

Medical Students Lose Their Competence in Clinical Skills if not Applied on Real Patients: Results of Two-Year Cohort Study

Tıp Öğrencileri Gerçek Hastalarda Uygulamadıkları Klinik Becerilerindeki Yeterliliklerini Kaybedebilirler: İki Yıllık Kohort Çalışması Sonuçları

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ABSTRACT Objective: Investigating loss of competence (LoC) in clinical skills of medical students over time, predictive factors on competency loss, and determining efficiency of refresher training on skill retention. **Material and Methods:** The second and third-year students (n=170 and 160 respectively), who gained skills of blood pressure measurement, taking pulse and body temperature in the first year of their medical education, were invited to vocational skills laboratory to perform these skills. Their performance for each skill was scored over 100 using standardized assessment forms. Socio-demographic characteristics and variables possibly effective on LoC were determined by a questionnaire. Next academic year, 159 third-year (former second-year) students received refresher training and performed the skills on real patients under observation. They sat for an objective structured clinical examination (OSCE) at the end of the third year. OSCE scores were used to explore efficiency of refresher training combined with real life applications. **Results:** LoC was significant in all skills. Multiple regression analysis revealed that “performing the skills in real life” was the unique predictor of LoC for all skills. “Gaining the skill before medical school” predicted LoC in blood pressure measurement and taking body temperature. “Time” and “gender” were predictors for loss of blood measurement skills. “Restudying the same year” predicted LoC in taking body temperature. Third-year students’ OSCE scores were higher than their performance scores attained one year ago. **Conclusion:** In time, LoC occurs in clinical skills of medical students if not performed after training. This can be compensated by refresher training and real life applications.

Key Words: Education, medical; clinical competence

ÖZET Amaç: Tıp öğrencilerinin edindikleri klinik becerilerde zamanla ne düzeyde yeterlik kaybı olduğunun, bunun nedenlerinin ve yenileme eğitimlerinin kaybı gidermedeki etkinliğinin araştırılması. **Gereç ve Yöntemler:** Birinci yıllarında kan basıncı ve vücut ısısı ölçümü, nabız sayma becerilerini kazanan ikinci ve üçüncü yıl öğrencileri (sirasıyla, n=170 ve 160) bu üç beceriyi uygulamak üzere Mesleki Beceri Laboratuvarı’na davet edildi ve gösterdikleri performans standart değerlendirme formlarıyla 100 üzerinden puanlandı. Sosyo-demografik özellikler ve beceride yeterlik kaybını etkileyebilecek olası faktörler anket formuyla belirlendi. Sonraki akademik yılda 159 üçüncü yıl (eski ikinci yıl) öğrencisi yenileme eğitimi olarak gerçek hastalar üzerinde, gözlem altında uygulamaya yaptılar. Bu öğrenciler akademik yılsonunda objektif yapılandırılmış klinik sınavı (OSCE) alınıp, üç beceri üzerinden değerlendirildiler. OSCE skorları yenileme eğitimi ile birlikte gerçek hayat uygulamalarının etkinliğini araştırmak için kullanıldı. **Bulgular:** Tüm becerilerde anlamlı yeterlik kaybı görüldü. Çoklu regresyon analizinde tüm becerilerde yeterlik kaybının belirleyicisi olan tek ortak değişken “gerçek yaşamda beceriyi uygulamış olma” idi. “Beceriye tıp fakültesi öncesinde öğrenme” kan basıncı ve vücut ısısı ölçme becerilerinde yeterlik kaybı üzerinde belirleyiciydi. Ayrıca, kan basıncı ölçme için “eğitim sonrası geçen zaman” ve “cinsiyet”, vücut ısısı ölçme için “aynı sınıfa tekrarlamak” yeterlik kaybını öngörmekteydi. Üçüncü sınıf öğrencilerinin OSCE skorları bir yıl önce aldıklarından yüksek bulundu. **Sonuç:** Tıp öğrencilerinin edindikleri klinik becerilerde zamanla ve eğitim sonrasında tekrarlanmadıkça yeterlik kaybı oluşmaktadır. Yenileme eğitimleri, uygulama fırsatlarıyla bir araya getirildiğinde yeterlik kaybı büyük oranda giderilmektedir.

Anahtar Kelimeler: Eğitim, tıbbi; klinik yeterlilik

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In the past, role of medical students in clinical skills training on real patients within medical practice was not beyond being an observer while a professional was performing clinical application. Due to risk of giving harm to the patients, students generally hesitated (or they were not allowed) to perform their skills on real patients.¹⁻⁷ As a solution, teaching clinical skills on phantom models using standardized training guidelines was suggested and vocational skills laboratories (VSL) were established on this purpose.¹ Teaching basic clinical skills on phantom models, students or simulated patients in VSL give medical students an opportunity for performing skills repeatedly without any time limitation and any risk of giving harm to the patients even in case of substantial errors.^{8,9}

First year medical students in Akdeniz University Faculty of Medicine gain the skills of blood pressure measurement, taking pulse and taking body temperature. However, due to structure of the curriculum, there is no opportunity for the students to apply these three skills on real patients until the third year of the school when clinical courses start. Considering that this may lead a loss of competence throughout two years, these three skills are taught again in addition to 21 extra clinical skills at the beginning of the third year to prepare the students for clinical training. Following this training period, students who achieved a competence level in basic clinical skills in VSL are allowed to perform these skills on real patients under observation of clinical trainers.

Competence-based training requires implementation of mastery learning strategy. Performing the targeted skill completely and properly while being observed by a trainer is a must for a student to leave the VSL as an individual who achieved required competence level.¹⁰ However, if the student cannot find any opportunity to apply the gained skill for a long time period, a loss in his/her competence may occur. Although this competency loss is frequently mentioned and accepted as true by medical teachers, Turkish medical literature has no report on this subject. We intent to cover this deficit conducting an appropriate research.

The purpose of this study was to answer following research questions:

1. Does any loss of competence in basic clinical skills of medical students occur over time?
2. Is there a relation between length of post-training time period and loss of competence?
3. Which characteristics or factors can be used to predict the loss of competence?
4. What is the efficiency of refresher training on retention of the skills?

MATERIAL AND METHODS

DESIGN

This was a prospective cohort research designed to follow-up competence levels of study group in three clinical skills between 2008-2009 and 2009-2010 academic years in order to explore loss of competence in skills and possible effective factors on competency loss.

STUDY GROUP

All of the second and third year students (n= 180 and 164, respectively) of Akdeniz University Faculty of Medicine in academic year 2008-2009 were targeted for the study. However, three second year students who were laterally transferred to our school and not trained on studied 3 skills when they were in the first year of their former schools, and seven second year students, who were not willing to participate, were excluded from the study. Among the third year students, one had health problems and three were reluctant to participate in the study. The remaining 330 students (170 from the second year and 160 from the third year) constituted the study group. We planned to follow-up 170 second year students in the next academic year (2009-2010) also, but 11 of them were excluded from the study due to reasons such as failing in the past year, leaving the school or lateral transfer to other medical schools. Therefore, we followed the remaining 159 third year students up in the academic year 2009-2010.

All participants were informed about the study and informed consent was obtained from each. Na-

mes and performance scores of the participants were concealed from the third parties. Our department secretary delivered and gathered all written documents including assessment forms and covered the names. Therefore, we used anonymous written forms both in assessments and in analysis of data without knowing which form belongs to whom.

SETTING

VSL in Akdeniz University Faculty of Medicine includes eight training rooms and one meeting room. In addition to undergraduate and postgraduate medical education activities, the laboratory also serves as a training center at undergraduate and post graduate level for other healthcare professionals such as nurses or health technicians. The 1st, 3rd, 4th, 5th and 6th year medical students receive training of 52 clinical skills in small groups. Generally phantom models or simulators are used in trainings, but occasionally skills are performed directly on students' own bodies. At the beginning of each academic year, a training guideline describing stages of all skills which will be taught in that year is delivered to the students. During skill training in VSL, each stage of the skill is read from the guideline and a trainer demonstrates each stage emphasizing key points. After completing stage by stage demonstration, the trainer performs the skill once again fluently to show real life performance level which is supposed to be achieved by the students at the end of training. Following demonstration, the students start trying the skill themselves using guideline and having feedback from the trainer. After multiple trials, when the students feel themselves ready, they show their performances in front of the trainer. The trainer evaluates the performances using structured assessment forms. The students showing full and proper performances are accepted competent in the skill and allowed to leave the training room. In case of unsatisfactory performances, students go on trials until achieving a full performance level.

Due to the curriculum of Akdeniz University Faculty of Medicine, clinical skills taught in the first year are re-taught at the beginning of the third year.¹¹

STUDIED CLINICAL SKILLS

We studied skills of blood pressure measurement, taking body temperature, and taking pulse, all of which were taught in the first year of medical education. These three skills are taught in VSL using standardized training guidelines. All trainers were previously trained to assure standardization on teaching clinical skills in small groups. A simulator on which systolic and diastolic blood pressure values can be arranged and an arm model were used in training of blood pressure measurement skills. Heart beats start to be heard at the point of systolic pressure value and end at diastolic pressure value while students are measuring the blood pressure via a stethoscope on an arm model. In training of taking body temperature, the students take their own axillary body temperature using a mercury thermometer and learn how to read the obtained value. In training of taking pulse, the students take the radial pulse from each other and learn how to calculate heart beat per minute. Refresher training of these three skills in year 3 is performed using the same methodology and devices by the same trainers.

DATA GATHERING

A- Determining Loss of Competence

The first phase of the study started in academic year 2008-2009. The second and third year medical students, who had previously gained skills of blood pressure measurement, taking body temperature and pulse in the first year of medical education, were invited to the VSL to perform these skills. The purpose was to determine loss of competence one year and two years after the first training. Therefore, data were gathered prior to refresher training of three skills for the third year students. A separate room (totally three rooms) was assigned for each skill. Each student performed each skill alone; more than one student at the same time were not allowed in the rooms. Student performances were observed and scored over 100 by experienced observers using standardized assessment forms. In order to assure standardization, observers in the rooms were not changed throughout the assessment process. At the end, we obtained three per-

formance scores over 100 for each student. According to working principles of the VSL, each participant should have shown 100% performance in three skills while they were in the first year, otherwise they would not be allowed to leave the laboratory. Therefore, the scores attained in our performance assessment revealed percentage value of competency loss. Lower scores indicated higher loss of competence.

In the second phase of the study, we continued with 159 third year students (former second year students) in the academic year, 2009-2010. This time, we assessed student performances in three skills at the end of the year after the participants received refresher training at the beginning of the year and found opportunity to perform the skills on real patients under observation of clinical teachers who used the same training guidelines. The third year students sit for an objective structured clinical examination (OSCE) at the end of the year and three skills handled in this study took part in the exam. Assessors and assessment forms were the same with those used in the first phase of the study. Student performances for each skill were scored over 100 in OSCE.

B- Determining Effective Factors on Loss of Competence

A questionnaire was prepared by the authors to explore possible effective factors on loss of competence and delivered to all participants. The questionnaire asks the participants' age, gender, current year of medical education, number of years spent in medical school, professions of the parents (responses were clustered in two groups as "professions related to healthcare" and "others"), whether they gained the three skills before starting medical school, whether they used the skills in real life, and if yes, frequency of use (responses were clustered in two groups as "used at least once" and "never used"), and whether studying medicine was their own decision.

DATA ANALYSIS

SPSS 13.0 was used in statistical analyses. Socio-demographic data and characteristics of the second and third year students in academic year 2008-2009 were compared using Chi-square test.

We used paired samples t test in comparison of student scores attained in performance assessment with the first year scores (accepted 100). Performance scores of the second and third year students were compared by student-t test. OSCE scores of the third year students attained in academic year 2009-2010 were compared with their performance scores attained in academic year 2008-2009 using paired samples t test. Predictive values of factors that can be effective on loss of competence were investigated by multiple regression analysis. P value less than 0.05 was set for statistical significance.

RESULTS

A. CHARACTERISTICS OF THE STUDY GROUP

Mean age was 21.6 ± 1.0 years. Other characteristics of the study group can be seen in Table 1. The unique difference between former clinical skill experience of the second and third year students in academic year 2008-2009 was frequency of using blood pressure measurement skill in real life (Table 2).

B. RESULTS OBTAINED IN ACADEMIC YEAR 2008-2009 (LOSS OF COMPETENCE AND PREDICTING FACTORS)

When we compared the mean scores of the second and third year students with those attained at the end of the training in the first year (accepted 100), we found a significant decrease in all skills (paired samples t test, $p=0.000$ for all comparisons). Mean scores of the second and third year students attained in the performance assessment of three basic clinical skills in academic year 2008-2009 are provided in Table 3. In comparison of the second and third year students regarding their scores attained from performance assessment of three skills, a significant difference in favor of the second year students was found in blood pressure measurement scores (Student t-test, $p=0.030$), (Table 3).

When all independent variables were set in multiple regression analysis to determine their predictive values for loss of competence, we found following variables statistically significant for each skill:

TABLE 1: Comparison of the second and third year students in academic year 2008-2009 regarding their characteristics.

Characteristics	Second year n (%)*	Third year n (%)*	χ^2	p
Gender				
Male	101 (50.8)	98 (48.2)	0.12	0.733
Female	69 (52.7)	62 (47.3)		
Re-studied any academic year				
Yes	26 (52.0)	24 (48.0)	0.01	0.940
No	144 (51.4)	136 (48.6)		
Decision to study medicine				
His/her own decision	147 (51.4)	139 (48.6)	0.01	0.913
Others' desire	23 (52.2)	21 (47.8)		
Profession of the parents				
At least one is from health sector	7 (36.8)	12 (63.2)	1.17	0.279
Out of health sector	163 (52.4)	148 (47.6)		

* Column percentages were given.

TABLE 2: Comparison of the second and third year students regarding their former experience on studied skills.

Skill	Second year n (%)*	Third year n (%)*	χ^2	p
Blood pressure measurement skill				
Gained before medical school	62 (48.4)	66 (51.6)	0.79	0.373
Gained in medical school	108 (53.5)	94 (46.5)		
Blood pressure measurement skill				
Never used on real patients	50 (63.3)	29 (36.7)	7.04	0.007
Used on real patients at least once	120 (47.8)	131 (52.2)		
Taking body temperature skill				
Gained before medical school	64 (46.4)	64 (46.4)	0.42	0.515
Gained in medical school	96 (50.0)	96 (50.0)		
Taking body temperature skill				
Never used on real patients	67 (50.4)	66 (49.6)	0.12	0.733
Used on real patients at least once	103 (52.3)	94 (47.2)		
Taking pulse skill				
Gained before medical school	86 (54.1)	73 (45.9)	0.81	0.367
Gained in medical school	84 (49.1)	87 (50.9)		
Taking pulse skill				
Never used on real patients	44 (53.0)	39 (47.0)	0.10	0.752
Used on real patients at least once	126 (51.0)	121 (49.0)		

* Column percentages were given.

Blood pressure measurement: Current year of medical education, performing the skill in real life, gaining the skill before medical school and gender (Table 4).

Taking body temperature: Performing the skill in real life, gaining the skill before medical school and re-studying one academic year (Table 4).

Taking pulse: Performing the skill in real life (Table 4).

C. RESULTS OBTAINED IN ACADEMIC YEAR 2009-2010 (THE EFFECT OF REFRESHER TRAINING)

After receiving refresher training at the beginning of the third year and performing the skills on real patients, end-of-year mean OSCE scores of the third year (former second year) students for three skills were significantly higher than the past year performance assessment scores attained by the same students (Table 5).

TABLE 3: Comparison of the second and third year students in academic year 2008-2009 regarding their performance scores.

Clinical skills	Second year (Mean ± SD)	Third year (Mean ± SD)	t	p*
Blood pressure measurement	76.2 ± 14.7	72.2 ± 18.1	2.185	0.030
Taking body temperature	50.1 ± 29.4	54.9 ± 27.3	-1.521	0.130
Taking pulse	82.6 ± 20.9	80.1 ± 22.8	1.036	0.300

* Student t-test.

TABLE 4: Predictive effect of independent variables on loss of competence in blood pressure measurement, body temperature taking and pulse taking skills.

Variables	Blood pressure measurement skill		Body temperature taking skill		Pulse taking skill	
	t	p*	t	p*	t	p*
Gender	5.607	0.000	0.745	0.457	1.743	0.082
Current year of medical education (post-training time period)	-2.753	0.006	1.913	0.057	-1.147	0.252
Re-studying any academic year	.419	0.675	-2.334	0.020	0.489	0.625
Profession of the parents	-0.563	0.574	-0.351	0.726	-0.770	0.442
Decision to study medicine with own desire	-.746	0.456	-0.286	0.775	-0.415	0.678
Performing the skill in real life	2.055	0.041	5.528	0.000	2.985	0.003
Gaining the skill before medical school	-3.264	0.001	-3.127	0.002	0.374	0.708

* Multiple regression analysis.

TABLE 5: Comparison of initial performance scores attained in academic year 2008-2009 and OSCE scores attained in academic year 2009-2010 by the followed-up students.

Clinical skills	Initial performance Mean. ± SD	OSCE* Mean ± SD	t	p**
Blood pressure measurement	76.2 ± 14.7	98.3 ± 3.1	-19.927	0.000
Taking body temperature	50.1 ± 29.4	90.9 ± 14.5	-5.270	0.000
Taking pulse	82.6 ± 20.9	99.0 ± 4.3	1.036	0.000

* Objective structured clinical examination

** Paired samples t test

DISCUSSION

Teaching some basic clinical skills in early phase of medical education in our school is commonly criticized and seen as a “useless effort”, since the students find no opportunity to perform these skills on real patients until the third year of medical education. Common argument is that if the students can not transfer the gained skills to real life in a short time period, due to structure of the curriculum, they will lose their competencies to some extent. We exactly agree with this view, and just because of this, the skills studied in the current re-

search are re-taught in the third year before clinical courses start. On the other hand, we also know from the literature that early implementation of clinical skills training in medical education curriculum increases self confidence and motivation of medical students to perform some clinical applications, help them feel like a doctor and facilitates future training and learning activities.¹²⁻¹⁴

In our study, we found a significant loss of competence in all skills of medical students regardless of which year they are in. The biggest loss was observed in taking body temperature. In assess-

ment form of this skill, half of the total score was allocated to reading the value on the thermometer properly. Most significant competency loss was observed at this reading stage, consequently mean performance score of this skill was found lower than those of other skills.

In the literature, there are some studies showing loss of competence in clinical skills over time. Greb et al. have reported that third year medical students do not retain medical genetics knowledge and skills learned in the first year of medical school.¹⁵ In another study, Engler et al. assessed interviewing and communication skills of medical students just after a relevant course and one year later.¹⁶ They found a significant decline in student process-oriented skills, and concluded that effective interviewing and communication skills can be not only learned but also forgotten.¹⁶ Similar to these two reports, we found a significant loss of competence in clinical skills of our students both one year and two years later than initial training.

Among the factors predicting loss of competence in clinical skills, performing the skill in real life was the most prominent and predicting factor for competency loss in all skills. Similarly, in a study conducted among emergency care professionals, Latman and Wooley concluded that retention of knowledge and skills was directly related to frequency of use in real life.¹⁷ Gaining the skill before medical school was predicting loss of competence in two skills: blood pressure measurement and taking body temperature. If there is a healthcare professional in the family or in the vicinity of the student, he/she generally learns how to measure blood pressure or take body temperature before starting medical school. After a formal training in the first year, these students reinforce their skills and find more opportunity to apply these skills outside the school. For all these reasons, their loss of competence becomes less than that of the others. Gender and current year of medical education (or length of post-training time period) were other predictors of competency loss in blood pressure measurement skill. In the performance assessment, second year students attained higher scores than the third year students and females were more suc-

cessful than males. As the time period after training increases, loss of competence is supposed to increase accordingly. Thereby, we expected to find a significant relation between post-training time interval and competency loss in remaining two skills too, but we did not. This suggests that linear association between competency loss and time disappears after a certain time period, and a plateau occurs since the students can retain at least some basic and simple stages of the skill long after the training. Regarding our results, we may assume that the required time period for occurrence of the plateau may differ from one skill to another. This difference is possibly associated with the complexity of the skill. In simple clinical skills, such as taking body temperature or pulse; there are not so many stages. When loss of competence occurs in main stages of the skills, a few skill stages were left behind to loose. On the other hand, in complex clinical skills including many stages like blood pressure measurement, longer time period is needed to reach the limit of loss of competence. As for gender, there are some publications in the literature showing that female students with their meticulous characteristics are more successful than males in some clinical skills.^{18,19} Similarly, we found that our female students were more successful than males in blood pressure measurement skill which is relatively more complex and requires more detailed practice. A surprising predictive factor for taking body temperature was re-studying any academic year due to failing in final exams. The students who re-studied one academic year showed less loss of competence in taking body temperature. This just can be explained by two other predictors which are gaining the skill before medical school and performing it in real life.

After refresher training and performing the skills on real patients, loss of competence among our third year students substantially decreased. The positive effect of refresher training will be permanent if it is combined with real life opportunities for medical students. Otherwise, some retention problems appear again over time. Curricula of medical schools should be structured by taking this reality into account.

CONCLUSION

This study revealed that a considerable loss of competence is seen in clinical skills of medical students over time. Refresher training combined with opportunities for students to perform the skills on real patients compensates competency loss. Opportunities for application of gained skills in real life soon after the training should be considered, while organizing the medical education curricu-

lum. If there is a long paucity between the training time and practice opportunities, then refresher training should be placed into appropriate components of the curriculum to ensure retention of the clinical skills before real life applications.

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