teaching, teachers provide students with a set of learning opportunities and have a major role in their academic progress and the achievement of their educational goals [1]. The classroom structure is undergoing changes at universities; nowadays, students need more engaging tasks, clear expectations and explanations, a good personal rapport with their instructors, honesty and the uninhibited use of technology [2]. Over the past few decades, there has been a resolute will for fundamental changes in medical education in terms of both structure and content, and student-oriented tendencies are evident in various medical disciplines [1]. Recent studies have shown that using different educational strategies in the classroom help enhance learning [2], and these studies have mainly been conducted to answer two fundamental questions:

What kind of education is more effective for medical students in achieving their learning goals?

Is this kind of education long-lasting?

The underlying idea of such efforts is for medical students to take advantage of an active student-oriented educational planning that increases their interest in and commitment to learning and helps them achieve better short- and long-term outcomes [3]. Nonetheless, due to the novelty of this challenging knowledge, the traditional structure of universities is often not built upon this understanding, which is explained by the finding that lack of active educational methods that enhance practical skills is not synonymous to inattention to learning [2]. The proper evaluation of clinical skills in medical students is an inseparable part of educational planning [4]. Medical education uses student's evaluations at regular intervals as the basis for improving learning skills [5]. Evaluating students leads to advancements in learning, reinforces the inherent motivation for learning, and increases the achievement of higher standards [6]. Proper evaluation is itself a major challenge in medical education [7], and just like active learning methods, it requires promotion and awareness [4]. Accordingly, in the past decade, medical schools have made tremendous new efforts to provide precise and reliable methods for the evaluation of knowledge, attitude, and skill indicators in medical students. Taking account of educational goals and the learning domain is therefore essential for choosing the right type of evaluation [6]. In 1990, George Miller proposed a pyramid for the assessment of clinical skills. This pyramid begins with assessing the cognitive domain and ends with assessing the psychomotor domain. In this model, professional authenticity increases by moving towards the pinnacle of the pyramid, where the assessment of professional duties nears its rightful level [8]. The four levels in the proposed model include "Knows", "Knows how", "Shows", and "Does". In 2002, Van der Vleuten added several effective assessment methods to the levels of Miller's proposed pyramid. The Objective Structured Clinical Examination/Objective Structured Practical Examination is one of them, which is located at the "Shows" level of Miller's pyramid [6]. This assessment method was first proposed by Harden in 1975 and was first applied in North American medical schools and began to be widely used in the UK in the 90's [9]. Objective Structured Clinical/

Practical Examination (OSCE/OSPE) is a flexible framework that assesses a wide range of tasks. The OSCE is one of the best assessment methods for measuring the students' realization of their educational goals in cognitive, emotional, and psychomotor domains [10]. Although external objective assessment tools show the same skills [11], it is clear that many factors can affect the students' examination results. In assessing the individual success rate of students, personality traits and the influence of the group to which the individual belongs cannot be overlooked [12]. The increase in the number of students has been associated with an increased diversity in their ethnicity, gender, and personality traits [2]. The effect of this diversity on students' success rate and also the effect of other variables related to intragroup functioning could be the subject of an entirely different research. The students' success rate may therefore be determined by issues other than the overall results, including: Personality traits found in students that obtain high scores Possible association between gender and academic skills [12] In a study conducted on OSCE/OSPE in 2002, Pathiyl and Mishra examined the effect of gender differences on personality skills in medical students [13]. The results obtained from a study conducted by Minter et al. (2005) showed that female surgical residents wished for their capabilities to appear less than their male counterparts [11]. Several studies have examined the effect of gender on success in the National Board Dental Examination (NBDE). For example, Stewart et al. investigated the skills of male and female dentistry students in the Perceptual Ability Test (PAT) and the Dental Admission Test (DAT), and their results showed that males were more successful than females in these tests [14]. Many studies have also shown that in certain subjects, gender can be one of the factors affecting the students' scores in Comprehensive Basic Sciences exam [15]. The present study was therefore designed and conducted to compare the OSCE/OSPE scores in biochemical laboratory between female and male nursing students of Shahid Beheshti University of Medical Sciences during years 2011 to 2015. The results may be used to understand the role of gender on students' success rate in a test of the "Shows" level of Miller's pyramid, so that the strengths and weaknesses of this variable could be used for better achievement of educational goals and further improvement of the students' learning behaviors.

METHODS

This study had a comparative descriptive design. The students' OSCE/OSPE scores in biochemistry laboratory for years 2011 to 2015 were available from the biochemistry laboratory archives. Since Hosseini and Vartanoosian (2010) had shown a direct (but not statistically significant) relationship between the total OSCE/OSPE scores and the written biochemistry exam scores, the crude OSCE/OSPE score (14 points) was taken instead of the biochemistry exam score [16]. All of the students participated in this study from 2011 to 2015 (census); over these four years, 649 students took this examination. The scores of 649 students (361 female and 288 male students), who had taken this examination over the noted four years (eight academic semesters) were collected. The examination during the eight semesters involved six stations, including station 1 (the identification and recognition of biochemistry tools

and equipment), station 2 (the calculation and measurement of salt in grams for preparing the molar solution), station 3 (recognizing the solubility of fats in different solvents), stations 4 and 5 (two procedures for identifying sugar ketosis using Selivanoff's test and detecting fat saponification, respectively) and station 6 (writing down the mechanism of saponification of fats, as in station 5). It should be noted that due to the diversity in the number of questions that the students were able to answer in writing, the questions at this station were displaced while maintaining the level of the educational domains. Since the number of students has increased, especially in the recent years, and despite full quarantine of the students, leakage of the skill competence questions was likely at the stations; therefore, in stations 4 and 5, where the results were to be reported as positive/negative, the results of these stations were swapped after the completion of the exam for every 10 to 15 students. The students' demographic information questionnaire and a researcher-made checklist were also used. For each student, the scores of each station and the entire 6 OSCE/OSPE stations were recorded in the checklist.

The validity and reliability of the checklist were assessed before conducting the test. To determine the criterion validity of the checklist, the relationship between the OSCE/OSPE scores and the written biochemistry exam scores was assessed. To determine its internal consistency, the correlation between the total OSCE/OSPE scores and the scores of each station was assessed. Pearson's correlation coefficient was calculated for determining both the criterion validity and the internal consistency ($r = 0.732$). The Pearson's correlation coefficient confirmed the test-retest reliability of the test ($r = 0.88$). The study subjects were ensured of the confidentiality of their data. The data obtained were analyzed using the SPSS-22 software with the descriptive statistical methods (including tables of frequency distribution and the mean and standard deviation indices). The normal distribution of the data was assessed using the Kolmogorov-Smirnov test. In line with the study objectives, the independent t-test was used to compare the scores between the male and female students and the one-way Analy-

sis of Variance (ANOVA) and Scheffe's post-hoc test were used to compare the scores by admission year.

RESULTS

Before the analysis of the data, the one-sample Kolmogorov-Smirnov test was used to ensure the normal distribution of the OSCE scores ($P > 0.05$). This study was conducted on the biochemistry lab scores of 649 nursing students at the Nursing and Midwifery School of Shahid Beheshti University of Medical Sciences from 2011 to 2015, whose final exam in the first semester was in the form of the OSCE/OSPE. The biochemistry OSCE/OSPE was designed within six stations. A total of 361 (55.6%) students were female and 288 (44.4%) were male, and the majority of the students were in the age range of 20 to 24 years (Table 1).

Table 1: The Frequency Distribution of the Students by Age

Age (year)	Frequency	Percentage
20 >	24	3.8
24 - 20	483	75.5
29 - 25	95	14.8
30 ≤	38	5.9
Total	*640	100

* Nine Students gave no Answers

Table 2: The Frequency Distribution of the Students by Admission Year

Admission Year	Frequency	Percentage
2011	41	6.3
2012	175	27
2013	160	24.7
2014	159	24.5
2015	114	17.6
Total	649	100

Table 3: A Comparison of the Mean Objective Structured Clinical/Practical Examination Scores in Biochemistry Laboratory Skills between the Female and Male Students by Admission Year (2011 to 2015)

Gender	Count	Mean Score	Mean Score Difference	Standard Deviation of the Mean Score Difference	Level of Statistical Significance
2011			0.82	0.62	0.20
Female	20	10.00			
Male	17	9.17			
2012			0.67	0.26	0.01*
Female	92	11.80			
Male	71	11.12			
2013			0.38	0.30	0.20
Female	92	11.29			
Male	63	10.90			
2014			-0.05	0.28	0.84
Female	86	11.76			
Male	58	11.81			
2015			0.11	0.26	0.67
Female	48	12.36			
Male	42	12.25			

* The P-Value obtained is Significant

A total of 588 (93.9%) students were single and 38 (6.1%) were married, and the marital status of 23 (3.5%) of the students was unidentified. Of the female students, 342 (94.2%) were single and 21 (5.8%) were married, and of the male students, 262 (92.3%) were single and 22 (7.7%) were married. Table 2 presents the frequency distribution of the students by admission year. According to the results, the mean score was 11.6 ± 1.83 in the female and 11.2 ± 1.75 in the male students (out of 14). The difference between the mean scores obtained by the male and female students was 0.34, which is statistically significant ($P = 0.02$).

The comparison of genders in terms of the mean scores of OSCE/OSPE by year of admission showed significant differences between them (at a significance level of 0.01) during the academic year of 2012 (Table 3).

The results of the one-way Analysis of Variance (ANOVA) showed significant differences between the age groups in the mean OSCE score, and Scheffe's post-hoc test showed that this difference was due to a difference between the age groups of < 20 and 25 to 29, and the other age groups, as those below age 20 had the highest mean score and the 25 to 29 age group had the lowest (Table 4).

DISCUSSION

According to the present findings, the mean score was higher in female than male students, which agrees with the results of a study conducted in 2016 by Jacues et al. on the effect of gender on obstetrics and gynecology clerkship in 1976 third-year medical students [17]. The results of two psychiatric studies, including one conducted by Berg et al. (2015) in Washington, D.C., on 577 medical students using OSCE [18] and another one by Kataoka et al. (2006-2007) in Japan on 400 first- to sixth-year students [19], showed higher scores in the female than the male medical students. A study conducted by Al-Mulhim et al. (2012) on 620 medical students in Saudi Arabia to assess the effect of gender on surgical skills, using OSCE, showed a significantly better performance of the skills in the female than the male students; however, no significant differences were observed between the genders in the written exam [20]. The results obtained in a study conducted by Hammad et al. (2013) in Jordan to assess dental skills using

OSCE showed no significant differences between 134 male and female students, who participated in this assessment [21]. Moreover, no significant differences were observed between the genders in the written exam, which is inconsistent with the present findings, perhaps due to the small sample size, the larger number of the stations, the type of skills assessed, and the dental exam covering only one year in Hammad's study. The results obtained by a dentistry article, published by Stewart et al. (2006) in Florida, US, showed a significantly higher rate of success in male than female students in the DAT and PAT [14], which disagrees with the present findings, perhaps due to the large number of male ($n = 280$) compared to female ($n = 136$) students and the different types of examination assessed in their study (not OSCE). Comparing the mean scores of the female and male students in OSCE/OSPE regarding biochemical laboratory skills by admission year (2011-15) showed that the mean score of the students admitted in 2012 was significant ($P = 0.01$). According to the results obtained in a study by McDonough et al. [22] to assess the effect of gender differences on the results of the final medical examination in the exam papers of 557 students (277 females and 280 males) of the University of Dublin over five years (1992-6), the female students continuously scored better than the male students every year except in 1992; however, the difference between the genders was statistically significant only in 1993 ($P = 0.04$). These results concur with the present findings. It is worth noting that the sample size assessed by McDonough et al. was smaller in 1993 compared to in the other years, while in the present study, the number of students was higher in 2012 compared to in the other years, and this difference may be attributed to the type of examination assessed, academic field, and academic level. The results of a study conducted by Wai et al. (2010) in the US on 1 600 000 American College Test (ACT) and Standardized Admission Test (SAT) applicants to determine the students' IQ in mathematical, verbal, written, and scientific reasoning skills over 30 years (1981 to 2010) showed that scientific reasoning skills had remained unchanged or only slightly increased in males over the last 20 years, while females had higher scores in verbal and written exams. Male's scientific reasoning skills showed a reduction in the 1980s, which could be due to the further encouragement of females and better role-modeling among them.

Table 4: A Comparison of the Mean Objective Structured Clinical/Practical Examination Scores in Biochemistry Laboratory Skills between the Age Groups

Count	Mean Score	Standard Deviation of the Mean Score Difference	Level of Statistical Significance
< 20		0.55	0.81
15	12.36		
8	12.50		
20 - 24		0.16	0.14
266	11.75		
187	11.51		
25 - 29		0.45	0.30
39	10.65		
38	10.18		
≥ 30		0.65	0.33
17	11.38		
18	11.73		

* The p-value obtained based on one-way ANOVA

These results are consistent with the present findings. Although some researchers believe that gender differences affect people's capabilities, the role of gender in cognitive abilities has not yet been proven [23]. Further studies are recommended to be conducted on the role of gender differences in each of the OSCE/OSPE stations to differentiate the assessment of cognitive capabilities and practical skills by gender. The analysis of the results showed a significant difference between genders in the mean crude scores, which were slightly higher in the female students. This finding may be due to mental maturity lagging three years behind in males than in females at age 18 [24], and males reaching physical maturity two years later than females [25], while both genders reach full maturity by the age of 24 [25, 26]. Since the results pertained to the scores obtained by students of the same discipline, academic level and school, future studies are recommended to investigate the students of other disciplines, academic levels, and schools to improve the generalizability of these findings.

CONCLUSIONS

There was a significant difference between the two genders in the mean crude scores obtained and the female students had slightly higher scores.

ETHICAL CONSIDERATION

Research approval was granted by the deputy of research of Shahid Beheshti University of Medical Sciences. Ethical approval was obtained from the Committee of Ethics in Research of the University (ethical code: IR.SBMU.PHNM.1394.320 on Tuesday 1st March 2016).

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CONFLICT OF INTEREST

There was no conflict of interest to be declared.

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AUTHOR CONTRIBUTION

Hosseini S. and Vartanoosian J. contributed to the study design. Hosseini F. was the statistic advisor. Faridi J. collected the data. All authors have approved the final manuscript.

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