

ORIGINAL ARTICLE

The Influence of Gender on Undergraduate Performance in Multiple Choice Testing in Clinical Disciplines at University of Dammam, Saudi Arabia

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Abstract: We assessed the influence of gender on the performance in surgical and medical disciplines in undergraduate final theory examinations at College of Medicine, University of Dammam, Saudi Arabia. The college admits 200 students (120 males and 80 females) every year in the 6 year degree program. The results of written exam for the year 2008-09 for all subjects were analyzed. The question papers consisted of multiple choice tests only. There were 50 assessments which included 19 from medical, 22 from surgical and 9 from pre-clinical disciplines. Using cross sectional design we analyzed the students' theory results. The female students showed overall better performance in all theory assessments (mean \pm SD; 71.21 \pm 7.89 vs. 67.14 \pm 8.08, $p=0.01$). In a subject-wise comparison, the female students showed significantly higher mean scores in 24 out of 50 assessments. Both the genders had comparable scores for medical disciplines (n=19 assessments), however, in surgical disciplines females' performance was superior (mean \pm SD; 72.0 \pm 6.6 vs. 67.47 \pm 7.0; $p=0.03$). The female students showed significantly better scores in surgical disciplines than in medical disciplines and they outperformed male students in overall scores in surgical disciplines.

Key words: Undergraduate assessment, Clinical Disciplines, Saudi Arabia

Introduction

In medical education the issue of gender has become increasingly important for academicians, health administrators and society at large. Several studies have found that female undergraduate students outperform male students in overall scores in basic and clinical subjects [1-3]. There are many factors which contribute to this performance. One of the important factors could be subject specific performance by females. An earlier study found that female students perform better in psychiatry, pediatrics and obstetrics and gynecology [4]. Several other reports have shown varying results in this regard [5-6]. The point of subject specificity was first raised by Norcini et al. (1985) in the American Board Internal Medicine Certifying Examinations where the gender gap was found to be subject specific [7]. The knowledge base, reasoning capacity and psychomotor skills required to attain proficiency vary with subjects. The authors also pointed out that the differences could be related to the type of the assessment method(s) used.

The clinical subjects which are taught during the course can be broadly divided into two disciplines- Medical (predominantly logic based) and Surgical (predominantly skill based). The theoretical learning in medical disciplines involves reasoning, logical and in-depth learning while surgical disciplines involve imaginative perceptual skills, visual learning and rote learning [8-10]. Keeping these views in background, we hypothesized that there would be differential performance by males and females in clinical disciplines in theory assessments. Our objective was to assess the influence of gender on performance in surgical and medical disciplines in final examinations (summative assessments) where multiple choice questions (MCQs) were sole method of assessment. We have used objective assessments using MCQs as they do not systematically discriminate gender as a method of assessment [11].

Methodology

We conducted this study at College of Medicine, University of Dammam (formerly King Faisal University) which was established in 1975. Here, the students are admitted to 6 year course in undergraduate medical program. Currently, two hundred students (120 males and 80 females) are admitted every year. The method of selection is based on the results of high school exit examination, performance on two written entrance tests and a personal interview. The curriculum used is hybrid type adopting a modular and integrated approach. There are three integrated modules inserted in program. The clinical subjects are taught in 4th, 5th and 6th year while the first three years include basic science and preclinical courses. The duration of course varies from 1 week to 10 weeks depending on the requirement of the course. For the purpose of effective teaching all student cohorts are divided into 4 batches on the basis of gender and optimal number in the class following random allocation (approx. 50 each). Although English is the second language, it is used as medium of instruction and assessment. The university follows a common curriculum. Both male and female students are taught by common faculty in separate batches and they take common examination for each course.

We examined the students' results for the year 2008-09 for the assessment of their performance in all subjects covering two semesters in a cross sectional design. The question papers for all examinations consisted of A- type MCQs and the time allowed was 2 minutes per MCQ. The examinees answered on OMR (Optical Mark Reader) answer sheets by blackening the bubble with a pencil. The number of assessments were 5, 4, 11, 22 and 8 (n=50 assessments) in 2nd, 3rd, 4th, 5th and 6th year, respectively. The assessments were divided into surgical and medical category based on conventional understanding. While majority of disciplines were easily classifiable in the above mentioned category, we did encounter difficulties in labeling certain disciplines such as radiology, anesthesiology and emergency medicine. The consensus decision of three faculty was adopted for such disciplines. Out of the total 50 assessments 19 belonged to medical disciplines and 22 belonged to surgical disciplines (rest 9 belonged to preclinical or basic subjects). The subjects included in medical discipline were; family and community medicine (FAMCO), pharmacology, internal medicine, dermatology, neurology, psychiatry and pediatrics (7 subjects with 19 assessments).

The subject included in surgical disciplines were; basic clinical skills, surgery, forensic medicine, otorhinolaryngology (ENT), ophthalmology, radiology, anesthesiology, emergency medicine, special surgery (urology, neurosurgery and orthopedics), and obstetrics and gynecology (OBYG) (10 subjects with 22 assessments). To know the overall performance across all subjects we also analyzed the assessments in preclinical years (4 subjects with 9 assessments- physiology and biochemistry from 2nd year; pathology and behavioral sciences from 3rd year).

Data analysis: We performed the data acquisition and data analysis by using scanner OPSCAN8, scantool-II software (NCS Pearson Inc. Microsoft, Bloomington, MN, USA) and IDEAL software (version 4.1). We used MS excel and statistical package NCSS2000 for data analysis. The data was tested for normal distribution. The mean scores were converted into mean % score for the purpose of comparison across assessments. The gender based groups were tested by t test. The comparison across the study years was tested by ANOVA. A *p* value of less than 0.05 was accepted for determining the level of significance.

Results

The mean numbers of students in the 50 assessments were 53.58±2.8 and 39.08±2.1 for males and females respectively. All scores were normally distributed. The female students showed significantly higher mean scores in 24 out of 50 assessments. The medical disciplines, where female students significantly outperformed male students included FAMCO, dermatology, internal medicine, psychiatry and pediatrics. The surgical disciplines, where female students outperformed significantly were basic clinical skills, forensic medicine, ENT, ophthalmology, radiology, anesthesiology, emergency medicine, surgery, special surgery and OBYG. Moreover, the male students did not show better performance than females in any of the subjects (Tab-1).

Table-1: Comparison of academic performances of male and female students in clinical disciplines.

No.	Subject/assessments	Yr	Max Marks	Male students			Female students			t	P
				Mean	SD	n	Mean	SD	n		
Medical Disciplines											
1	FAMCO	4	80	44.83	9.09	103	51.56	7.2	75	-5.511	0.001
2	Pharmacology -I	4	100	73.03	12.77	31	74.21	14	28	-0.331	NS
3	Pharmacology -II	4	100	74.78	10.22	27	71.67	13	30	1	NS
4	Internal medicine I	4	80	49.66	5.71	91	49.42	6.7	73	0.242	NS
5	Internal medicine-II	4	80	45.59	5.98	32	48	4.6	11	-1.376	NS
6	Pharmacology -I	5	60	37.11	5.03	28	37	7.9	20	0.055	NS
7	Pharmacology -II	5	60	37.48	6.1	23	38.37	6.3	19	-0.461	NS
8	Dermatology -I	5	50	36.09	5.32	57	37.21	5.6	43	-1.016	NS
9	Dermatology -II	5	50	32.64	6.2	50	38.09	4.7	32	-4.498	0.001
10	Neurology -I	5	80	56.91	7.06	56	58.98	8.5	43	-1.294	NS
11	Neurology -II	5	80	57.16	10.68	49	59.72	7	32	-1.305	NS
12	Internal medicine -I	5	80	44.67	8.49	51	51.88	6.6	33	-4.367	0.001
13	Internal medicine -II	5	80	48.28	6.92	57	48.36	7.5	44	-0.055	NS
14	Psychiatry -I	5	50	36.45	5.28	55	36.98	5.9	43	-0.46	NS
15	Psychiatry -II	5	50	33.08	5.32	49	37.22	4	32	-3.984	0.001
16	Internal medicine -I	6	100	53.76	12.1	55	52.89	11	38	0.355	NS
17	Internal medicine -II	6	100	52.79	11.43	57	58.94	8	35	-3.036	0.003
18	Pediatrics -I	6	80	52.65	7.38	49	58.26	5.9	34	-3.848	0.001
19	Pediatrics -II	6	80	50.1	6.74	58	53.82	6.2	38	-2.787	0.006

No.	Subject/assessments	Yr	Max Marks	Male students			Female students			t	P
				Mean	SD	n	Mean	SD	n		
Surgical Disciplines											
20	Basic Clinical Skills	4	75	50.09	7.37	103	56.01	6.92	75	-5.483	0.001
21	Forensic medicine A	4	40	27.87	4.34	38	30.08	2.9	24	-2.416	0.001
22	Forensic medicine B	4	40	29.69	3.83	29	28.96	4.3	25	0.653	NS
23	Forensic medicine C	4	40	27.82	4.09	34	29.64	3.4	25	-1.863	NS
24	Introduction to Surgery -I	4	100	75.92	5.54	86	77.42	5.5	76	-1.728	NS
25	Introduction to Surgery -II	4	100	60.5	8.04	30	64.36	5.7	11	-1.708	NS
26	ENT -I	5	70	45.52	6.9	64	55.03	5.6	36	-7.519	0.001
27	ENT -II	5	70	43.93	6.88	46	47.88	6.9	40	-2.647	0.001
28	Ophthalmology -I	5	55	35.37	6.43	60	40.11	4.9	35	-4.042	0.001
29	Ophthalmology -II	5	55	35.02	5.5	50	37.6	6	40	-2.111	0.001
30	Radiology -I	5	70	43.2	5.43	65	48.97	5	36	-5.405	0.001
31	Radiology -II	5	70	48.09	4.54	47	49.75	5.3	40	-1.554	NS
32	Anesthesiology -I	5	50	33.95	4.52	65	38.58	3.5	36	-5.731	0.001
33	Anesthesiology -II	5	50	35.16	3.75	50	34	4.3	38	1.334	NS
34	Emergency medicine -I	5	50	41.95	3.24	65	43.67	3.1	36	-2.654	0.009
35	Emergency medicine -II	5	50	41.02	3.27	46	42.48	3.7	40	-1.941	NS
36	Special surgery -I	5	80	42.19	6.34	59	47.34	5.2	35	-4.267	0.001
37	Special surgery -II	5	80	50.46	6.01	52	53.39	6.7	41	-2.194	0.03
38	OBGY -I	6	80	50.4	8.53	47	53.47	4.7	34	-2.068	0.04
39	OBGY -II	6	80	52.52	7.41	60	53.38	8.1	37	-0.523	NS
40	Surgery -I	6	100	69.34	6.68	50	66.57	7.1	37	1.853	NS
41	Surgery -II	6	100	63.55	11.17	53	74.91	7.6	35	-5.677	0.001

The female students achieved significantly higher overall scores (females vs. males; 71.21±7.89 vs. 67.14±8.08; mean ±SD) in 50 assessments (Figure 1).

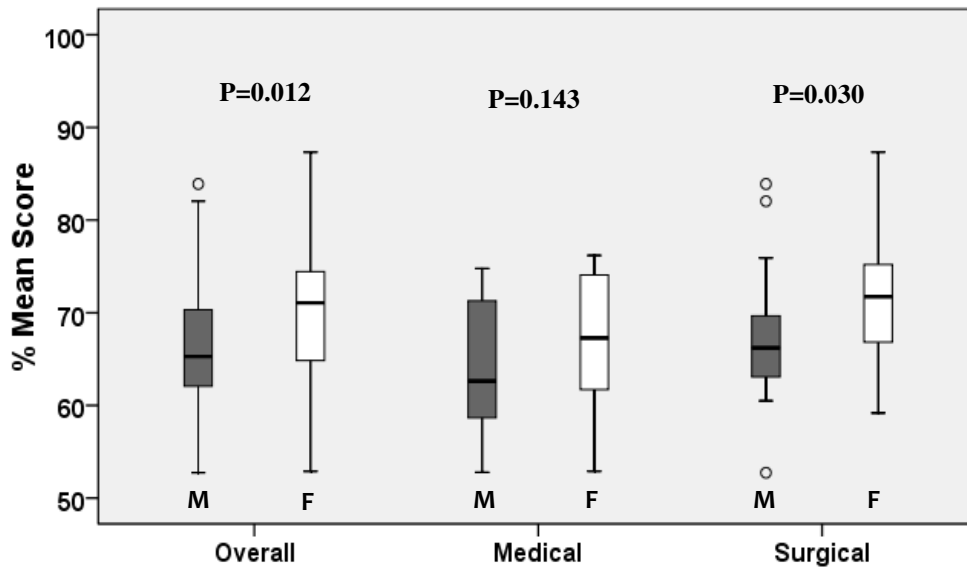


Figure 1: Box plots depicting performance of male (M) and female (F) students.

Both the genders had comparable overall scores for medical disciplines (n=19 assessments), however, in surgical disciplines females' performance was superior (mean \pm SD; 72.0 \pm 6.6 vs. 67.47 \pm 7.0). In a subject-wise comparison, the female undergraduates showed significantly higher mean scores in 12 out of 22 assessments in surgical disciplines and 8 out of 19 medical disciplines. The overall performance of male undergraduates was similar in both medical (n=19) and surgical (n=22) disciplines (64.07 \pm 7.05, 95% CI 60.68-67.48 vs. 67.47 \pm 7.01, 95%CI 64.36-70.58). In contrast, the female students showed significantly better scores in surgical disciplines when compared with medical disciplines (67.49 \pm 7, 95% CI 64.12-70.87 vs. 72.09 \pm 6.6, 95% CI 69.16-75.01). Both genders showed significant decline in overall mean scores from 2nd year to 6th year (Figure 2). Even then, the female students showed significant higher scores in 5th year (p=0.035) when compared to the male students.

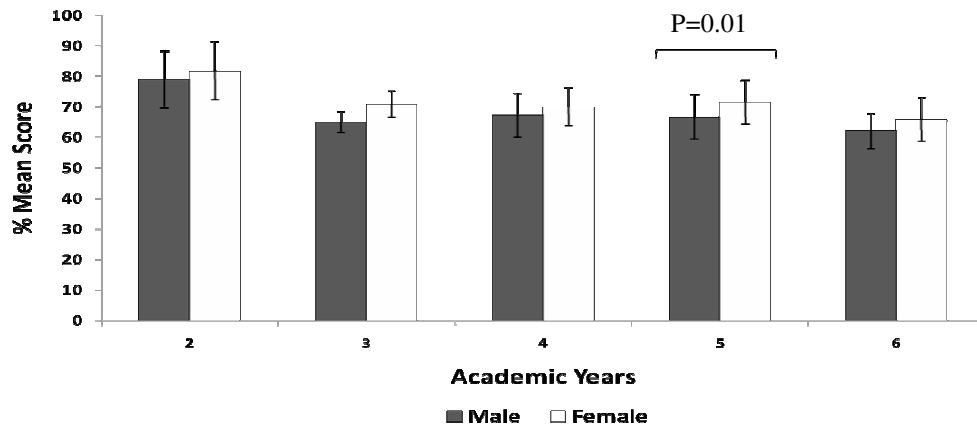


Figure 2: Comparison of percentage mean scores of male and female students across academic years

Among preclinical subjects female undergraduates outperformed in biochemistry, pathology and behavioral science. Moreover, the male undergraduates did not show better performance than females in any preclinical subjects. We did not observe any difference in overall theory scores in preclinical years for male and female students.

Discussion

The results showed that the female undergraduate students performed better than male counterparts in overall scores in surgical disciplines in Saudi Arabia. However, both genders showed equal performance in overall scores in medical disciplines. In addition, the female students showed overall better performance in theory assessments than male students. Thus, the overall superior performance by females appears to be due to high scores they obtained in surgical disciplines. We also found that overall performance in preclinical years was similar for both the genders. Our results regarding overall performance are consistent with several previous reports [1-3, 12] and the results of preclinical years are consistent with the findings of Omigbodun and Omigbodun [12].

There may be several factors responsible for the better performance of female students. Psychological traits pertaining to learning appear to be the most plausible reasons for our results. It has been reported that females possess better vigilance and they are better at scanning the physical environment [13]. It might give them an edge over males and consequently, they show better ability to recall more details from learning exposure in surgical disciplines. In the present set up, the time available for attempting MCQs assessment was relatively more than conventional standard as an attempt to overcome language difficulties. It is known that females are better at reading comprehension, perceptual speed and associative memory skills [14]. Therefore, the provision of extra time could have favored them in quick comprehension of the contents. It has also been argued that females have a tendency of having anxiety and nervousness while taking an examination [15]. The provision of extra time in these examinations could have probably minimized this. Thus, the extra time available could have played a positive factor favoring females to perform better. There is no doubt that surgical disciplines require more imaginative perception and psychomotor skills [10]. Further, learning of theoretical constructs of surgical disciplines requires comparatively more visuospatial perception. Females inherently possess better imaginative perception and associative memory [14]. Thus, these qualities may favor the females to perform better in surgical disciplines. Learning approach is another important factor which might be responsible for better performance by female students. It has been shown that females are more likely to adopt surface learning approach and thus, they are likely to have better performance in MCQ type of assessment [16-17]. All these factors, put together, could explain the differences in subject specific performances found by several previous researchers [4,7]. Besides the above mentioned factors, other factors like diligence and socio-cultural environment may favor females. Castagnetti and Rosti (2008) have suggested that higher score by females generally are likely to be due to 'greater efforts exerted by female students' [1].

Our results have certain limitations. These results are based on the examination using MCQs only. Therefore, our findings cannot be extrapolated to the assessment where other methods of assessments are used. The grouping of surgical or medical disciplines is also based on conventional understanding. Certain amount of the overlap is inherent in disciplines with reference to cognitive constructs. A further study using taxonomical distribution of contents vis-à-vis required cognitive skills may provide a larger evidence of this phenomenon. Some earlier studies have analyzed the gender performance in the light of performance at the entry level [2,18]. In our cross sectional design, it was not possible to collect data on entry performance for last 6 years. It has been shown earlier that the process of admission ensures equal academic standards in Saudi Arabia [18]. In the present study, the performance in surgical and medical disciplines is differential and it certainly indicates that the female students do possess different skills. Therefore, we believe our conclusions are valid with reference to the differential performance. We are not aware of any such study which has reported comparative performance by male and female students in all subjects during medical graduation using objective assessments in theory.

Our report provides substantial evidence that female students outperform male students in the majority of surgical disciplines at undergraduate level. More studies are needed to ascertain whether such a trend is valid for post-graduate level in surgical disciplines. The study also indicates towards redesigning the postgraduate selection procedures. A discipline based selection procedure will favor the academic needs of the medical profession. Thus, there is a possibility to promote and accommodate women in academics. There has always been a dearth of women medical professionals in the society. Our study provides evidence base for genders' influence on performance in medicine. Our findings suggest how the specific academic traits in females can help them to pursue the medical discipline of their choice. It will also encourage the women population to pursue the particular discipline and rise higher in the ladder of medical profession.

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