



THE IMPACT OF SKILL'S LAB TRAINING ON THE CLINICAL PERFORMANCE OF FINAL YEAR MEDICAL STUDENTS AT MEDICAL COLLEGE, IN JEDDAH

Reham Mohammed Wagdy^{*1,2}, Nadeem Ikram¹, Munnaza Aqeel Zahid¹, Mohammad Ashraf Balbaa^{1,3}, Ibrahim Ahmed Zaki¹, Atef Hamed Asal¹ and Mayyadah Jamal Mheidat¹

¹Medicine Program, Batterjee Medical College for Sciences and Technology, Jeddah, Kingdom of Saudi Arabia.

²Department of Pediatrics, Faculty of Medicine, Alexandria University, Alexandria, Egypt.

³Department of Surgery, Faculty of Medicine, Menoufia University, Menoufia, Egypt.

Received date: 22 July 2018

Revised date: 12 August 2018

Accepted date: 02 September 2018

Corresponding author: Reham Mohammed Wagdy

Batterjee Medical College for Sciences and Technology, Jeddah.

ABSTRACT

Skill laboratories have an essential role in medical education as it provides equal learning opportunities for Medical students before approaching the real patient. The study aimed to evaluate the impact of skill lab training (CSL) at preclinical years on the clinical performance of final year medical students. It was Cross-sectional study. Students of final year MBBS, 2018 at Batterjee Medical College, Jeddah, Saudi Arabia who had been trained in the skills lab in the preclinical years were enrolled in the study. A questionnaire of 31 questions with responses on Likert Scale as strongly disagree, disagree, agree and strongly agree was conducted. Also, student's marks of final year clinical exams regarding general surgery, internal medicine, pediatrics, obstetrics were compared to skill lab marks of the third preclinical. There were 25 (35.2%) male and 46 (64.8%) female students out of 78, with the mean age of 23.41 ± 0.63 years. The response rate was 91%. The frequency of students who agreed on the importance of CSL at preclinical years was significantly high ($p < 0.001$). A significant correlation was found between the marks of basic clinical skills at the third-year medical school of those respondents and their test marks at clinical exams of main subjects' surgery, internal medicine, pediatrics and obstetrics & gynecology ($P < 0.001$, $P = 0.004$, $P < 0.001$, $P = 0.008$, respectively). In conclusion, early skill lab training at medical college had positive impact on clinical performance and academic achievement of final year medical student.

KEYWORDS: Clinical skills Lab, clinical training, Manikins, Medical students achievement.

INTRODUCTION

Acquisition of clinical skills is not only an important objective and competency for medical students as stated by Lehmann et al. but also it becomes crucial for professionalism in medical practice (Lehmann, 2013). Clinical skills may contribute to successful outcomes in patient care as recommended (Zheng, 2015). Competencies in basic clinical skills are required for all junior doctors regardless of final specialty. Newly qualified doctors are not prepared for clinical practice according to the views of many consultants in Europe and this was explained by Matheson et al as a result of the decline in practical skills. The Inadequacy of clinical training of medical students at hospitals is a rising problem that might be caused by many factors (Matheson, 2009). The unwillingness of the patients to be examined by the medical students is one of the factors as reported (Akaike, 2012). The problem is further

aggravated by increasing number of medical students in which the traditional approach of clinical training over patients "see one, do one" becomes ineffective (Werner, 2013). Many students were observed to be hesitant during clinical examinations on the patients because of being afraid of making mistakes or they might harm the patients.

Skill laboratories have been established in many medical colleges worldwide whether for the problem based or traditional curricula to enable medical students to acquire the necessary basic skills examination and history taking before practicing on real patients and that had been studied (Akaike, 2012, Werner, 2013 & Rush, 2014). Clinical skill laboratories (CSL) training depends principally on the use of simulated patients which involve the use of standardized patients or well-trained persons to mimic patients with various ailments.

Simulation-based medical education has been growing rapidly, (Zheng, 2015). Skill labs offer medical students a good chance to practice with the policy of 'mistake forgiving' training environment that improves their procedural skills as stated (Al-Yousef, 2004). Christopher study proposed that basic procedural and surgical skills should be included in the National Undergraduate Curriculum of Surgery to equip train the newly qualified doctors with needed skills for better patient safety (Davis, 2014). The proper timing is controversial, some studies recommended the early introduction of clinical skills learning to pre-clinical years as this might help beginners to learn easily, as it enhances student confidence level, improve their communication skills and their professional attitude before hospital exposure (Shuid 2015).

Batterjee Medical College for Sciences and Technology (BMC) in Jeddah, is a private college and has established skills lab in 2013 for clinical training in medicine program during the early three preclinical years. The duration of study in the medicine program is 5 years and hospital training starts 4th year onwards till the end of 5th year. The skill lab works under the supervision of consultants of Medicine program. Students are divided into groups and each group contains usually 15 students supervised by facilitators for duration of 3 hours per week. The session starts with 30 minutes demonstration performed by the instructors followed by students' practice. Protocols for the concerned skill are shared with the students prior to the training. Evaluation for the exam is OSCE stations. Evaluation during OSCE is performed with the help of checklists covering all the topics being taught in the skills lab. At the end of third year, the students acquire the ability to perform history taking, examine different body systems on simulated patients or manikins and practice some basic procedures as injections or catheterization on manikins, besides practicing proper communications skills. Final year medical students practice and examine real patients in different hospitals mainly in general surgery, internal medicine, pediatrics and obstetrics & gynecology. They are assessed by OSCE exam consisting of stations, long and short cases.

The objective of the study was to determine the impact of skill laboratory training at preclinical years on the clinical performance of final year medical students undergoing traditional curriculum at BMC.

MATERIAL AND METHODS

It was a cross-sectional study, conducted at Batterjee Medical College for Sciences and Technology (BMC), Jeddah among the Final year Medical students. The study was approved by Ethical Committee of BMC.

The participants were recruited through convenience purposive sampling including both the genders of final year MBBS class at BMC that had underwent skill laboratory training. The data collection tool was a

closed-ended self- developed validated questionnaire composed of 31 items with options of answers as strongly disagree, disagree, agree and strongly agree on the Likert scale as shown in Table 1. Also, it included three open ended questions. The students were informed about the confidentiality of their responses. It was distributed to the whole class of 78 students but only 71 returned the duly filled questionnaire. Reliability of the instrument was determined through internal consistency by applying Cronbach's alpha test. The alpha value was set at 0.978 for significance. Meanwhile, validity was assessed by Pearson coefficient. Moreover, in our study the student marks of clinical exams of the following subjects; general surgery, internal medicine, pediatrics, and obstetrics & gynecology (including OSCE stations, short and long case) were recorded along with marks obtained in 3rd preclinical OSCE exam and compared. Data was entered and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Qualitative data were described using numbers, percent with mean, standard deviation and statistical significance by Chi-Square test. Pearson coefficient was used to correlate between quantitative variables. The significance of the obtained results was judged at the 5% level.

Skill lab unit at BMC

Clinical skill lab unit was established at Batterjee Medical College, Jeddah, Saudi Arabia at 2013 to impart clinical skills to medical students. Additional task assigned was to integrate clinical teaching to these students including art of history taking and Physical examination. through manikins or simulators. Simulators were provided by administration. Skill lab curriculum has been distributed in the early three medical years of medical school for the traditional curriculum corresponded to the given basic science before being modified to be integrated with the blocks of the problem based curriculum for new batches. Concerning the traditional batches, each batch included 120 students, divided into 8 groups, 15 students each supervised by facilitators during the session and they consumed about 3 hours in the training session. Every session started by demonstration 30 minutes for conducted by skill lab instructors followed by practicing and training. CSL under supervision of a consultants; in surgery, pediatrics, internal medicine and obstetrics & gynecology. Assessment of the students was mainly OSCE based on checklists prepared for clinical scenarios. By the end of the academic year, all students were required to fill a feedback survey related to teaching efficacy and examination.

RESULTS

The current study was conducted on final year medical students (n =78). Only 71 students participated in the study, therefore, the response rate was 91%. Male students represented 35.2% (n=25) and the females were 64.8% (n=46).The mean age of the students was 23.41 ±0.63years.

Skill lab training in preclinical years was valuable for the clinical training at hospitals was agreed by the highest percentage of students with a statistically significant difference ($p < 0.001$). The training improved their communication skills and professional attitude. The difference between frequencies and percentages of students responding for various levels of an agreement was statistically significant ($p < 0.001$) as shown in table 1 and Figure 1.

Statistically significant correlation was found between the marks of basic clinical skills at third year with the marks obtained in the clinical exams in subjects of General surgery, internal medicine, pediatrics and obstetrics & gynecology ($P < 0.001$, $P = 0.004$, $P < 0.001$, $P = 0.008$, respectively) in the final year as shown in table 2.

There were very few students who failed in the final year OSCE exam as shown in Table 3.

Table 1: Response of the final year students to the training in clinical skills lab in the preclinical years. (n= 71).

| Clinical Skills Questionnaire | Level of agreement | | | | Mean | SD | p |
|---|--------------------|------------|------------|----------------|------|-----|---------|
| | Strongly disagree | Disagree | Agree | Strongly agree | | | |
| The clinical skills topics and curriculum at preclinical years matched with the needed skills for my clinical training at hospitals at M4 and M5 | 3(4.2%) | 3(4.2%) | 44(62%) | 21(29.6%) | 3.2 | 0.7 | <0.001* |
| The clinical skills curriculum has provided me with basic knowledge and basic skills about history taking and examination of patients which prepared me for starting clinical training at hospitals later | 1(1.4%) | 6(8.5%) | 34(47.9%) | 30(42.3%) | 3.3 | 0.7 | <0.001* |
| The skills lab training improved my professional attitude towards patients | 4(5.6%) | 6(8.5%) | 36(50.7%) | 25(35.2%) | 3.2 | 0.8 | <0.001* |
| Practicing communication skills at skills laboratory with different situation improved the patient-doctor relationship at hospitals | 4(5.6%) | 7(9.9%) | 41(57.7%) | 19(26.8%) | 3.1 | 0.8 | <0.001* |
| The clinical laboratory helped me to overcome anxiety and stress in dealing with real patients | 3(4.2%) | 15(21.1%) | 36(50.7%) | 17(23.9%) | 2.9 | 0.8 | <0.001* |
| The role of three methods for history taking at skill lab improved my capabilities for history taking with real patients | 2(2.8%) | 16(22.5%) | 34(47.9%) | 19(26.8%) | 3 | 0.8 | <0.001* |
| The history taking of variable types of patient's complaints and problems improved my cognitive skills for differential diagnosis | 2(2.8%) | 15(21.1%) | 41(57.7%) | 13(18.3%) | 2.9 | 0.7 | <0.001* |
| In my opinion, training on manikins was beneficial and almost near to actual training on real patients | 2 (2.8%) | 13 (18.3%) | 43 (60.6%) | 13 (18.3%) | 2.9 | 0.7 | <0.001* |
| The chest examination on simulated patients facilitated chest examination on real patients at hospitals | 2 (2.8%) | 6 (8.5%) | 47 (66.2%) | 16 (22.5%) | 3.1 | 0.6 | <0.001* |
| The heart examination on simulated patients facilitated heart examination on real patients at hospitals | 3 (4.2%) | 8 (11.3%) | 44 (62.0%) | 16 (22.5%) | 3 | 0.7 | <0.001* |
| The abdominal examination in clinical skills laboratory was similar to that in clinical training hospitals | 3 (4.2%) | 4 (5.6%) | 38 (53.5%) | 26 (36.6%) | 3.2 | 0.7 | <0.001* |
| The neurological examination on simulated patients facilitated neurological examination on real patients | 3 (4.2%) | 11 (15.5%) | 41 (57.7%) | 16 (22.5%) | 3 | 0.7 | <0.001* |
| The musculoskeletal examination in skills laboratory facilitated musculoskeletal examination in reality | 3 (4.2%) | 10 (14.1%) | 41 (57.7%) | 17 (23.9%) | 3 | 0.7 | <0.001* |
| The general physical examination on simulated patient's facilitated general physical examination on real patients | 5 (7%) | 9 (12.7%) | 38 (53.5%) | 19 (26.8%) | 3 | 0.8 | <0.001* |
| Practicing swelling examination and breast examination in skills laboratory helped me to practice swelling examination in true hospital setting | 5 (7%) | 14 (19.7%) | 39 (54.9%) | 13 (18.3%) | 2.8 | 0.8 | <0.001* |

Data were described using number and percent, in mean \pm SD

Table 1: Response of the final year students to the training in clinical skills lab in the preclinical years. (n= 71)
"Continued".

| | Level of agreement | | | | Mean | SD | p |
|---|--------------------|------------|------------|----------------|------|-----|---------|
| | Strongly disagree | Disagree | Agree | Strongly agree | | | |
| Gynecological examination on manikins in skills laboratory was beneficial before meeting female patient's | 5 (7%) | 16 (22.5%) | 31 (43.7%) | 19 (26.8%) | 2.9 | 0.9 | <0.001* |
| Auscultation of abnormal breath sounds on Manikins facilitated my training to identify different respiratory diseases on real patients at M4, M5 at hospitals | 7 (9.9%) | 11 (15.5%) | 38 (53.5%) | 15 (21.1%) | 2.9 | 0.9 | <0.001* |
| Auscultation of abnormal heart sounds and murmurs on Manikins facilitated my training to identify different cardiac diseases and congenital heart defects on real patients at M4, M5 at hospitals | 8 (11.3%) | 13 (18.3%) | 37 (52.1%) | 13 (18.3%) | 2.8 | 0.9 | <0.001* |
| Practicing the technique of growth parameters measurement in skills laboratory facilitated my examination for pediatric patients | 4 (5.6%) | 12 (16.9%) | 41 (57.7%) | 14 (19.7%) | 2.9 | 0.8 | <0.001* |
| The clinical skills procedures (Suturing, catheterization, dressing, bandaging, injections, CPR ...etc.) developed my manual skills in medicine | 7 (9.9%) | 12 (16.9%) | 38 (53.5%) | 14 (19.7%) | 2.8 | 0.9 | <0.001* |
| The OSCE exams at skill laboratory prepared me for OSCEs exams at hospitals | 3 (4.2%) | 10 (14.1%) | 41 (57.7%) | 17 (23.9%) | 3 | 0.7 | <0.001* |
| The OSCE stations at skills laboratory were variable and valuable | 3 (4.2%) | 7 (9.9%) | 46 (64.8%) | 15 (21.1%) | 3 | 0.7 | <0.001* |
| Skills lab training has positive impact in my preparation (through history and examination) for long case discussion at hospitals | 2 (2.8%) | 12 (16.9%) | 43 (60.6%) | 14 (19.7%) | 3 | 0.7 | <0.001* |
| Skill lab had developed my capabilities in decision making and differential diagnosis before hospital training | 7 (9.9%) | 15 (21.1%) | 37 (52.1%) | 12 (16.9%) | 2.8 | 0.9 | <0.001* |
| Skill lab protocols were clear, illustrated with sufficient data | 2 (2.8%) | 7 (9.9%) | 46 (64.8%) | 16 (22.5%) | 3.1 | 0.7 | <0.001* |
| The skill labs instructors were efficient and well trained | 4 (5.6%) | 6 (8.5%) | 45 (63.4%) | 16 (22.5%) | 3 | 0.7 | <0.001* |
| The clinical skills team was supportive and cooperative during training | 3 (4.2%) | 6 (8.5%) | 40 (56.3%) | 22 (31%) | 3.1 | 0.7 | <0.001* |
| Skill lab session duration (3 hours) once /week was enough | 5 (7%) | 5 (7%) | 42 (59.2%) | 19 (26.8%) | 3.1 | 0.8 | <0.001* |
| I am satisfied with instructor/ student ratio at session to be 1/ 15 | 5 (7.0%) | 7 (9.9%) | 39 (54.9%) | 20 (28.2%) | 3 | 0.8 | <0.001* |
| The clinical skills venue, labs, instrument and manikins were optimum for training purposes | 4 (5.6%) | 7 (9.9%) | 43 (60.6%) | 17 (23.9%) | 3 | 0.8 | <0.001* |
| Globally, skill lab training in preclinical year was valuable for my clinical training at hospital | 2 (2.8%) | 3 (4.2%) | 39 (54.9%) | 27 (38.0%) | 3.3 | 0.7 | <0.001* |

Data were described using number and percent, in mean \pm SD

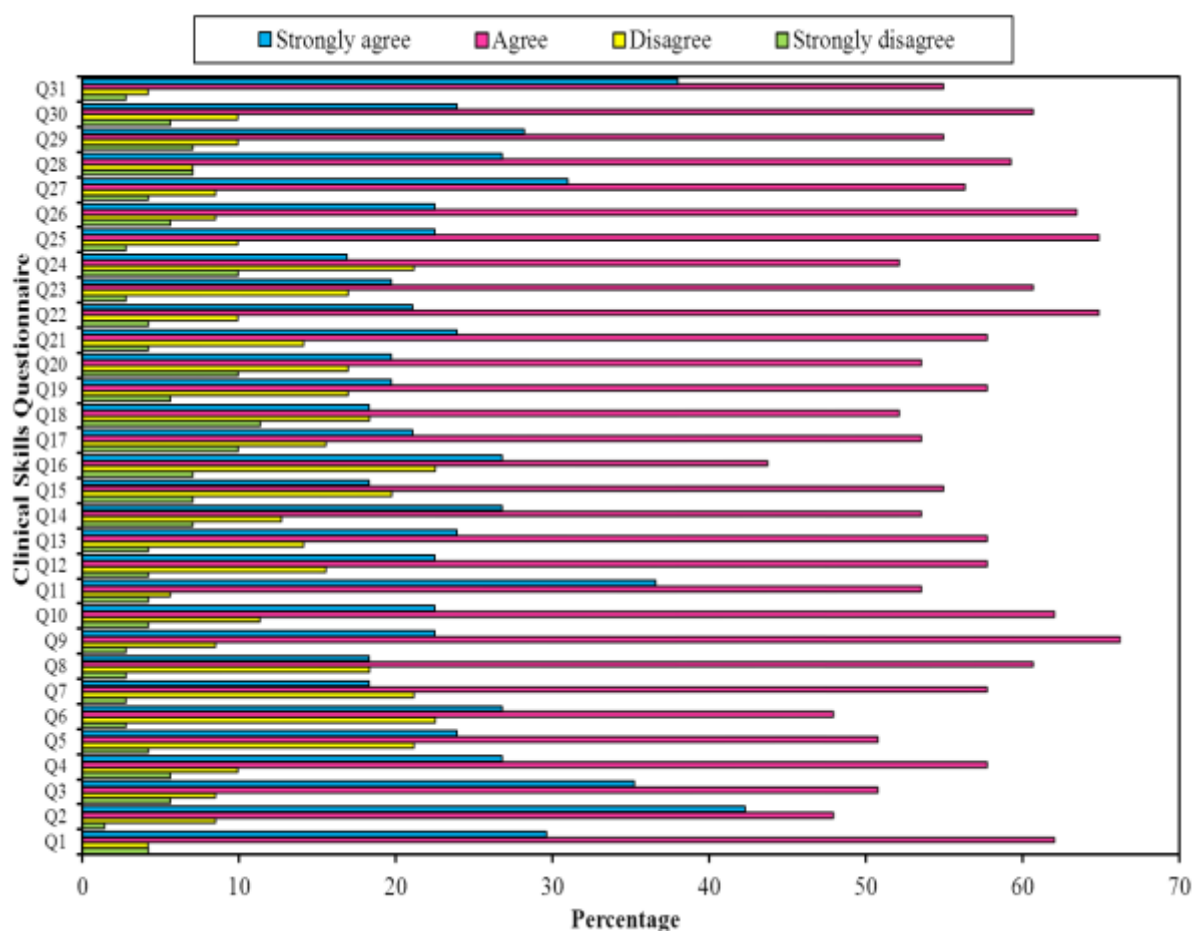


Figure 1: Response of the final year students to the skills lab questionnaire in percentage.

Table 2: Correlation between marks of basic clinical skills in 3rd year to clinical skills marks of different specialty in final year.

| | Mean | SD | Basic clinical skills (88.1, +8.3) | |
|-----------------------------------|------|------|------------------------------------|---------|
| | | | r | p |
| Surgery | 77.5 | 9.9 | 0.432 | <0.001* |
| Internal Medicine | 71.6 | 9.6 | 0.341 | 0.004* |
| Obstetrics& Gynecology | 74.1 | 6.9 | 0.313 | 0.008* |
| Pediatrics | 82.9 | 10.6 | 0.493* | <0.001* |

r: Pearson coefficient

*: Statistically significant at $p \leq 0.05$

Table 3: The result of final year students in the clinical subjects.

| | |
|----------------------------------|---------------|
| Subjects | n = 71 |
| Surgery | |
| No. of fail students | 1 |
| Internal Medicine | |
| No. of fail students | 5 |
| Obstetrics and Gynecology | |
| No. of fail students | 0 |
| Pediatrics | |
| No. of fail students | 2 |

Fail* < 60% of total marks in OSCE in a subject

DISCUSSION

Skill laboratories have a crucial role in medical education. Studies have shown that the basic health

knowledge of the students is improved when there is integration of clinical teaching with the basic health science. Liaqat et al reported that providing clinical knowledge to the students had a positive impact on

learning and understanding the basic health science by the students (Ali, 2011). A study in Nepal concluded the valuable role of CSL in preclinical training and recommended the follow up of these skills through a longitudinal study (Upadhyay, 2017). Therefore, our study evaluated the reflection of early skill lab training at preclinical years on the clinical performance of final year's medical students during their clinical exams. In addition, the current study also evaluated the student's perceptions and opinions about their experience in preclinical skill lab training.

Our study revealed that the students were satisfied and better prepared to examine the patients in hospital in clinical rotation of General surgery, internal medicine, obstetrics & gynecology and pediatrics, after undergoing preclinical training in the first three years. They were comfortable in taking history performing, abdominal, chest, heart, neurological, and musculoskeletal examination together with examination of lumps, breast, auscultation of normal and abnormal heart and breath sounds, including techniques of measuring growth parameters. Our student's satisfaction was similar to a study done (Hashim, 2016) which reported about 91% of final year medical students were satisfied with the role of CSL in acquisition of basic skills, knowledge and attitude. Another study conducted at King Saud University, Riyadh on third and fourth year medical students 'significant difference between the satisfaction scores among genders ($p=0.001$) in which males' satisfaction was higher than females. Whereas this was contradictory to our study which showed no significant difference between male and females' satisfaction (Agha, 2015).

Almost 70% of the students were satisfied that gynecological examination on manikins was beneficial before examining real patients, the importance of simulation in practicing and learning skills has been studied (Traynor, 2010 & Ennen, 2010). Practicing communication skills in the preclinical skills improved communication with the real patients in the final year as reported by 60 (85%) of the students. This was similar to the study done (Imran, 2016) which observed that introduction of clinical skills session in the preclinical years improved the communication skills with patients during the final years.

A quite large number of students ($n=22$, 31%) did not agree that the skills lab training developed capabilities in making decisions and differential diagnosis. This could be addressed by providing them with more scenarios included in the related topics in future. Also a number of students ($p=21$, 30%) found auscultation of abnormal heart sounds and murmurs were difficult to identify on real patients. These are taught on simulated patients using blue tooth device through recordings on computers. This could be improved by teaching on manikins with abnormal heart sounds.

The students 62 (87%) were satisfied that the instructors were efficient, cooperative and well trained to perform the procedures. This was similar to a study by Soliman at King Saud Medical University in which 82% of the students considered the friendly and helpful behavior of the instructors (Soliman, 2008). One of the barriers for learning was the increased number of the students in each batch was reported by some of the students in the open-ended question. This observation was similar to another study (Hitz, 2011) in which he reported that student volume together with institutional support were the perceived barriers to preclinical trainings. A number of students $n=58$ (82%) of the students were satisfied that OSCE in the preclinical years has prepared them for the OSCE exams in the final year. This was similar to a study done by Nasir et. Al in which the survey was done on final year students which had the experience of OSCE for the first time and they suggested an early inclusion of OSCE to decrease their anxiety and stress (Nasir, 2014).

Correlation between the marks of preclinical and clinical years showed that there was a significant correlation of the marks obtained in Surgery ($p<0.001$), Internal medicine ($p=0.004$), Obstetrics & Gynecology ($p=0.008$), and Pediatrics ($p<0.001$). In a study by Khan et.al. significant difference in the marks of OSCE final year exam was seen by the students who had gone through clinical skills training in the preclinical years compared to the one who did not undergo the training (Khan, 2017).

The results of the final year exams in the subjects of surgery, internal medicine, obstetrics & gynecology and pediatrics show that clinical skills training in the preclinical years may have contributed to the success in the final year.

CONCLUSION

Medical students perceived skill laboratory training as a favored learning strategy for improving their levels in clinical skills. CSL was considered mandatory step prior to the hospital training for better professional practice, attitude and for better academic achievements.

ACKNOWLEDGEMENT

We gratefully acknowledge all skill lab staff of Batterjee Medical College for Sciences and Technology, Medicine Program and BMC administration staff for their support and cooperation.

Funding: No financial benefits have been received from any party related directly or indirectly to the subject of this article.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: Ethical approval was obtained from the Ethical Review Committee, The study has been

approved by ethical Committee of Batterjee Medical College for Sciences and Technology (BMC) and Alexandria University. Ethical Review Committee of Faculty of Medicine, Alexandria University.

REFERENCES

- Lehmann R, Bose HM, Simon A, Nikendei C, Huwendiek S. An innovative blended learning approach using virtual patients as preparation for skills laboratory training: perceptions of students and tutors. *BMC Medical Education*, 2013; 13: 23.
- Zhang MY, Cheng X, Xu A D, Luo L P, Luo LP, Yang X. Clinical simulation training improves the clinical performance of Chinese medical students. *Medical Education online*, 2015; 20: 28796. DOI: 10.3402/meo.v20.28796.
- Matheson C and Matheson D. How well prepared are medical students for their first year as doctors? The views of consultants and specialist registrars in two teaching hospitals. *Postgraduate Medical Journal*, 2009; 85: 582-589.
- Akaike M, Fukutomi M, Nagamune M, Fujimoto A, Tsuji A, Ishida K, et al. Simulation-based medical education in clinical skills laboratory. *Journal of Medical Investigation*, 2012; 59: 28-35.
- Werner A H, Nikendei C, Keifenheim K, Bosse HM, Lund F, Wagner R, et al. "Best Practice" Skills Lab Training vs. a "see one, do one" Approach in Undergraduate Medical Education: An RCT on Students' Long-Term Ability to Perform Procedural Clinical Skills. *PLOS ONE*, 2013, 8(9).
- Rush S, Ooms A, Marks-Maran D, Firth T. Students' perceptions of practice assessment in the skills laboratory: An evaluation study of OSCAs with immediate feedback. *Nursing Education and Practice*, 2014; 14: 627-34.
- Al-Yousef NH. The clinical skills laboratory as a learning tool for medical students and health professionals. *Saudi Medical Journal*, 2004; 25(5): 549-51.
- Davis C R, Toll E C, Bates A S, Cole M D, Smith F C T. Surgical and procedural skills training at medical school – a national review. *International Journal of Surgery*, 2014; 12: 877-882.
- Shuid AN, Yaman MN, Abd Kadir RA, et al. Effect of early clinical skills teaching on 3rd year medical students' learning: The student perspective *Journal of Taibah University Medical Sciences*, 2015; 10(1): 126-32.
- Ali L, Nisar S, Ghassan A, Khan S A. Impact of clinical skill lab on students' learning in preclinical years. *J Ayub Med Coll Abbottabad*, 2011; 23(4).
- Upadhayay N, Clinical training in medical students during preclinical years in the skill lab. *Adv Med Educ Pract*, 2017; 8: 189–194.
- Hashim R, Qamar K, Khan MA, Rehman S. Role of Skill Laboratory Training in Medical Education - Students' Perspective. *Journal of the College of Physicians and Surgeons Pakistan*, 2016; 26(3): 195-198.
- Agha S, Alhamrani AY, Khan MA. Satisfaction of medical students with simulationbased learning. *Saudi Med J.*, 2015; 36(6): 731-6.
- Traynor M, Gallagher A, Martin L, Smyth S. From novice to expert: Using simulators to enhance practical skill. *Br J Nurs*, 2010; 19(22): 1422–1426.
- Ennen CS, Satin AJ. Training and assessment in obstetrics: The role of simulation. *Best Pract Res Clin Obstet Gynaecol*, 2010; 24: 747–758.
- Imran M, Khan S A, Aftab T. Effect of preclinical skill lab training on clinical skills of students during clinical years. *Pak J Physiol*, 2016; 12(3): 30-32.
- Soliman M M, Neel K F. Students' perception of one year experience with the clinical skills laboratory at King Saud University Medical College. *Journal of Taibah University Medical sciences*, 2008; 3(2): 140-47.
- Heitz C, Eyck R T, Smith M, Fitch M. Simulation in Medical Student Education: Survey of Clerkship Directors in Emergency Medicine. *West J Emerg Med.*, 2011; 7(4): 455–460.
- Nasir AA, Yusuf AS, Abdur-Rahman LO, Babalola OM, Adeyeye AA, Popoola AA et al. Medical Students' Perception of Objective Structured Clinical Examination: A Feedback for Process Improvement; *Journal of surgical education*, 2014; 71(5): 701-6.
- Khan MA, Shabbir F, Qamar K and Rajput TA. Effect of skill laboratory training on academic performance of medical students. *J PMA*, 2017; 67(5): 711-14.