









# Attitude and Perception of Dental Students and Dentists toward Efficacy of Typhodont Exercise Practiced as a Part of Preclinical Conservative Dentistry Curriculum for Routine Clinical Practice

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## Abstract

**Objective** Dentistry is a blend of both surgery and medicine. Cavity preparation in dentistry is a routine procedure used to remove defects or dental caries, which is irreversible and requires advanced skills. Preclinical training is done on typhodont, which are replicas of teeth that exhibit tooth morphology, as part of the dental curriculum. The aim of this study was to assess the attitude of dental professionals toward the efficacy of typhodont exercise in clinical practice.

**Materials and Methods** This study was a cross-sectional study conducted on dental professionals to understand the efficacy of typhodont exercise in clinical practice. The questionnaire consisted of 23 close-ended questions. The responses were coded as number/score (1–10). Responses were compiled on a MS Excel Worksheet and subjected to SPSS package. Chi-squared test and Mann–Whitney U test were used to analyze data.

**Results** A total of 250 responses were collected. About 72.8% participants stated that it helped them get oriented to the operating position. Regarding the preclinical exercises relevance to clinical exercise, a score of about 7 was obtained. However, the simulation of gingiva received a score of 5. Suggestions like integration of augmented reality (AR), virtual reality (VR), haptic technology along with extracted teeth as a adjunct to the typhodont exercise were received.

**Conclusion** This study suggested that preclinical typhodont exercises help the students in preparing for the upcoming clinical postings. However, the augmentation of typhodont exercise with AR, VR, haptic technology, and use of extracted teeth can furbish the current state of preclinical curriculum for conservative dentistry.

## Keywords

- ▶ typhodont
- ▶ conservative dentistry
- ▶ preclinical
- ▶ augmented reality
- ▶ virtual reality

## Introduction

Dentistry is a blend of surgery with medicine. It focuses more on surgical treatment rather than relying on medicinal methods. These surgeries involve physical removal, repair, or adjustment of the affected organs and tissues via the means cutting and manipulating structures to restore their function. In dentistry, dental caries is the most frequently encountered disease that still remains the prime cause of tooth ache and decay globally.<sup>1</sup> Aside from caries, tooth trauma, injuries, and developmental flaws can all cause a disruption in the normal morphology of the tooth. To deal with and manage such situations in clinical practice, aspiring dentists must have the knowledge, expertise, and abilities to diagnose, treat, and manage dental cases involving caries, trauma, or any type of functional or acquired disability involving the teeth.<sup>2</sup>

Since cavity preparation or cavity cutting is an irreversible process,<sup>3</sup> a dentist must have specialized skills designed to handle the carious lesions which necessitate extensive hands-on training prior to handling patients.

The dental curriculum consists of preclinical exercises designed to prepare students to perform the most exemplary surgical procedure on any human. Mannikins of humans, tooth and head, face and neck region for dentistry, which simulate the human body, are typically used in these exercises. Every future surgeon must be able to work with their hands. These preclinical exercises help to achieve them. Thus, it is critical for every student who aspires to be a surgeon to not only perform but excel at these mannikins because they will soon be replaced by patients with whom the person must excel.

Typhodont are simulated tooth models depicting the tooth morphology and to a very limited extent, its anatomy.<sup>4</sup> These are the types of patient simulators that are currently utilized in the majority of dentistry schools all over the world. They consist of ivory teeth in which the preclinical students perform their cavity preparation with the help of attached mannikins. This kind of process aids in introducing trainees to the correct operating procedures that must be followed when treating patients. However, one of the major drawbacks or limitations of typhodonts is the clinical diversity in tooth morphology, differences in dentitions and occlusions, and preclinical students' performance on typhodont that cannot clearly reflect their performance on a patient in an actual clinical setup.<sup>5</sup>

Studies done previously found that typhodonts play an important role in the students theoretical curriculum.<sup>6,7</sup> Two other researches done revealed that typhodonts are a poor predictor of students clinical performance.<sup>5,8</sup> All these studies done focused mainly on evaluating the role of typhodonts in routine prosthetic crown cutting. There still exists dearth of literature on the assessment of efficacy of typhodont preclinical conservative dentistry exercises in routine clinical practice. The aim of this article is to gauge this literature gap and understand the attitude of dental students and dentists toward the efficacy of preclinical conservative dentistry typhodont exercise in the routine clinical practice.

## Materials and Methods

This study was a cross-sectional survey of dentists and dental students from the Navi Mumbai region. Prior to the start of the study, the Scientific Review Committee (SRC) and the Institutional Ethics Committee (IEC) approval was obtained (Protocol No.: IEC357072022 Version No.: 001). A detailed questionnaire was developed, with questions designed to gauge the individual's attitude and perception of typhodont exercise during the preclinical years. Validation of the questionnaire was done by 10 subject experts.

The questionnaire had 23 close-ended questions. Gender, area of work/study, qualification, and other basic socio-demographic questions were asked, followed by attitude and perception questions. There were nine questions with four different variables such as "yes," "no," "maybe," and "can't comment." Eight Likert scale questions ranging from "1" (least relevant) to "10" were asked (most relevant). The final question was an open-ended question asking for suggestions concerning how to conduct the typhodont exercise (► Fig. 1).

Participants were those who availed informed consent for the study. The following individuals met the inclusion criteria: Endodontists, other dental specialists, general dentists, postgraduate (MDS) students, undergraduate dental students from the third year onwards, and interns students in their first and second years of BDS were excluded from the study because they had not yet had any clinical experience. The questionnaire was distributed via electronic means such as WhatsApp and email. To avoid errors in data quality, participants were asked to respond immediately. Confidentiality of the participants was maintained

## Statistical Analysis

Data collected was compiled on a Microsoft (MS) Office Excel Worksheet and subjected to statistical analysis using an appropriate package like Social Package for Social Sciences (SPSS). Collected data was divided into two groups: group 1: dental students and group 2: dentists. Descriptive statistics like frequency (*n*) and percentage (%) of categorical data, mean and standard deviation of numerical data in each group were calculated. For comparison of data, chi-squared test was used. Responses collected on Likert scale were coded as numerical and the comparison was done using Mann-Whitney U test. Keeping  $\alpha$  error at 5% and beta error at 20%, power at 80%, *p*-value less than 0.05 was considered statistically significant.

## Results

A total of 250 responses were invited as well as collected; thus, a 100% response rate was achieved. Of this, 149 (59.6%) were dental students representing group 1. The remaining 101 (40.4%) were dentists representing group 2, who responded to the questionnaire (► Table 1).

► Table 2 shows comparison of the responses for the questions with variable: "yes," "no," "maybe," and "can't comment." The comparison was done using chi-squared test.

**Study Title: Attitude and Perception of Dental Students and Dentists towards Efficacy of Typhodont Exercise Practiced as a part of Preclinical Conservative Dentistry Curriculum for Routine Clinical Practice**

1. Do you give consent to the following study?  
 Yes  
 No

2. Name: \_\_\_\_\_

3. Gender:  
 Male  
 Female  
 Others

4. Qualification:  
 III-B.D.S. Student  
 IV-B.D.S. Student  
 Intern  
 Post Graduate (M.D.S.) Student  
 Endodontist  
 Dental Practitioner (General Other Specialist)

5. College/Clinic/Hospital Area of Work: \_\_\_\_\_

6. Did you undertake any typhodont exercise during your preclinical years of B.D.S.?  
 Yes  
 No  
 Maybe  
 Can't comment

7. On a scale of 10, how inclined were you towards typhodont exercise?  
 1 2 3 4 5 6 7 8 9 10  
 Least           Most

8. While reviewing the theoretical content, did the typhodont exercise help in easing the learning and understanding process?  
 Yes  
 No  
 Maybe  
 Can't comment

9. On a scale of 1 to 10, how much did it help you during clinical postings?  
 1 2 3 4 5 6 7 8 9 10  
 Least           Most

10. Has it helped you in choosing the correct and appropriate treatment plan for your patients?  
 Yes  
 No  
 Maybe  
 Can't comment

11. Has it helped you in determining the restorative material for your patients' treatment?  
 Yes  
 No  
 Maybe  
 Can't comment

12. Has it allowed you to get oriented to the proper operating position while treating patients?  
 Yes  
 No  
 Maybe  
 Can't comment

13. Has it allowed you to get accustomed to various essential dental equipment?  
 Yes  
 No

Maybe  
 Can't comment

14. On a scale of 1 to 10, how accurate has the typhodont exercise been in stimulating a patient's mouth?  
 1 2 3 4 5 6 7 8 9 10  
 Least           Most

15. On a scale of 1 to 10, how accurate is the simulation of nature of the gingiva?  
 1 2 3 4 5 6 7 8 9 10  
 Least           Most

16. On a scale of 1 to 10, how much confidence did you gain to treat a patient while performing clinical procedure on a typhodont?  
 1 2 3 4 5 6 7 8 9 10  
 Least           Most

17. On a scale of 1 to 10, how much confidence did you gain while performing clinical procedure on a typhodont that you won't expose the pulp while treating a patient in the clinic?  
 1 2 3 4 5 6 7 8 9 10  
 Least           Most

18. Was the exercise helpful in obtaining the initial dentin depth?  
 Yes  
 No  
 Maybe  
 Can't comment

19. On a scale of 1 to 10, how confident were you while performing on a typhodont that you have reached the desired and required cavity depth while treating a patient in the clinic?  
 1 2 3 4 5 6 7 8 9 10  
 Least           Most

20. Have you ever performed restorative procedures on extracted teeth?  
 Yes  
 No  
 Maybe  
 Can't comment

21. Do you think that it is better to perform the preclinical work on extracted teeth rather than typhodonts?  
 Yes  
 No  
 Maybe  
 Can't comment

22. On a scale of 1 to 10, how strongly do you believe that typhodont preclinical exercise helps an individual get used to the restoration procedure while also considering the associated hard and soft tissues of the oral cavity?  
 1 2 3 4 5 6 7 8 9 10  
 Least           Most

23. What suggestion would you like to give in regards to improvement and overall conductance of typhodont exercises at the preclinical levels?  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Fig. 1** Questionnaire Form used.

**Table 1** Frequency and percentage distribution

	Dental students	Dentists
Male	35 (14%)	40 (16%)
Female	114 (45.6%)	61 (24.4)

In this study, 154 (61.6%) participants (85 dental students and 69 dentists) responded that it is better to perform the preclinical work on extracted teeth rather than on typhodont. Two-hundred five (82%) (127 dental students and 78 dentists) participants agreed that the exercise allowed them to get accustomed to various essential dental equipment. One-hundred eighty-two (72.8%) participants (104 dental students and 78 dentists) responded stating that the exercise helped them get oriented to the operating position.

► **Table 3** shows comparison of the responses collected using Likert scale coded as numbers (score). The analysis was done using Mann–Whitney U test. The responses saw a statistically highly significant difference ( $p < 0.01$ ) with higher values in group 1 (dental students) for the question asked for relevance of exercise in clinical postings and clinics (mean value: 8.07 for dental students and 7.85 for dentists). In regard to simulation of gingiva, mean value was 5.53 for dental students and 4.74 for dentists ( $p < 0.01$ ).

The last part of the questionnaire was an open-ended question asking for suggestions in regard to overall conductance of the typhodont exercise and its future prospects. The

respondents answered suggesting the continuation of typhodont exercise along with incorporation of extracted teeth exercises with more in-detailed pathological application or real-life dental caries simulation into the artificial or extracted tooth. Use of augmented reality (AR) and virtual reality (VR) along with haptic technology was also suggested.

**Discussion**

The purpose of our study was to understand the perception of dental students and dentists toward typhodont exercises its relevance in the clinical practice. A study done by Gartenmann et al concluded that preclinical exercise, irrespective of the field, is sufficient to implement skills needed to prepare the students for the clinical environment. However, incorporation of newer and innovative methods is necessary.<sup>9</sup>

Laboratory-based practical is an effective tool used in conjugation with the theoretical lectures.<sup>10</sup> This study showed that majority (85.2%) of dental students and dentists felt that the preclinical exercises help in understanding the theoretical content. Similar results were obtained by Kabra et al where 60% of the students responded were found to ascertain standard of knowledge-based questions.<sup>6</sup> Study done by Gul et al had similar results where 80% of the participants believed the same.<sup>7</sup> Velayo et al also found in their study that the preclinical training on typhodont models and in the classroom was associated with clinical performance of the students.<sup>11</sup>

**Table 2** Responses for attitude and perception toward typhodont exercise

Questions	Options	Groups		Total	p-Value
		Dental students	Dentists		
Did you undertake any typhodont exercise during your preclinical years of BDS?	Can't comment	0	0	0	0.306#
	Maybe	0	1	1	
	No	1	2	3	
	Yes	148	98	246	
While reviewing the theoretical content, did the typhodont exercise help in easing the learning and understanding process?	Can't comment	1	2	3	0.811#
	Maybe	19	13	32	
	No	1	1	2	
	Yes	128	85	213	
Has it helped you in choosing the correct and appropriate treatment plan for your patients?	Can't comment	12	11	23	0.048*
	Maybe	34	32	66	
	No	26	24	50	
	Yes	77	34	111	
Has it helped you in determining the restorative material for your patient's treatment?	Can't comment	9	7	16	0.096#
	Maybe	27	18	45	
	No	36	38	74	
	Yes	77	38	115	
Has it allowed you to get oriented to the proper operating position while treating patients?	Can't comment	7	2	9	0.519#
	Maybe	15	8	23	
	No	23	13	36	
	Yes	104	78	182	
Has it allowed you to get accustomed to various essential dental equipment?	Can't comment	3	2	5	0.335#
	Maybe	12	11	23	
	No	7	10	17	
	Yes	127	78	205	
Was the exercise helpful in obtaining the initial dentin depth?	Can't comment	4	5	9	0.242#
	Maybe	30	15	45	
	No	27	27	54	
	Yes	88	54	142	
Have you ever performed restorative procedures on extracted teeth?	Maybe	2	1	3	0.000**
	No	76	2	78	
	Yes	71	98	169	
Do you think that it is better to perform the preclinical work on extracted teeth rather than typhodonts?	Can't comment	13	8	21	0.292#
	Maybe	39	17	56	
	No	12	7	19	
	Yes	85	69	154	

#represents statistically non significant difference ( $p > 0.05$ )\*represents statistically significant difference ( $p < 0.05$ )\*\*represents statistically highly significant difference ( $p < 0.01$ )

Transition from preclinical to clinical training is very challenging.<sup>12</sup> It is critical for students to gain confidence in their ability to treat patients. In this study, it was projected that majority of the dental students and dentists believed that they gained enough confidence to treat the patient in clinics (mean score: ~7). Similar results were obtained in the

study done by Kabra et al where 94% students stated that the exercise helped them in boosting their confidence and treat patients more efficiently.<sup>6</sup> In this study, most of the dental students and dentists responded that the exercise helped them during their clinical postings (score: 8) which indicates its efficacy in routine clinical practice.

**Table 3** Responses of Likert scale coded as numerical (score)

	Group	n (score)	Mean	SD	SE mean	t-value	p-Value of t-test
On a scale of 1 to 10, how inclined were you toward typhodont exercise?	1	149	8.09	1.633	0.134	1.379	0.169#
	2	101	7.77	2.044	0.203		
On a scale of 1 to 10, how much did it help you during clinical postings?	1	149	8.07	1.697	0.139	0.972	0.332#
	2	101	7.85	1.884	0.187		
On a scale of 1 to 10, how accurate has the typhodont exercise been in simulating a patient's mouth?	1	149	6.72	1.903	0.156	0.932	0.352#
	2	101	6.49	1.993	0.198		
On a scale of 1 to 10, how accurate is the simulation of nature of the gingiva?	1	149	5.53	2.398	0.196	2.654	0.008**
	2	101	4.74	2.152	0.214		
On a scale of 1 to 10, how much confidence did you gain to treat a patient while performing clinical procedure on a typhodont?	1	149	7.20	1.896	0.155	1.986	0.048*
	2	101	6.69	2.111	0.210		
On a scale of 1 to 10, how much confidence did you gain while performing clinical procedure on a typhodont that you won't expose the pulp while treating a patient in the clinic?	1	149	6.52	2.350	0.193	3.097	0.002**
	2	101	5.56	2.439	0.243		
On a scale of 1 to 10, how confident were you while performing on a typhodont that you have reached the desired and required depth while treating a patient in the clinic?	1	149	7.07	1.921	0.157	3.135	0.002**
	2	101	6.21	2.434	0.242		
On a scale of 1 to 10, how strongly do you believe that typhodont preclinical exercise helps an individual get used to the restoration procedure while also considering the associated hard and soft tissues of the oral cavity?	1	149	6.99	2.045	0.168	2.611	0.010*

#represents statistically non significant difference ( $p > 0.05$ ).

\*represents statistically significant difference ( $p < 0.05$ ).

\*\*represents statistically highly significant difference ( $p < 0.01$ ).

However, studies done by Nunez et al and Curtis et al suggest that preclinical exercises are not an indicator of clinical success.<sup>5,8</sup>

Prior to the introduction of typhodont, extracted teeth were preferred for the preclinical exercises. Extracted teeth are superior to typhodont models in terms of texture, morphology, overall tooth anatomy, and radiodensity that lacks in the typhodont models.<sup>13</sup> In this study, a total of 154 (61.6%) dental students and dentists believed that it is better to perform preclinical exercise on extracted teeth rather than typhodont models. This was similar to a study done by Smitha et al where 75% of the students preferred extracted teeth against typhodont teeth. However, due to various factors like unavailability and inability to procure healthy and workable extracted teeth and possible cross infection risks, typhodont seem to serve the purpose without hindering much of the learning.<sup>14</sup>

The main objective of preclinical typhodont exercise is to simulate a clinic-like atmosphere. In this study, it was pointed that the accuracy of typhodont models in simulating the oral cavity was just slightly accurate (mean score: ~6) while for simulation of gingiva and the associated hard and soft tissue was just accurate (mean score: ~5) suggesting scope for betterment in regard to the overall simulation of the oral cavity. The results obtained were similar to a study done by Haralur and Al-Malki where 82.5% suggested

improvements in the simulation ability of the typhodont models in respect to the periodontium, tongue, and the surrounding hard and soft tissues.<sup>15</sup>

In the final question of this questionnaire study, respondents were asked to make suggestions about the overall conductance and future prospects for the typhodont preclinical exercise. Some of the common and relevant suggestions were selected that include using extracted teeth alongside traditional typhodont teeth. Incorporation of simulated dental caries in the teeth for preclinical exercises was also suggested. Many of the respondents suggested using AR, VR and haptic technology. AR is a type of technology that combines a real and virtual environment to provide an interactive experience.<sup>16</sup> VR refers to a computer-simulated environment.<sup>17</sup> Haptic technology, which is a more recent form of technology, involves tactile sensation while interacting with computer-generated objects.<sup>18</sup> Khalaf et al have stated that all these technologies have a potential to improve the current state of learning and performance of undergraduate students during the preclinical years. These tools can be used as an adjunct complementing the currently employed methods.<sup>19</sup>

However, there are certain limitations pertaining to this study that can serve as future prospects. A larger sample size to evaluate a larger population regarding the same is imperative. Also, there is a need for researches focused on

evaluating the student's performance on typhodonts used in preclinical conservative dentistry with their performance in patients. This can give an in-depth and detailed understanding of the efficacy of the typhodonts in the preclinical conservative dentistry curriculum. Studies should be undertaken to assess the usability, efficacy, and accuracy of newer technologies like AR, VR, and haptic technology with respect to conservative dentistry.

## Conclusion

It is critical to solicit feedback from both dental students and dentists to keep the curriculum up to date with the current educational and practical landscape. According to the findings of this study, the majority of dental students and dentists prefer typhodont exercise at the preclinical level to become acquainted with surgical procedures before beginning clinical postings and attending patients. According to the responses from the current study, the typhodont exercise allows an individual to become oriented to chair positions, handle surgical instruments, and gain confidence in performing the clinical procedure. However, simulation of gingiva as well as other oral hard and soft tissue should be improved. Use of typhodont in association with AR, VR, haptic technology, and the use of typhodont along with extracted teeth can prove to polish the current state of preclinical curriculum for conservative dentistry.

### Ethical Approval

Prior to the commencement of the study, appropriate approval for the Institutional Ethical Committee (IEC) was taken under the IEC Number: IEC357072022.

### Patient/Participant Declaration of Consent Statement

Informed consent was obtained from the participants.

### Authors' Contributions

All authors contributed equally in data conception and design, data collected, statistical analysis, manuscript preparation and final approval of the manuscript.

### Data Availability Statement

All the data collected is available with the corresponding author upon request.

### Conflict of Interest

None declared.

## References

- 1 Yadav K, Prakash S. Dental Caries: A Review. *Asian J Biomed Pharm Sci* 2016;6:1–7
- 2 Kutsch VK. Cariology and caries management. In: *Contemporary Esthetic Dentistry*. Mosby; 2012:1–32
- 3 Lee B, Kim JE, Shin SH, et al. Dental students' perceptions on a simulated practice using patient-based customised typhodonts during the transition from preclinical to clinical education. *Eur J Dent Educ* 2022;26(01):55–65
- 4 Perry S, Bridges SM, Burrow MF. A review of the use of simulation in dental education. *Simul Healthc* 2015;10(01):31–37
- 5 Nunez DW, Taleghani M, Wathen WF, Abdellatif HM. Typhodont versus live patient: predicting dental students' clinical performance. *J Dent Educ* 2012;76(04):407–413
- 6 Kabra P, Choudhary E, Bindal N. Impact of preclinical training on students clinical performance: a cross sectional analysis. *Biosci Biotechnol Res Commun* 2020;13(15):200–203
- 7 Gul M, Asghar S, Sami Z. Dental students' perception on preclinical operative dentistry course. *J Bahria Univ Med Dent Coll* 2015;5(04):1789183
- 8 Curtis DA, Lind SL, Brear S, Finzen FC. The correlation of student performance in preclinical and clinical prosthodontic assessments. *J Dent Educ* 2007;71(03):365–372
- 9 Gartenmann SJ, Hofer D, Wiedemeier D, Sahrman P, Attin T, Schmidlin PR. Comparative effectiveness of hand scaling by undergraduate dental students following a two-week pre-clinical training course. *Eur J Dent Educ* 2019;23(01):1–7
- 10 Braga MM, Lenzi TL, Ferreira FR, et al; luSTC Group. Impact of a tutored theoretical-practical training to develop undergraduate students' skills for the detection of caries lesions: study protocol for a multicenter controlled randomized study. *JMIR Res Protoc* 2017;6(08):e155. Doi: 10.2196/resprot.7414
- 11 Velayo BC, Stark PC, Eisen SE, Kugel G. Using dental students' preclinical performance as an indicator of clinical success. *J Dent Educ* 2014;78(06):823–828
- 12 Malau-Aduli BS, Roche P, Adu M, Jones K, Alele F, Drovandi A. Perceptions and processes influencing the transition of medical students from pre-clinical to clinical training. *BMC Med Educ* 2020;20(01):279. Doi: 10.1186/s12909-020-02186-2
- 13 Decurcio DA, Lim E, Chaves GS, Nagendrababu V, Estrela C, Rossi-Fedele G. Pre-clinical endodontic education outcomes between artificial versus extracted natural teeth: a systematic review. *Int Endod J* 2019;52(08):1153–1161
- 14 Smitha D, Tijare MS, Amith H, Gujjar KR, Sharma R. Knowledge, attitude and practice regarding handling of extracted human teeth among students of a dental college in Bhopal. *J Indian Assoc Public Heal Dent* 2014;12(04):276. Doi: 10.4103/2319-5932.147661
- 15 Haralur SB, Al-Malki AE. Student perception about efficacy of preclinical fixed prosthodontic training to facilitate smooth transition to clinical context. *J Educ Health Promot* 2014;3(01):73. Doi: 10.4103/2277-9531.134898
- 16 Wu HK, Lee SWeY, Chang HY, Liang JG. Current status, opportunities and challenges of augmented reality in education. *Comput Educ* 2013;62(01):41–49
- 17 Lee M, Lee SA, Jeong M, Oh H. Quality of virtual reality and its impacts on behavioral intention. *Int J Hospit Manag* 2020;90:102595
- 18 Sreelakshmi M, Subash T. Haptic technology: a comprehensive review of its applications and future prospects. *Mater Today Proc* 2017;4(2, Part B):4182–4187
- 19 Khalaf K, El-Kishawi M, Mustafa S, Al Kawas S. Effectiveness of technology-enhanced teaching and assessment methods of undergraduate preclinical dental skills: a systematic review of randomized controlled clinical trials. *BMC Med Educ* 2020;20(01):286. Doi: 10.1186/s12909-020-02211-4