

## **Effectiveness of Mini-CEX as an Assessment Tool in Pediatric Postgraduate Residents Learning**

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**ABSTRACT**

**OBJECTIVE:** To determine the effectiveness of Mini-CEX as a formative assessment instrument in improving the clinical skills of postgraduate residents in Pediatrics.

**METHODOLOGY:** This cross-sectional study was conducted during January - August 2021 at Ziauddin Medical University. A total of 176 Mini-CEX encounters were conducted on twenty-two Pediatric postgraduate residents by eight faculty members. The non-probability convenience technique was used for sampling. Each resident underwent one Mini-CEX encounter per month, and the ratings were recorded. An Objectively Structured Clinical Evaluation (OSCE) was conducted before the first Mini-CEX session, and the last and the mean scores were compared. Data were analyzed using SPSS version 20. ANOVA was used to determine inferential statistics to calculate the p-value and the improvement in score over time to report statistical significance.

**RESULTS:** Mean scores of all clinical competencies improved with subsequent Mini-CEX sessions. Maximum improvement was noted in clinical management skills and organization/efficiency. Marked improvement was observed in OSCE scores before the first Mini-CEX session and after the eighth session (p-value <0.001). An increase in the satisfaction rate of both faculty and residents with each subsequent Mini-CEX session was also noted.

**CONCLUSION:** Mini-CEX effectively improves pediatric postgraduate residents' clinical learning; therefore, it should be incorporated into the national residency program.

**KEYWORDS:** Clinical competency, Feedback, Formative assessment, Medical Education, Mini-CEX, Workplace-based assessment

**INTRODUCTION**

Mini Clinical Evaluation Exercise (Mini-CEX) is a structured and validated workplace-based assessment (WPBA) tool, initially developed in 1995 in the USA, to evaluate the clinical competencies of internal medicine residents<sup>1</sup>. Three components of Mini-CEX are clinical performance, direct Observation, and timely, constructive feedback. The developed countries have widely used Mini-CEX for undergraduate and postgraduate training, and several international research studies have emphasized its feasibility and acceptability. However, there are some inconsistencies in the research literature regarding its effectiveness as a workplace-based assessment method<sup>2</sup>. Moreover, only a few studies from developing countries highlight the role of Mini-CEX in improving trainees' clinical skills<sup>3</sup>.

Mini-CEX for continuous evaluation of postgraduate trainees has not yet been incorporated into the pediatric residency program by the College of Physicians and Surgeons Pakistan<sup>4</sup>. This study was designed to determine the effectiveness of Mini-CEX as a formative assessment tool in improving the learning and clinical performance of Pediatric postgraduate trainees. The study was conducted to evaluate the usefulness of Mini-CEX and make recommendations for its introduction as a mandatory requirement for the national residency program in Pediatrics. Moreover, there is no research study from Pakistan on using Mini-CEX as an assessment tool for Pediatric residents. Therefore, the effectiveness and usefulness of Mini-CEX as a teaching and formative assessment tool in the context of Pediatrics needs to be established, especially in developing countries, by conducting research studies on a larger scale<sup>5</sup>. The purpose of this study was to evaluate the role of Mini-CEX in improving clinical competencies and skills of pediatric residents in the local context and thus will serve as a basis for future research.

**METHODOLOGY**

This prospective, cross-sectional study was undertaken at the Department of Pediatrics at Ziauddin Medical University during January - August 2021. A total of 22 Pediatric postgraduate residents in their second year of training and eight faculty members were included in this study. The same faculty members conducted all eight Mini-CEX encounters of the same group, ensuring that all eight faculty members assessed the postgraduate residents. Written informed consent was taken from the students and those residents who were unwilling to participate in the study were excluded. The hospital's Ethics Review Committee approved the study (ERC No.2701020SEPED), after which the study was initiated. The non-probability convenience sampling technique was used for sampling. Before the initiation of the study, a workshop to train the faculty in Mini-CEX was held. A ten-station OSCE was conducted before Mini-CEX sessions, and another was arranged after the last. Same stations were included in both OSCE, and their mean scores were recorded on a performa and compared after that. Each trainee underwent eight Mini-CEX encounters, i.e. one per month. The Mini-CEX encounters were assessed, and the scores were recorded on a modified Mini-CEX evaluation form, pilot tested before being administered. Cronbach's alpha was calculated to measure the reliability of items included in the clinical encounter form.

A total of 176 clinical encounters were conducted in various clinical settings. The core competencies assessed included: physical examination, clinical judgment, history taking, clinical management, counseling skills, professionalism, and broader clinical competence. The performance in Mini-CEX encounters was rated on a 9-point Likert scale. If the scores were between 1-3, the assessments were considered unsatisfactory, i.e. there were gaps in knowledge or skills that would not be expected at the level of training and some concerns about professionalism or patient safety. If the trainee was generally clinically competent and with clinical competencies such as communication skills and professionalism at their expected level of training, the scores were between 4-6 and the assessments were considered satisfactory. If the trainees performed beyond their desired level of learning scores with no concerns about their clinical competence, they were assigned scores between 7-9 which was considered excellent. The satisfaction of assessors and residents with Mini-CEX was also recorded on a 9-point Likert scale ranging from extremely satisfied to highly dissatisfied. Furthermore, the time given to Observation and feedback was also recorded.

Data from Mini-CEX clinical encounter forms were entered and analyzed using SPSS version 20. Mean and standard deviation (SD) were calculated for quantitative variables. ANOVA was used to determine inferential statistics to calculate the p-value and the improvement in score over time to report statistical significance. Paired t-test was applied to compare the mean and standard deviation (SD) of students' OSCE scores before and after performing the Mini-CEX. For quantitative variables, an independent t-test was used. A Chi-square test was used for qualitative variables. The results were expressed as percentages and frequencies, and a p-value of less than 0.05 was considered significant.

RESULTS

A total of 176 Mini-CEX encounters took place over eight months. A maximum number of encounters, i.e. 65(36.9%), were assessed by assistant professors (**Figure I**). As all the faculty members were trained in the use of Mini-CEX before the initiation of the study to ensure inter-rater reliability, no difference in assessment scores concerning faculty designation was observed.

For Mini-CEX encounters, patients with a wide array of clinical problems were selected. The majority of the clinical cases, i.e. 62(35.2%), belonged to the infectious disease category, 31(17.6%) had neurological and respiratory problems, and the gastrointestinal and cardiac cases were 27(15.3%) and 25(14.2%), respectively. Out of 176 clinical encounters, 148(84.1%) were conducted on new patients, while 28(15.9%) were on follow-up patients. The majority of the cases, i.e. 156(89.9%), were moderate in complexity, while 17(9.6 %) were highly complex, and only 1(0.6%) was of low complexity. Those clinical cases with a straightforward diagnosis and no comorbidity were considered low complexity. Those with an evolving clinical presentation or one or two comorbidities were moderately complex cases. In contrast, patients with multi-morbidity and high analytical complexity requiring a holistic approach were considered highly complex<sup>6</sup>. A total of 37(21.02%) % observations were made in the emergency department, 33(18.76%) were conducted in the out-patient department (OPD), 51(28.97%) in the Pediatric ward, 43(24.43%) took place in the Pediatric Intensive Care Unit (PICU) and 12(6.82%) in the Neonatal Intensive Care Unit (NICU). The mean observation time was 16.5 minutes (range 15–20 minutes), while the mean feedback time was 9 minutes (range 5–10 minutes). It was observed that during May, the examiner satisfaction with Mini-CEX decreased, which could be explained by the increased clinical workload of the faculty during this month. However, an overall increase in the satisfaction rate of both trainees and assessors with Mini-CEX encounters for eight months was observed (**Figure II and III, respectively**).

**FIGURE I: ASSESSOR DESIGNATION AND FREQUENCY OF MINI-CEX ENCOUNTERS**

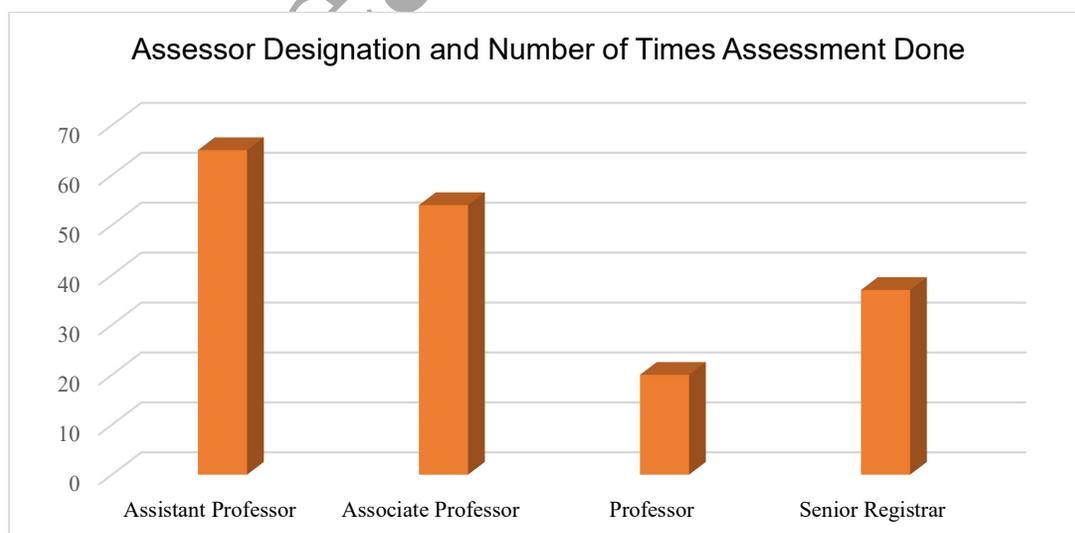


FIGURE II: MEAN PLOT OF STUDENT SATISFACTION USING MINI CEX

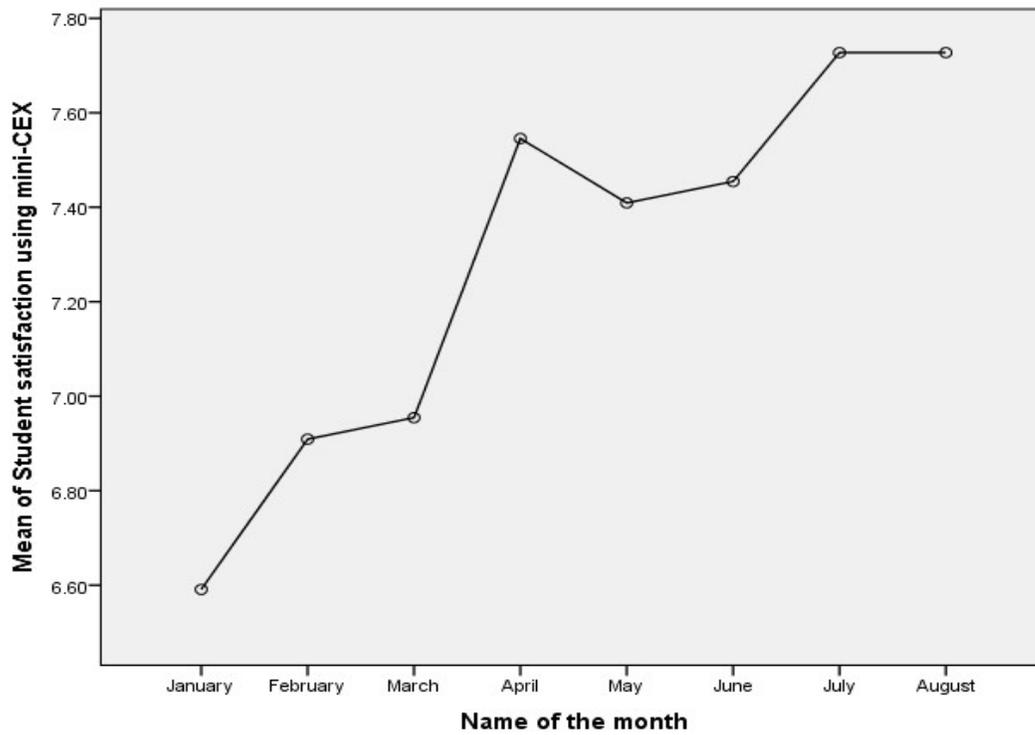
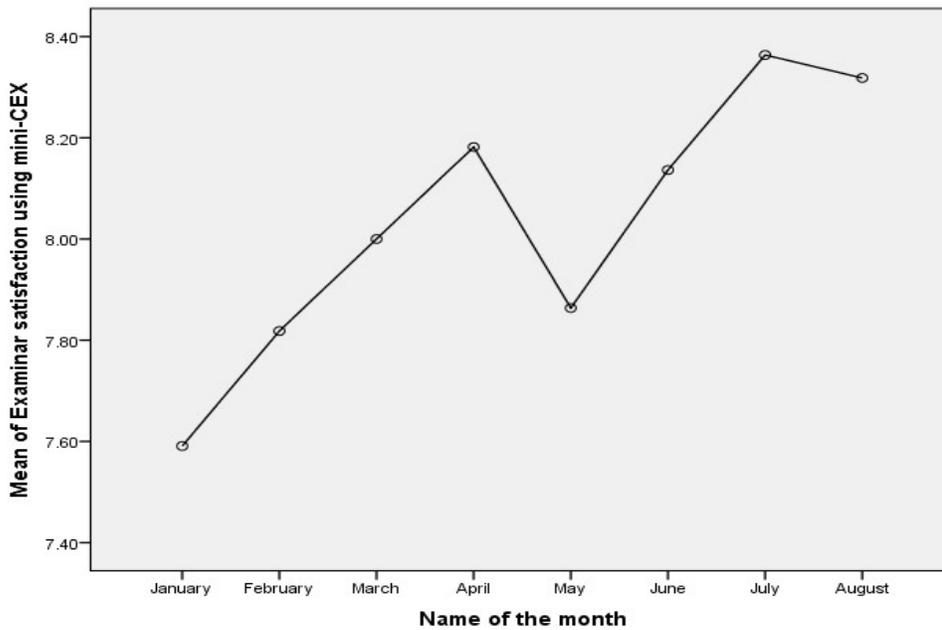


FIGURE III: MEAN PLOT OF EXAMINER SATISFACTION USING MINI CEX



A Cronbach's alpha of 0.9 indicated high internal consistency reliability of Mini-CEX items. The mean scores and Standard Deviation (SD) of all the competencies observed during the eight Mini-CEX sessions (**Table I**). A progressive improvement in mean scores of competencies in subsequent Mini-CEX encounters was observed, i.e. from encounter 1st till encounter 8th; there was a rising trend in the mean scores of the trainees ( $p$ -value  $<0.001$ ) (**Table II**). Mean score on the first encounter was highest for professionalism and physical examination skills. In contrast, the maximum improvement in the mean score was observed in clinical management skills and organization/efficiency. The mean score in OSCE Pre and post-Mini-CEX sessions is shown in table II. Paired sample t-test was significant between the mean scores of pre and post-Mini-CEX OSCE (**Table III**).

**TABLE I: COMPARISON OF MEANS OF COMPETENCIES EVALUATED DURING EIGHT MINI-CEX SESSIONS**

Skills Assessed	Jan 21	Feb 21	Mar 21	Apr 21	May 21	Jun 21	July 21	Aug 21	<i>p-value</i>
	Mean±SD								
History Taking	3.86±. 35	4.18±. 58	4.5±. 59	5.04±. 65	5.22±. 81	5.95±. 72	6.36±. 84	6.86±. 88	<. 0001
Physical Exam	3.90±. 42	4±. 61	4.6±. 65	4.86±. 71	5.59±. 85	6.13±. 63	6.22±. 86	7.13±. 99	<. 0001
Critical Thinking	3.68±. 71	4.13±. 83	4.40±. 59	4.95±. 84	5.59±. 66	5.81±. 95	6.40±1.0	6.9±. 92	<. 0001
Counselling Skills	3.72±. 45	4.18±. 58	4.45±. 67	4.90±. 68	5.18±. 66	5.86±. 94	6.36±. 72	6.81±1.05	<. 0001
Management Skills	3.54±. 73	4.18±. 85	4.63±. 65	4.90±. 97	5.54±. 80	6.13±. 94	6.54±. 73	7.04±. 99	<. 0001
Professionalism	4.0±. 00	4.09±. 42	4.45±. 59	4.86±. 56	5.27±. 63	5.68±. 89	6.22±. 81	6.81±1.0	<. 0001
Organization/ Efficiency	3.59±. 79	4.09±. 86	4.68±. 56	5.27±. 82	5.36±. 95	5.95±. 84	6.72±. 88	7.09±1.06	<. 0001
Overall Clinical Competence	3.77±. 52	4.18±. 58	4.68±. 64	5.13±. 63	5.54±. 80	6.0±. 69	6.68±. 71	7.13±. 99	<. 0001

**TABLE II: MEAN SCORE IN OSCE PRE AND POST MINI-CEX SESSIONS**

		Mean	N	Std. Deviation
Pair 1	Pre-Mini CEX OSCE marks	60.2273	22	8.20529
	Post-Mini CEX OSCE marks	64.2273	22	6.68283

**TABLE III: PAIRED MEAN SCORE DIFFERENCES BETWEEN PRE AND POST MINI-CEX OSCE**

		Mean	Std. Deviation	<i>P-value</i>
Pair 1	Pre Mini CEX OSCE Marks	-	3.5456	.000
	Post-Mini CEX OSCE Marks	4.0000	2	

## DISCUSSION

Mini-CEX helps assess a trainee's ability to focus on diagnosis, management plan, and counseling skills in real-life clinical practice using direct Observation<sup>2</sup>. In Pakistan, only a few studies have been conducted at undergraduate and postgraduate levels for assessing the effectiveness and utility of Mini-CEX as a workplace-based evaluation tool in residency training programs<sup>7</sup>. As per our knowledge, this was the first local study of its kind to be conducted with Pediatric postgraduate residents aiming to assess the effectiveness of Mini-CEX in improving their clinical competencies.

This study observed a significant and progressive improvement in the postgraduate residents' performance in nearly all the clinical competencies in subsequent Mini-CEX encounters. The difference between the mean scores for each clinical skill on the first Mini-CEX session and the last session was statistically significant. These findings can be explained by the fact that Mini-CEX helps identify gaps in teaching and learning, and instructional strategies can then be modified accordingly<sup>8</sup>. Moreover, timely, constructive, and contextual feedback given to the trainees by the evaluators led to the observed improvement in performance. The findings of this study agree with the results of Azeem M et al.<sup>9</sup> and a few other studies from India<sup>10,11</sup>, wherein the clinical performance of a majority of residents significantly improved in the later sessions of mini-CEX when juxtaposed with the initial session. In a study on Mini-CEX by Baqai S 2018<sup>12</sup>, a substantial improvement in the clinical performance of postgraduate residents in Gynecology and Obstetrics was observed, which they attributed to direct Observation as well as timely and constructive feedback.

In our study, profound improvement was seen in residents' organizational efficiency and clinical management skills. Similar findings have been reported in a study from Lahore by Zareen A 2018<sup>13</sup> wherein maximum improvement was observed in the trainees' organizational efficiency. However, a study from Islamabad by Saeed N 2015<sup>14</sup> with undergraduate trainees reported a profound improvement in history-taking, clinical judgment, and communication skills over successive Mini-CEX encounters.

In contrast to other local studies<sup>13,15</sup>, a different aspect of this study was an OSCE conducted before the first Mini-CEX session and after the last session, and the scores were compared after that. A significant improvement in the mean OSCE score was observed, which was indicative of the efficacy of Mini-CEX in improving the clinical competencies of trainees. A similar study by Kim S et al.<sup>8</sup> corroborates these findings, wherein a decrease in the failure rate on the undergraduate summative OSCE was observed from 12% pre -Mini-CEX to 2% post-Mini-CEX ( $p$ -value =0.046). On the contrary, a study from Peshawar by Shah MI 2021<sup>16</sup> did not find Mini-CEX effective in improving undergraduate students' summative assessment scores.

To improve reliability and minimize inter-rater bias in this study, multiple faculty members conducted 8 Mini-CEX encounters per trainee. Moreover, 89.9% of the clinical cases in our study were of similar complexity. Several studies<sup>17,18</sup> have advocated using multiple raters and at least 8 Mini-CEX encounters in an academic year of a trainee for better reliability and validity.

We observed a significant and progressive increase in the mean satisfaction level of the faculty and residents over subsequent Mini-CEX encounters. An increase in the residents' satisfaction level can be explained based on the fact that the feedback provided at the end of each Mini-CEX was directed at improving the trainee's performance and fostering self-reflection. The high satisfaction rate of the faculty can be attributed to the flexibility and convenience of conducting Mini-CEX encounters<sup>19</sup>. Goel A 2015<sup>20</sup> and Gupta S 2017<sup>21</sup> have reported similar results, with a majority of students feeling satisfied with the feedback provided to them by their teachers and considering it feasible in most Pediatric clinical

settings. A similar study by Khalil S 2017<sup>22</sup> and Bashir K et al.<sup>23</sup> reported that faculty and residents had high acceptability for Mini-CEX. Zareen A 2018<sup>13</sup> have reported a satisfaction rate with Mini-CEX of 87.5% in postgraduate residents of Gynecology and Obstetrics.

In this study, the average observation time was 16.5 minutes, while the feedback time was 9 minutes. Saeed N 2015<sup>14</sup> reported similar results with an average observation time of 16.4 minutes and 9.8 minutes for feedback. Thus, the entire exercise can be easily adjusted to the busy work schedule of the faculty.

## **CONCLUSION**

Mini-CEX as a formative assessment tool leads to a significant improvement in the clinical competencies of Pediatric postgraduate residents with subsequent clinical encounters. It is recommended that further research studies to elucidate the role of Mini-CEX in improving clinical learning be conducted in Pakistan to reorganize both undergraduate and post-graduate national curricula.

**Ethical Permission:** Ziauddin University ERC letter No.2701020SEPED, Dated: 25.11.2020

**Conflict of Interest:** The authors have no conflict of interest to declare.

**Financial Disclosure / Grant Approval:** No funding agency was used for this research.

**Data Sharing Statement:** The data supporting this study's findings are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## **AUTHOR CONTRIBUTIONS**

Ehsan S: Study design, data collection, literature review, analysis, drafting and interpretation of the manuscript.

Usmani A: Contributed to the idea and critical review of the manuscript.

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