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Comparison of Younger and Older medical student performance outcomes

A retrospective analysis in Japan

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Abstract

The present study examined the impact of age on medical student repeat-year experience and performance outcomes on the objective structured clinical examination (OSCE), Clinical Clerkship (CC), and other relevant examinations in the Japanese medical school system. This retrospective analysis examined the number of students with repeat-years and the years required to graduate, stratifying students by the age they entered medical school (Younger: within 4 years of high school graduation; Older: 5 or more years after high school graduation). Scores of the Pre-CC OSCE, Computer-based testing (CBT), CC performance, CC integrative test, and graduation exams were compared among those graduating from our medical school between 2018 and 2020, and examined correlations between student age and performance outcomes. From 2018 to 2020, 328 medical students graduated. Of these, 283 had entered within 4 years of high school graduation (Younger), while 45 did so 5 or more years after high school graduation (Older). The number of repeat-years did not differ significantly between groups. The average number of years required to graduate was slightly higher for the Older group and the Younger group scored significantly higher on the CC integrative test. No significant differences were found for the remaining tests. These results suggest that older medical students in general show no significant inferiority in their performance of most clinical skills and competencies relative to younger students in Japan.

Abbreviations: CBT = Computer-based testing, CC = Clinical Clerkship, OSCE = Objective Structured Clinical Examination.

Keywords: accomplishment, age difference, Clinical Clerkship, medical students, summative tests

1. Introduction

In Japan, passing the required entrance examination and are admitted to medical school immediately following high school graduation.[1] Meanwhile, considerable number of students require several years to pass these entrance exams, while others choose to get a university degree or work for a few years before entering medical school. Accordingly, Japanese first-year medical students include a non-negligible number of older medical students in addition to those just out of high school.

Previous studies have examined how demographic factors such as gender and age influence academic performance, dropout rates, and having to repeat a year (hereafter, "repeat-year").[2,3] Thus far, these studies have focused primarily on academic achievement in the early stages of the medical education curriculum.[4,5]

Clinical education is integrative and complex academic discipline and can be one of the major reasons why many students require a repeat-year.[6,7] Repeat-year not only delays a student's graduation plans but also creates great stress to the students. In clinical curricula, previous academic performances as well as the acquisition level of technical and non-technical skills have been found to impact academic success.[8] While various studies have evaluated Clinical Clerkship (CC) performance among medical students, these have focused mainly on specific skills.[9] Conversely, no study has examined their achievements from the viewpoint of student age, especially with regard to the CC and other relevant exams. Therefore, the present study conducted the evaluation on how medical student age influenced CC performance and other relevant exam outcomes.

In this study, correlations between age and the number of repeat-years and performance outcomes on the Pre-CC Objective Structured Clinical Examination (OSCE), Computer-based testing (CBT), CC, post-CC integrative test, and graduation exam were examined among medical students graduating

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The datasets generated during and/or analyzed during the current study are publicly available.

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from one Japanese medical school in three consecutive years (2018-2020).

2. Materials and methods

2.1. Ethical considerations

This study was approved by the Research Ethics Committee of Osaka Medical and Pharmaceutical University (No. 2021-003). Subjects were informed that they could withdraw from the study if they notified the investigator through the university homepage. This study population included no minors, as all 4 to 6th year medical students in Japan are >21 years old.[10,11]

2.2. Settings

As is the case for most medical schools in Japan, Osaka Medical and Pharmaceutical University requires its students to take the CBT and Pre-CC OSCE in their 4th year, before they enter into CC in their 5th and 6th years. The 5th year CC integrative test is taken at the end of a student's 5th year, and the graduation exam and graduation in the 6th year.[12] The students' grade and summative test are shown in Table 1.

2.3. Study population

Three hundred twenty eight students of Osaka Medical and Pharmaceutical University who graduated between 2018 and 2020 were evaluated.[10]

2.4. Study measures

2.4.1. Classification of "younger" and "older" medical students. Given that most universities and colleges worldwide require a 4-year undergraduate education prior to medical school, comparison was performed between medical students who entered medical school within 4 years of high school graduation (Younger) and those who did so 5 or more years after high school graduation (Older) (Fig. 1).

2.4.2. Pre-CC OSCE content and evaluation. In 2005, with the intent to ensure basic clinical competency among medical students, the Common Achievement Test Organization (CATO) was established as a third party and introduced the Pre-CC OSCE and CBT to evaluate basic medical knowledge. The Pre-CC OSCE and CBT are performed to ensure minimum clinical skills to undergo CC in medical students. The Pre-CC OSCE evaluates 7 different aspects of a student's basic clinical competency, as follows: medical interview, head and neck examination, chest examination, abdominal examination, neurological examination, emergency response, and basic clinical technique. The Pre-CC OSCE is carried out at 7 stations; one (medical interview) is 10 minutes long, while the remaining six (physical examinations and basic skills) are 5 minutes each.[11] During their allotted time at each station (5 or 10 minutes), students perform core clinical skills such as a medical interview and physical examinations. Scores for each component of the Pre-CC OSCE are calculated as the average of the scores given by two examiners. Examiners evaluate the communication, medical safety, and consultation skills on a checklist.

Table 1

Grade and related summative evaluations in 2018 to 2020 clinical education curriculum.

4th grade	Pre-CC OSCE, CBT
5th grade	CC performance, CC integrative test
6th grade	Graduation exam

CBT = Computer-based testing, CC = Clinical Clerkship, OSCE = Objective Structured Clinical Examination.

2.4.3. CBT content and evaluation. The CBT consists of multiple-choice questions and extended matching items; students are given six hours to answer 320 questions pertaining to basic clinical knowledge. The final evaluation is based on 240 of these questions, the difficulty and discriminating power of which are validated from past pooled data. The remaining 80 questions are trial questions and therefore not used for the evaluation. The questions are standard tested by the CATO. The CBT assesses clinical disciplines and related basic medical knowledge. Scores for the CBT (percentage and item response theory (IRT)-based score) are calculated by the computer.

2.4.4. CC content. Medical students undergo a basic CC during their 5th year. During this training, the student participates in CCs in all clinical departments of the hospital over the course of 32 weeks, with each CC spanning roughly one to two weeks in duration. Once students complete the basic CC, they must then select a discipline they wish to study for 14 weeks in their 6th year. In Japan, the CC forms the basis of clinical training. In contrast to conventional clinical training, which involves only observation and no practice, during the CC, students participate as members of a medical team to perform actual medical procedures and care.[13] The range of medical procedures that students are allowed to perform during their CC is defined and the procedures are carried out under the supervision of an instructing physician. This enables students to acquire practical clinical skills while also developing identity and personal responsibility as a physician.

During the CCs, supervising physicians of each department evaluate the clinical skills of students using an evaluation sheet based on the mini CEX and Direct Observation of Procedural Skills (DOPS). This assessment comprises a 5-point evaluation sheet for 16 parts (80%), a subjective evaluation by the organizer of each department (10%), and a written report (10%).[10]

Scores for each CC are collected by the medical education center and used to calculate an average score. In this study,

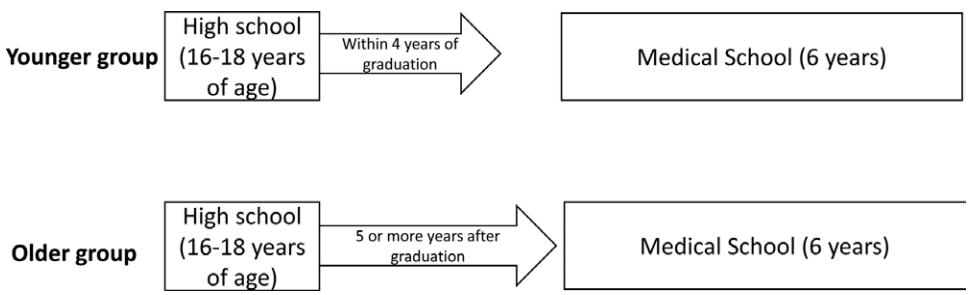

Figure 1. Educational timeline for Younger (within 4 years of high school graduation) and Older (5 or more years after high school graduation) medical students.

accomplishment was used on the basic CC (32 weeks) score, since all medical students are required to participate in the basic CC.

2.4.5. 5th year integrative test. The 5th year integrative test is performed after the basic CC and comprises scantron-based multiple choice questions and extended matching items. Students are given 7 hours to answer roughly 220 to 230 questions pertaining to clinical knowledge.

2.4.6. 6th year graduation exam. The 6th year graduation exam consists of four scantron-based multiple choice exams: two 7-hour and two 14-hour integrative exams, for a total of roughly 1200 questions. The 6th year integrative consists of multiple-choice questions and extended matching items, and students are required to answer questions about clinical knowledge over the course of 7 hours. The four graduation tests were calculated under the ratio (1:1:4:4) and the calculated percentage was used for summative evaluation for graduation.

2.5. Statistical analysis

Statistical analysis was performed using JMP® 11 (SAS Institute Inc., Cary, NC, USA). Results were compared using the unpaired Student *t* test, Chi-square test, or Pearson correlation test. Medical student age was determined by adding the school year to the age they entered medical school. Data are presented as mean ± SD. $P < .05$ was considered statistically significant.

3. Results

From 2018 to 2020, 328 students graduated. Of these, 283 entered this school within 4 years of high school graduation (Younger), while 45 of them did so 5 or more years after high school graduation (Older). The average year from high-school graduation to medical school entrance was 1.4 ± 1.1 years in the Younger group, while it was 8.7 ± 4.4 years in Older group ($P < .001$).

The number of repeat-years and the average number of years needed to graduate from medical school are shown in Table 2. The number of repeat-years did not significantly differ between groups ($P = .802$), whereas the average number of years needed to graduate was slightly longer for the Older group ($P < .001$).

A comparison of Pre-CC OSCE scores is shown in Table 3. While the Younger group performed significantly better than the Older group in the medical interview component ($P = .037$), no significant group-dependent differences were evident for the other components.

Student scores and performance evaluations among graduates from all three years as related to age are presented in Table 4. Although the Younger group performed significantly better on the CC integrative test ($P = .003$), no significant differences were observed for the other tests.

Correlations between age and performance outcomes are shown in Table 5. While significant differences in the CC integrative test (5th year) and graduation exam (6th year) ($P = .012$, $P = .003$) was observed, no significant correlation was noted for other achievements.

4. Discussion

From a global perspective, entrance into medical school as an older student is not a novel trend. Traditionally, American medical education systems require students to graduate from high school and attend university before they enter medical school.[14,15] The strongest argument for their introduction there was that of diversity.[16] It is generally thought that recent graduates would have higher levels of motivation and lower levels of attrition relative to those who have been out of school for a longer period.[17] Another assumption is that mature students are more capable of making informed career choices.[18] There are reports that age of medical student does not affect the leave of absence rate in U.S. medical school.[19,20] Furthermore, one systematic review also showed negative correlation between age and United States Medical Licensing Examination Step 2 clinical knowledge.[21] These results in the U.S. are generally compatible to this study.

In 2018, it was detected that scores from medical school entrance examinations for older or female students were found to have been manipulated to exclude them deliberately from admission; this trend was discovered to have occurred in admissions offices of at least nine medical schools across Japan.[22] One reason for such discrimination was that the medical schools

Table 2

Number of repeat-year students and years required to graduate, 2018 to 2020.

Number of graduating students	All n = 328	Younger group (within 4 years of high school graduation) n = 283	Older group (5 or more years after high school graduation) n = 45	*P*
1+repeat-years	40	34	6	.802
No repeat-years	288	249	39	
Years required to graduate	6.23	6.22±	6.28±	.001*

*$P < .05$.

Table 3

Comparison of Pre-CC OSCE scores between Younger and Older medical students.

	Medical interview	Head and neck examination	Chest examination	Abdominal examination	Neurological examination	Emergency response	Basic technique	Total OSCE score
Younger group* N = 283	78.0 ± 10.2	89.1 ± 8.1	87.4 ± 10.3	91.0 ± 8.1	86.9 ± 8.9	91.0 ± 7.3	85.0 ± 8.5	87.0 ± 5.1
Older group** N = 45	73.2 ± 10.4	85.6 ± 8.4	82.9 ± 12.0	88.1 ± 10.8	84.6 ± 9.9	88.7 ± 9.0	81.4 ± 11.4	83.4 ± 6.4
P value	.037*	.267	.156	.873	.529	.728	.347	.066

OSCE = Objective Structured Clinical Examination, Pre-CC = Pre-Clinical Clerkship.

Data are presented as mean ± SD.

* Younger group entered medical school within 4 years after high school graduation.

** Older group entered medical school 5 or more years after high school graduation.

Table 4

Comparison of Younger and Older medical students with regard to scores on the graduation exam, the CC integrative test, CC performance evaluation, CBT, and the IRT.

	Graduation exam (6th year)	CC integrative test (5th year)	CC performance evaluation (5th year)	CBT (4th year)	CBT-IRT
Younger group* N = 283	75.2 ± 5.8	73.2 ± 6.8	79.1 ± 3.2	79.5 ± 7.9	528.9 ± 85.4
Older group** N = 45	73.4 ± 5.3	70.1 ± 7.0	78.4 ± 2.4	78.6 ± 9.6	546.6 ± 86.6
P value	.71	.003*	.057	.216	.541

CC = Clinical Clerkship, CBT = Computer-based testing, IRT = item response theory.

Data are presented as mean ± SD.

* Younger group entered medical school within 4 years after high school graduation.

** Older group entered medical school 5 or more years after high school graduation.

Table 5

Correlations between medical student age and graduation exam scores, CC integrative test scores, CC performance evaluation, CBT percentages, IRT, Pre-CC OSCE.

	Graduation exam (6th year)	CC integrative test (5th year)	CC performance evaluation (5th year)	CBT (4th year)	CBT-IRT	Total Pre-CC OSCE
R	–0.139	–0.164	–0.033	0.006	0.010	–0.003
Co-efficient	0.0193	0.0269	0.0043	0.00036	0.001	0.0009
P	.012*	.003*	.543	.898	.871	.957

CC = Clinical Clerkship, CBT = Computer-based testing, IRT = item response theory, OSCE = Objective Structured Clinical Examination, Pre-CC = Pre-Clinical Clerkship.

*$P < .05$.

heavily relied on a workforce consisting of their own graduates.[23] Accordingly, these schools attempted to increase the proportion of younger doctors, reasoning that older graduates would have less remaining time in their life to work. In order to determine how widespread this discrimination was, the government initiated a nationwide investigation and revealed that, in fact, many medical schools were imposing similar restrictions on older student admissions.[24,25]

These results suggest that the number of repeat-years did not significantly differ between the two age groups, and that the average number of years needed to graduate was slightly longer in the Older group than in the Younger group. While the Younger group performed significantly better than the Older group in the medical interview component, no significant group-dependent differences were found for other Pre-CC OSCE components. In addition, although the Younger group scored significantly higher on the CC integrative test, no other group-dependent differences were observed for the other tests. Furthermore, significant group-dependent differences in the CC integrative test (5th year) and graduation exam (6th year) scores were found, whereas no significant correlation was found for other achievements or evaluations. Collectively, these findings suggest that although older medical students demonstrate inferiority to the younger students in a few clinical aspects, no critical differences were evident.

Medical schools are known to be stressful environments for students, and many medical students experience mental illness or instability.[1] In Japan, a decline in general academic performance as well as an increase in the number of those who drop-out or require repeat-years has been noted. It is essential for instructors at medical schools to be well aware of these changes and ensure that the necessary support required by their medical students is offered. Effective support requires an evaluation of student learning tendencies. With regard to learning support, these findings suggest that medical school faculty may need to offer additional support to older medical students as they seem to struggle somewhat with acquiring technical and non-technical skills. They may benefit, for example, from extra training in conducting medical interviews. It is also important that these trends in clinical achievements are made known to older medical students so that they are aware of their own need for additional studying or training.[26]

This study has several limitations worth noting. First, summative evaluation of CC performance, and other integrative test in a single number were performed though medical students rotate through so many subject areas, are assessed on so many skills.[27] Second, evaluation was performed on the effects of age with regard to their influence on clinical components of the Japanese medical education curriculum because integrative tests on clinical components are not performed prior to graduation from medical school. Finally, as the data came from a single institution, these findings may be limited somewhat in their generalizability to medical schools in other countries. In the future, it is warranted to evaluate how medical student age affects not only postgraduate clinical performance, but also its relationship with undergraduate factors.[28]

5. Conclusion

Age effect examinations on medical student performance of clinical competencies were performed in a Japanese medical school. These results suggest that older medical students show no significant inferiority in their performance of the majority of clinical skills relative to their younger counterparts. Additional learning support for older medical students may still be warranted.

Author contributions

All authors have read and approved the manuscript approved the final version.

N.K. performed the study, statistical analysis, and wrote the manuscript.F.T. performed the study and wrote the manuscript.

K.T. performed interpretation of data, prepared the manuscript, and provided critical comments.

S.W.L. performed interpretation of data, prepared the manuscript, and provided critical comments.

R.K. performed interpretation of data, prepared the manuscript, and provided critical comments.

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