

## Effect of a Formative Objective Structured Clinical Examination on the Clinical Performance of Undergraduate Medical Students in a Summative Examination: A Randomized Controlled Trial

NAZDAR EZZADDIN ALKHATEEB<sup>1</sup>, ALI AL-DABBAGH<sup>2</sup>, MOHAMMED IBRAHIM<sup>3</sup> AND NAMIR GHANIM AL-TAWIL<sup>4</sup>

From Departments of <sup>1</sup>Pediatrics, <sup>2</sup>Surgery, <sup>4</sup>Community Medicine, College of Medicine, Hawler Medicine University, Erbil, Kurdistan region, Iraq; and <sup>3</sup>Clinical Training, Queensland Health Service, Australia.

Correspondence to: Dr Nazdar Ezzaddin Alkhateeb,  
Department of Pediatrics, College of Medicine, Hawler Medical University, Erbil, Kurdistan region, Iraq.  
nazdar.alkhateeb@med.hmu.edu.iq  
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**Objective:** To study the effect of formative Objective structured clinical examination (OSCE) on the undergraduate medical students' performance in a subsequent summative-OSCE assessment. **Methods:** In a randomized single-blind trial, 130 fifth year medical students at Raparin hospital, Erbil were assigned to intervention ( $n=61$ ) and control group ( $n=69$ ). Formative-OSCE was performed for the intervention group in pediatric module with feedback on their performance *versus* standard pediatric module for the control group. Students' clinical performance was assessed by a summative-OSCE. Multiple regression was used to predict the summative-OSCE score depending on the participation in formative-OSCE along with the other factors. **Results:** Eleven students were excluded because of early drop-out, leaving 119 students for analysis. The summative-OSCE mean score (out of a total score of 100) in intervention group 64.6 (10.91) was significantly lower as compared to the control group 69.2 (10.45). **Conclusion:** Single formative-OSCE does not necessarily lead to better performance in subsequent summative-OSCE.

**Keywords:** Assessment, Clinical competence, Educational measurement, Medical Education.

**Trial Registration:** Clinical trial.gov/NCT 035 99232.

Assessment is the cornerstone of any educational project. It gives evidence about the success in the achievement of specific learning outcomes [1,2]. Depending on the time and the intent, assessment can serve three functions: diagnostic, a function for prevention of learning difficulties; formative, a function for regulating learning with delivery of feedback; and summative, a function for certificate or social recognition [3].

As the assessment role shifts from a pure assessment of learning to assessment for learning, there is an incentive to determine how and when assessment of different forms have educational value [4]. Unlike other professional training culture, true feedback culture is not cultivated in medical education. Therefore, a formative assessment must be at the core of student training, not just included to fulfill accreditation requirement [5].

In a performance-based assessment, the Objective Structured Clinical Examination (OSCE) has gained importance because of its reliability [2], and could be used in a summative or formative way to measure clinical competence [6-8]. There are several medical schools where formative assessments are established and carried

out on regular basis; unfortunately, it is not very frequent in the Mediterranean countries [1]. Meanwhile, undergraduate medical education in Iraq is going through a transitional period and has started the process of changing its curriculum to competency-based medical education – formative assessment of students' performance is a requirement in this process.

*Accompanying Editorial: Pages 733-34.*

Though previous studies suggest that formative-OSCE contributes positively to final summative examination performance [9], these were based on the students' perception [10,11]. Therefore, this study aims to look for evidence to evaluate if a single formative-OSCE has an impact on student's clinical performance in summative competency-based assessment.

### METHODS

A single-blind randomized controlled trial was conducted on fifth year medical students who attended a seven-week pediatric module at Raparin pediatric hospital, Erbil between September 2016 and May 2017. Our medical college provides a 6-year MBChB program. Students

were divided randomly by the registration office into four groups: A, B, C and D with around 40 students per group, which attended the pediatric module at a specific time of the year. At the end of pediatric module, students' clinical competencies were assessed by a summative-OSCE. Students' performance data (fourth year grade point average (GPA)) was obtained from student records. A student's GPA is a standard way of measuring academic achievement at the end of academic year. Each course is given a certain number of credits depending on the content of the course. It is calculated by the  $\Sigma$  (scores obtained by the students in each course x the credit unit of that course) /  $\Sigma$  credit units.

The trial was approved by our institutional ethics committee. All students were suggested to participate in the study and provided written consent. Student groups were randomized with a computer program (Microsoft Excel 2010) into two groups: intervention group and control group. Students were not randomized as individuals from each of the groups to avoid knowledge contamination between the students of the same group. We concealed the groups' allocation until the start of the intervention (**Fig. 1**).

A formative-OSCE was performed for the intervention group at the beginning of the pediatric module to assess the competencies they gained from previous modules. The author explained the purpose of formative-OSCE as a learning experience in the study group. Failing the

formative-OSCE had no adverse effect on the final summative scores and the participation was voluntary. In comparison, the participants in control group were attending the standard pediatric module.

The formative-OSCE design involved a blueprint development that served as a guideline for the development and face-validation of the eight stations, which were both interactive and static. The interactive stations included history taking, examination, communication and procedural skills while non-interactive stations included data interpretation, management and a video-station.

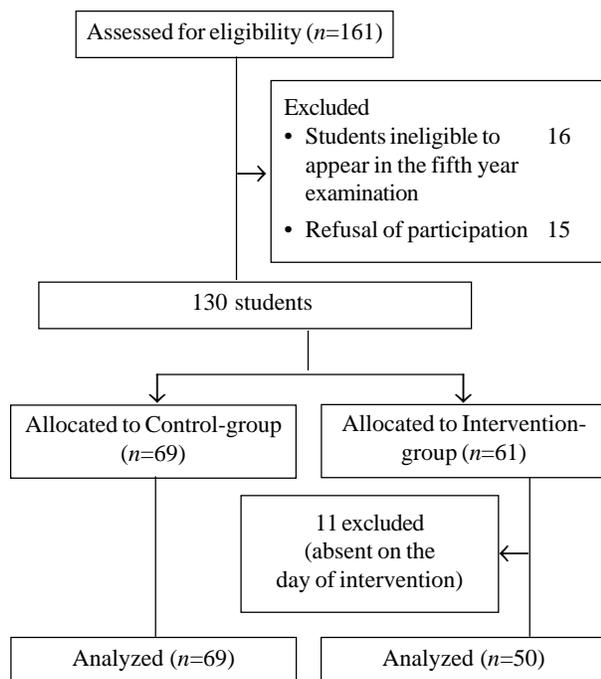
The formative-OSCE examiners consisted of two teaching staff and 11 postgraduate pediatric board trainees, who were trained by the investigators. At the time of result declaration, students received feedback on their performance in the formative-OSCE on a one-to-one basis. Feedback was given by the author as narrative feedback as well as scores.

The examiners in the summative-OSCE were blinded to the group assignment and the two-teaching staff who took part in the intervention, did not participate in the summative exam. The allocation sequence was generated by a person not involved in the data analysis. The main outcome was the students' performance in summative-OSCE. This was measured by students' summative-OSCE scores with the passing mark of a total of at least 50 from all stations.

Statistical Package for Social Sciences (IBM SPSS version 21) was used for data analysis. Sample size was calculated based on previous studies [12] by statistical software, the power was set at 90% and  $\alpha=0.01$ . Accordingly, the estimated sample size was 27 for each group. Considering the non-response rate probability, the authors decided to include all the students. Students' t-test used for two independent samples and paired t-test to compare between pre- and post-module OSCE scores of the same group. Multiple regression was used to analyze effect of different factors on summative-OSCE and McNemar test to compare proportions of the same sample (formative and summative-OSCE success rate of the intervention group). A *P*-value of less than 0.05 was considered significant.

**RESULTS**

Of the 161 students who attended the seven weeks pediatric module and screened, 130 were eligible for enrolment (**Fig. 1**). We excluded 11 students of the intervention group from the initial analysis as they did not participate in the formative-OSCE due to their absence on the day of formative-OSCE. There were no significant



**FIG. 1** Study flow chart.

differences in the baseline characteristics of the two groups except for the place of residence (**Table I**).

The intervention group’s summative-OSCE mean (SD) score 64.6 (10.9) was significantly higher than their formative-OSCE mean (SD) score 53.5 (8.3) ( $P<0.001$ ). A comparison of both intervention and control group did not show a statistically significant difference in pass rate in the summative-OSCE [48/50 (96%) and 67/69 (97%), respectively]. Interestingly, the mean (SD) summative-OSCE score of the control group 69.2 (10.45) was higher than that of the intervention group 64.61(10.91) ( $P=0.02$ ).

Multiple regression analysis revealed that the summative-OSCE scores were positively correlated with the previous year grade point average, and negatively correlated with participation in the formative-OSCE ( $P<0.001$ ) (**Table II**).

**DISCUSSION**

The formative-OSCE introduction did not result in a considerable change in the overall summative-OSCE pass rate in the intervention group compared with the control group, similar to results obtained by Chisnall, *et al.* [6], but it improved the students mean score in the intervention group if compared with their formative-OSCE mean.

This finding supports the work of other studies in this area linking medical students review of formative-OSCE scores and their performance in summative-OSCE [13]. But it is contradictory to other researches that appreciate the role of formative assessment in improving the overall performance in OSCE [14,15].

One criticism of much of the literature on formative

assessment effectiveness is that it does not depend merely on its availability; it rather relies upon the quality and communication tools of the assessment feedback [16]. In this study, feedback on students’ performance in formative-OSCE was provided by the authors in form of comments and numerical scores. Even though it is difficult to disagree with the efficiency of numerical scores for summative purposes, its use for formative purposes that guide progress in learning has long been argued [17]. Numerical scores and letter grades would tend to direct students’ concentration to the self and away from the task, thus leading to a negative impact on performance [17,18]. According to cognitive evaluation theory, even positive feedback that is useful for students can be weakened by negative motivational effects as a result of giving grades or comparing the students to a norm [19].

Feedback could be immediate or delayed according to its timing. When it is planned to facilitate lower-order learning outcomes, for example, the recall of facts, prompt feedback works best. However, when higher-order learning outcomes are a concern and necessitate the transfer of what has been learned to a new situation, delayed feedback probably works better [20]. In this study, feedback was given when the results were released (delayed); although, it is suggested that students prefer immediate feedback [20].

Another factor is that having four summative-OSCEs for the four groups of the 5th year might have contributed to possible difference in summative examination difficulty; although, all the OSCEs had the same blueprint. This was noticed when comparison was made between the mean (SD) summative-OSCE scores gained by the intervention group 64.6 (10.9) with what was gained by the excluded students from the intervention group 53.4 (15) ( $P<0.001$ ), even though there was no significant

**TABLE I** BASELINE CHARACTERISTICS OF FIFTH YEAR MEDICAL UNDERGRADUATES ENROLLED IN THE STUDY (N=119)

Factors	Student-group	
	Control group (n=69)	Intervention group (n=50)
<i>Place of residence*</i>		
Local	43 (62.3)	49 (98)
Dormitories	26 (37.6)	1(2)
<i>English-based secondary school#</i>		
No	60 (86.9)	42 (84)
Yes	9 (13.04)	8 (16)
Female gender	38 (55.07)	27 (54)
Previous year GPA	Average-grade	Average-grade
Mean (SD)	61.48 (6.3)	66.37 (6.7)

\* $P<0.001$ ; # $P=0.6$ ; \$ $P = 0.9$ .

**TABLE II** OUTPUT FOR A MULTIPLE-REGRESSION MODEL WHERE THE DEPENDENT VARIABLE IS SCORES OF SUMMATIVE-OSCE (N=119).

Model	B	P value	95.0% Confidence-Interval for B (Lower-Bound, Upper-Bound)
(Constant)	10.226	0.201	(-5.542, 25.994)
Previous year GPA	0.951	<0.001	(0.703, 1.199)
English-based secondary school	-0.613	0.798	(-5.340, 4.114)
Male gender	0.171	0.917	(-3.068, 3.410)
Place of residence (dorm)	1.374	0.532	(-2.964, 5.713)
Participation in formative-OSCE	-8.754	<0.001	(-12.491, -5.018)

#### WHAT THIS STUDY ADDS?

- Participation in a single formative-OSCE did not improve the students' performance in a subsequent summative-OSCE.

difference in their GPA of the previous year. Whilst this was a potential limitation, it had the benefit of excluding prior knowledge influence on success in the summative-OSCEs.

Moreover repeated administration of OSCE by teaching hospitals improves the performance of students on the successive summative-OSCE [15]. However, in our study formative-OSCE was carried out once.

To conclude, students who faced a single formative-OSCE obtained less summative-OSCE scores than their peers in control group.

*Contributors:* MI,NA,AA: study design and concept; NG was the trial coordinator and participated in data analysis and interpretation. NA: data collection, data entry and wrote the draft of manuscript. All authors critically reviewed and approved the manuscript.

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