# Knowledge decay in undergraduate education in paediatrics

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**Abstract**

***Background***: Knowledge decay, or poor retention, is a problem experienced among the undergraduate students and even by their teaching faculty. During the undergraduate course in paediatrics, this knowledge decay is seen between the first (4th semester) and second (8th semester) clinical posting with wasting of time and faculty resources in reinforcement of this acquired knowledge again.

***Objectives:*** To identify the extent and reasons for the knowledge decay in undergraduate medical education in paediatrics.

***Method****:* Mixed method comparative study was conducted among 8th semester students posted in Department of Paediatrics. The end of posting multiple choice questions (MCQ) test in 4th semester was re-administered as a pre-test in 8th semester along with open ended questions for their reasons. The marks obtained in both tests were compared and analysed using the paired t-test.

***Results****:* The marks of 225 students were compared between the 2 posting sessions. Decay of acquired knowledge was found to be statistically significant among all sections of paediatrics, with the most decay being in the knowledge of anthropometry and least decay in infectious diseases and haematology. The long gap between the two postings, lack of theory knowledge and paediatrics not being an examination subject in the second year, were the reasons given for the decay.

***Conclusions****:* Significant loss of acquired knowledge was found in paediatrics between 4th and 8th semester clinical postings after initial good acquisition. The lack of reinforcement in the intervening years was the main reason for knowledge decay from the students' perspective.

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(Key words: Knowledge decay, retention, reinforcement)

## Introduction

Knowledge decay, otherwise referred to as poor retention of knowledge, is one of the main reasons of evolution of innovative teaching practices, integrated teaching curriculum and other newer teaching methodologies. The MBBS teaching curriculum incorporates clinical exposure from the second year of MBBS in order to orient the students to clinical medicine while going through the various subjects simultaneously in the 4 years. Hence, the students are exposed to clinical subjects like medicine, paediatrics, surgery, etc. well before the subjects actually are completed in the lecture classes. In Paediatrics, the total number of teaching hours being only 100, the students are exposed to clinical case taking and analysis well before their lecture classes have begun. Hence, during their first clinical paediatric posting, i.e. in the 4$^{th}$ term /semester in second year, a lot of the teaching methodology is planned so as to incorporate the vital aspects of case taking and case analysis along with the basics of paediatrics. This introductory posting is expected to form a basis for the next postings as the students, after finishing their first posting return to the subject in the clinics in the final years of MBBS. It is during this second interaction with the students, that this phenomenon of poor knowledge retention has been observed and many precious clinical hours are wasted in reinforcing the basics that were extensively covered initially. As the retention of this knowledge is important to the students to further their understanding in the latter postings, early identification of their knowledge decay will help in taking corrective measures at an earlier stage. No study has been hitherto done to estimate the knowledge decay within the MBBS course, nor in clinical subject knowledge. Similar studies were done only in the retention of basic science knowledge or skills retention[1,2,3]. Hence, this study is one of the initial studies that aims to identify the knowledge decay in paediatrics that has occurred between the two clinical postings and thus propose reinforcement of the knowledge to effectively utilize resources, as well as maximize the learning among the undergraduate MBBS students.

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**Objectives**

To identify the extent and reasons for the knowledge decay in undergraduate medical education in paediatrics.

**Method**

The study was done as a mixed method comparative study at Kasturba Medical College and Hospital wherein the target population comprised all the 8th semester students in the final year of MBBS. Institutional ethics committee approval was obtained and consent for participating in the study was obtained from the students. When the students attended their first day in the paediatric department in their second clinical posting in the 8th semester, they were administered a pre-test which comprised the same multiple choice questions (MCQs) that appeared in their previous clinical examination after their first posting in paediatrics. The marks of the same students in the end of posting multiple choice test conducted after the introductory posting in the 4th semester was tabulated in the various knowledge domains in the subject along with the pre-test scores. The demographic details were tabulated and the scores in both tests were compared to identify knowledge decay. The knowledge in paediatrics was sub classified into two sections, an exclusive paediatric section comprising questions in development, immunisation, nutrition and anthropometry and a systemic paediatric section which included questions in respiratory, cardiovascular, central nervous and alimentary systems, infection and haematology. The students were also asked to comment upon the reasons for this poor retention, if any. The data was analysed using Mann Whitney test, paired t-test in the SPSS version 17. The qualitative data were tabulated as number of responses. Figure 1 is a flow chart of the methodology.

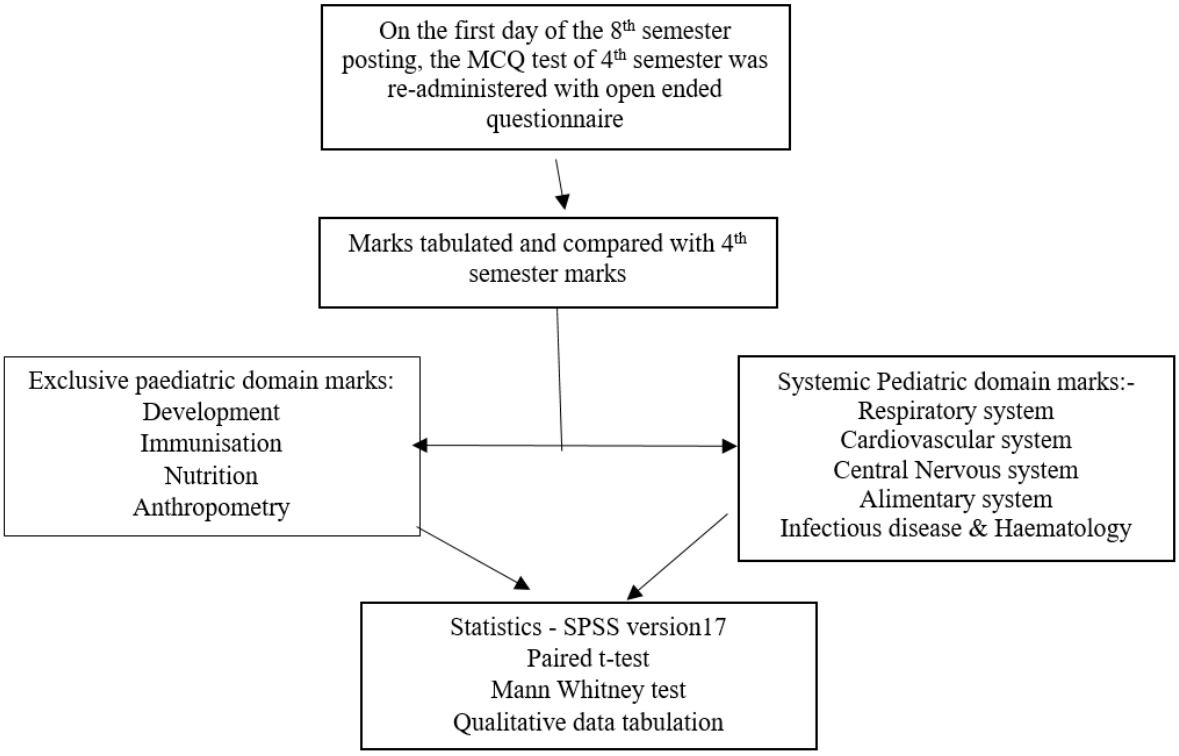


**Figure 1: Methodology flowchart**

**Results**

In our study, a total of 250 students were taken as the target population in the 8th semester in their second clinical posting in paediatrics. Out of these 250, the data of only those students who had taken both tests were computed for comparison, which came to a total of 225. Out of the 225 students, 91 (40%) were males and 134 (60%) were females. The Medical College admits students under the General Merit category, the Foreign category, the Non-resident Indian category and the Government category as shown in Table 1.

**Table 1**

***Study population with respect to category of admission***

| Category | Number (%) |
|---|---|
| General merit | 148 (66) |
| Foreign | 17 (7) |
| Non-resident Indian | 12 (6) |
| Government | 48 (21) |
| Total number of students | 225 |

When the marks of the students were analysed, with respect to the number of correct answers in the domain of exclusive paediatrics (Table 2), it was found that, in 4th semester, 65% of the students answered the development questions correctly as compared to only 43% in the 8th semester. In the section regarding immunisation, 63% got this section correct in 4th semester as compared to only 22% in 8th semester. Similarly, in the 4th semester, 59% got the questions on nutrition right in the 4th semester whereas only 11% got this section right in the 8th semester and in anthropometry, 68% of correct answers reduced to 8% in the 8th semester.

**Table 2:** ***Comparison between the numbers of 4th and 8th semester students who answered the questions correctly in the Exclusive Paediatrics Knowledge Domain***

| Exclusive paediatrics knowledge parameter | 4th Semester | | 8th Semester | |
|---|---|---|---|---|
| | Correct answers Number (%) | Incorrect answers Number (%) | Correct answers Number (%) | Incorrect answers Number (%) |
| Development | 146 (65) | 79 (35) | 96 (43) | 129 (57) |
| Immunisation | 142 (63) | 83 (37) | 49 (22) | 176 (78) |
| Nutrition | 133 (59) | 92 (41) | 25 (11) | 200 (89) |
| Anthropometry | 153 (68) | 72 (32) | 19 (8) | 206 (92) |

In the systemic paediatrics domain (Table 3), 65% and 66% of the students had correctly answered the questions of the respiratory system and cardiovascular system respectively, as compared to 30% and 29% who got these questions correct in the 8th semester. In the central nervous system, alimentary system and other chapters, 60% 55% and 65% had answered these sections correctly in the 4th semester; however in the 8th semester, this percentage had reduced to 15%, 47% and 39% respectively in these chapters.

**Table 3:** ***Comparison between the numbers of 4th and 8th semester students who answered the questions correctly in the Systemic Paediatrics Knowledge Domain***

| Systemic paediatrics knowledge parameter | 4th Semester | | 8th Semester | |
|---|---|---|---|---|
| | Correct answers Number (%) | Incorrect answers Number (%) | Correct answers Number (%) | Incorrect answers Number (%) |
| Respiratory system | 146 (65) | 79 (35) | 67 (30) | 158 (70) |
| Cardiovascular system | 148 (66) | 77 (34) | 66 (29) | 159 (71) |
| Central Nervous system | 133 (60) | 92 (40) | 34 (15) | 191 (85) |
| Alimentary system | 125 (55) | 100 (45) | 106 (47) | 119 (53) |
| Infectious diseases & hematology | 146 (65) | 79 (35) | 89 (39) | 136 (61) |

The students' marks in both the above domains were analysed with respect to their category of admission and it was evident that in all categories (General merit, Foreign, Non Resident Indian and Government) there was a decay in the retained knowledge between the 4th and 8th semesters. The results were analysed using the one-way ANOVA test as given in Table 4

**Table 4:** ***Comparison between various categories of admission and their knowledge using one-way ANOVA test***

| Category of admission | Exclusive paediatric domain (max marks = 4) | | Systemic paediatric domain (max marks = 6) | | Total marks (max marks = 20) | |
|---|---|---|---|---|---|---|
| | 4th semester | 8th semester | 4th semester | 8th semester | 4th semester | 8th semester |
| General | 3.89 | 1.66 | 2.67 | 0.75 | 13.4 | 4.45 |
| Foreign | 3.18 | 2.18 | 2.59 | 1.00 | 11.4 | 6.3 |
| NRI | 3.5 | 2.0 | 2.17 | 0.92 | 11.3 | 5.6 |
| Government | 4.15 | 1.67 | 2.27 | 1.04 | 12.9 | 4.6 |

As the data had various proportion of high performers and those who scored poorly, it did not form a normative representation of the data and hence further analysis was done using the Mann Whitney test to analyse the performance of the students with respect to the gender (Table 5) This data had a wide difference in performance between the semesters, but there was no statistical significance in the performance in each semester between males and females.

**Table 5:** ***Comparison between the 4th and 8th semester students' knowledge with gender as the variable by Mann Whitney test (median scores)***

| Gender | Exclusive paediatric domain (max marks = 4) | | Systemic paediatric domain (max marks = 6) | | Total marks (max marks = 20) | |
|---|---|---|---|---|---|---|
| | 4th semester | 8th semester | 4th semester | 8th semester | 4th semester | 8th semester |
| Male | 03 | 01 | 03 | 02 | 12 | 04 |
| Female | 03 | 01 | 04 | 02 | 14 | 04 |

When these results were analysed for statistical significance using the paired t-test, the following results emerged (Table 6): In the exclusive paediatric domain, the mean score in all aspects of exclusive paediatrics reduced from the 4th to the 8th semester and this reduction was highly statistically significant. Even in the systemic paediatric domain, there was a significant reduction in the scores. Upon analysing the total marks, the mean total marks of 12.8 reduced to 3.04 in the 8th semester which too was highly statistically significant as shown in the table 6.

**Table 6:** ***Paired t-test for comparison of knowledge at the end of 4th semester with knowledge retained at the start of 8th semester***

| Knowledge domain | 4th semester | | 8th semester | | t value | *p*-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| Exclusive paediatric domain | 2.55 | 0.97 | 0.84 | 0.83 | 21.2 | <0.0001 |
| Systemic paediatric domain | 3.87 | 1.25 | 1.72 | 1.23 | 17.3 | <0.0001 |
| Total marks | 12.8 | 3.14 | 4.69 | 3.04 | 27.73 | <0.0001 |

*SD: standard deviation*

When the marks were further analysed within the exclusive paediatric domain, very significant reduction of test scores between the two semesters was found in knowledge of development, nutrition, anthropometry and immunisation, with the maximum reduction found in the knowledge of anthropometry (Table 7).

**Table 7:** ***Paired t-test for comparison of knowledge at the end of 4th semester with knowledge retained at the start of 8th semester within the exclusive paediatric domain***

| Knowledge domain within exclusive paediatrics | 4th semester | | 8th semester | | t value | *p*-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| Development | 0.65 | 0.47 | 0.43 | 0.49 | 5.06 | <0.0001 |
| Immunisation | 0.63 | 0.48 | 0.22 | 0.41 | 9.34 | <0.0001 |
| Nutrition | 0.59 | 0.49 | 0.11 | 0.31 | 12.34 | <0.0001 |
| Anthropometry | 0.68 | 0.46 | 0.08 | 0.28 | 16.19 | <0.0001 |

*SD: standard deviation*

When the responses were obtained from the students for the reasons for their knowledge decay, most of them felt that the long gap of nearly 2 years between the 2 clinical exposures in paediatrics was the main cause for the decay (Table 8). The next common reason mentioned was the fact that there were other basic subjects to focus upon in the second year, and paediatrics not being in an upcoming examination, there was not much focus on long term retention of knowledge. Some students felt that the incomplete knowledge of basic sciences in the 4th semester and the absence of lecture classes in paediatrics in the second year were also responsible for the poor understanding and hence the lack of retention of knowledge. The other reasons that appeared infrequently were that the basics of clinical subjects were unclear in the second year, the understanding of the para-clinical subjects was only after the completion of the second year, clinical pathophysiology not being understood in the earlier posting in paediatrics.

**Table 8:** ***Reasons cited by students for poor knowledge retention between the two clinical postings in paediatrics***

| Reason – multiple reasons per form | Number |
|---|---|
| Better to have posting in 6th semester for better retention & smooth transition to final year | 30 |
| Basics of examination not known in 4th semester | 18 |
| Basics of subject not understood in 4th semester | 28 |
| No reinforcement from 4th to 8th semester so skills and theory forgotten due to long gap period | 45 |
| Other basic subjects to focus upon in 4th semester | 30 |
| Paediatrics theory classes not yet begun in 4th semester so difficult to assimilate information and retain | 21 |
| Paediatrics not an examination subject in 2nd year so less focused upon | 29 |
| Too many students posted together in 4th semester | 12 |
| Postings for one month is too short and as all final year subjects, this too should be a 1½ month posting in 4th semester | 12 |
| Postings of allied sciences in 6th semester should be in 4th and paediatrics in its place | 24 |
| Anxiety at forgetting everything in 4th semester worsens 8th semester performance | 02 |
| The basic subjects' knowledge(pathology, microbiology and pharmacology) is not complete by this 4th semester posting hence understanding poor | 12 |
| No response | 08 |

**Discussion**

In our study, the knowledge decay was identified between the two clinical postings in paediatrics with the loss in the acquired knowledge being most apparent in the domain of exclusive paediatrics. This was explained by the lack of reinforcement in this section which deals with paediatrics exclusively. The decay in knowledge was significant even in the domain corresponding to systemic paediatrics. However, the marginally better score could be explained by the overlap in the subject with other subjects of final year like general medicine in these sections. A similar study done in basic paediatric cardiology where the authors had studied the knowledge decay in paediatric cardiology, both in knowledge and skills, reported that the loss of knowledge was much more that the loss of skills in the subject[4]. They also reported that lack of use of the knowledge and lack of reinforcement contribute to the decay.

In our study, there was no statistical difference between the knowledge decay between boys and girls and both groups showed knowledge decay between the two clinical postings. In the study done by Bunmi Malau Aduli in Australia they compared the retention of knowledge in basic sciences among medical students and found that the retention of knowledge of basic sciences was better in the latter years of medical training as the students correlated the basic sciences with clinical cases and in the initial years when the clinical understanding was yet to be established, the knowledge tended to decay. In this study, similar MCQ test was administered in all the medical academic years and the scores were analysed similar to the current study with gender as a variable[1]. There the boys performed better but in our study, no such finding was found and there was no statistical significance in the difference of scores between the 2 cohorts of students.

When the domain of exclusive paediatrics was further analysed, significant knowledge decay was found in all sections and the least knowledge retention was in the section on anthropometry as compared to development, immunisation and nutrition. This poor retention was also seen in systemic paediatric domain. When we analysed the causes for this decay, the main cause is the lack of reinforcement of this acquired knowledge in the 2 years that elapse between the 1st and 2nd clinical postings in paediatrics. In the study by Fenando Amaral, they have reported about a phenomenon named as the priority phenomenon which explained the knowledge decay by the information given to the students between two assessments in the traditional curriculum[4]. This could explain the decay in our setting too. The student perspectives too state similarly with the lack of reinforcement and lack of paediatrics being a priority subject as well as poor understanding of basics being the cause for the decay. With the introduction of newer and innovative teaching methods, their effect on retention has not been studied. In this study, as in a study by Rodrigez R, where the retention was evaluated after the introduction of a new teaching programme in pharmacology[3]. In a study done by Amanda et al, they reported that despite the introduction of team-based learning (TBL) in their curriculum early in the preclinical years, when the students' knowledge was tested in the latter years, the lack of reinforcement caused the knowledge to decay and not get translated into long term retention[5]. This study had a similar conclusion as our study with the need for regular reinforcement in the various academic years for long term retention.

There were some limitations in our study, We estimated the existence of knowledge decay; however, the assessment of skills, and whether the skills too decay and to what extent could not be done in this study. Other studies done by Wayne et al and Martínez Natera OC have studied the decline in skills and knowledge and have reported that the decline has been primarily in skills after the training in trauma and life support[8,7]. Another limitation of this study has been that the retention of the knowledge and skills in the workplace as interns has not been studied and this provides scope for further research on this topic. We recommend the introduction of a short supplementary posting in the intervening years to reinforce the knowledge and reduce the decay by repetitive student practice, patient exposures along with repeat assessments.

**Conclusions**

In our study, there has been significant loss of acquired knowledge in paediatrics between the two clinical postings after initial good acquisition. The lack of reinforcement in the intervening years has been main reason for this knowledge decay from the students' perspective.

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