

# Comparison of oral health behaviour between dental and non-dental undergraduates in a university in southwestern China—exploring the future priority for oral health education

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## Research article

**Keywords:** oral health education, oral health care, dental students, non-dental students

**Posted Date:** June 17th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-22269/v2>

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**Version of Record:** A version of this preprint was published on September 7th, 2020. See the published version at <https://doi.org/10.1186/s12903-020-01232-1>.

# Abstract

**Background:** Based on a national survey in 2015, people's oral health knowledge and attitudes in China have greatly improved after decades of oral health education (OHE). However, dental caries and periodontal disease are still serious oral problems. People's oral health behaviour has not kept up with the pace of knowledge and attitudes. The objective of this study was to determine undergraduates' oral health behaviour status and existing problems by comparing dental students and non-dental students at Sichuan University. We hope to provide some suggestions for future OHE.

**Methods:** A quasi-experimental study designed with a pre-test and a post-test group was conducted. A total of 217 dental students and 135 non-dental students were enrolled. They were given a course of OHE focused on oral health behaviour. A survey about oral health behaviour and knowledge was conducted before and after the course.

**Results:** According to the pre-course survey, dental students surpassed non-dental students in terms of toothbrushing frequency, method, time and flossing. Unfortunately, flossing was overlooked by all the students. After the course, both dental and non-dental students showed strong willingness to improve their oral health behaviour. More non-dental students than dental students were willing to use toothpicks and Chinese herbal toothpaste before and after the course.

**Conclusion:** OHE focused on behaviour plays a positive role for university students. Future OHE and interventions should focus on flossing, toothbrushing methods, toothpicks, Chinese herbal toothpaste and modifications to adopt new media.

## Background

Oral disease is a worldwide epidemic and has imposed a huge burden [1]. The number of people with untreated oral conditions worldwide increased from 2.5 million in 1990 to 3.5 billion in 2015, with a 64.0% increase in disability-adjusted life years due to oral conditions [2]. Among these conditions, untreated dental caries, severe periodontitis, and missing teeth are the three most common and influential oral diseases [1].

Fortunately, most oral diseases, especially dental caries and periodontal diseases, are largely preventable. Among various approaches, the most cost-effective methods are health education and intervention. Oral health education (OHE) has been a part of services for disease prevention since the 1900s [3]. OHE can improve oral health knowledge and attitudes of reducing plaque, gingival bleeding and caries increments [4]. It is also effective in improving behaviour, such as toothbrushing and flossing, to decrease dental plaque accumulation. As a result, OHE can improve oral health to some extent [5].

In China, OHE has been conducted for years. The national campaign "The National Teeth Love Day" was established in 1989 and has proposed a topic for oral health education every year [6]. After decades of effort, the national survey in 2015 showed that approximately 60.0% of citizens had basic knowledge

regarding oral health, and 84.9% of them had a positive attitude [7]. However, the caries rates of children aged 3-5 and elderly people aged 65-74 were 62.5% and 98.0%, respectively, which were much higher than 10 years ago. In addition, 87.4% of adults between 35-44 years old suffered from gingival bleeding [7]. These findings may suggest that people's oral health behaviour had not improved entirely with the pace of knowledge and attitudes in China. The aim is now to strengthen OHE more effectively to improve people's oral health behaviour. Therefore, we need to investigate the current status of the oral health behaviour of Chinese people, identify existing problems and provide solutions for future OHE.

Since 2016, several oral-related policies have been published in China. One policy clearly states that we have to promote OHE in preschool and primary school [8]. In addition, as China is facing the aging population and upcoming social-economic burden resulted from elderly [9], it's urgent to pay more attention on elderly people's OHE. Children are often too young to accept OHE and fail to do well in oral health. Their oral health mainly depends on their parents' correct guidance over a long period of time [10]. Many surveys have revealed that parents' behaviours are associated with children's oral health behaviour [11-13]. Additionally, teacher-led OHE in school is equally effective as dentist-led OHE in improving the oral hygiene status of adolescents [14]. With regard to elderly people, several reports have shown that their oral health is positively correlated with education [15, 16]. China has a large number of elderly and undereducated people [17], which places a great burden on OHE. However, their offspring may contribute to improving the health of elderly people by transferring knowledge and practices [18-20]. Considering that the dentist-to-population ratio is 1:10,000 in China [21], it might be feasible and efficient to educate adults, who assume triple roles as individuals, parents (or teachers) and children, to act as OHE assistants, to improve all people's oral health behaviour.

In-school undergraduates aged 18-22 years are at an important phase of transition from adolescence to adulthood [22], and they will become parents (or teachers) in a few years. The earlier an oral health behaviour is established, the more benefits it will have and the longer it will be retained [23]. Compared to adults who are busy working or feeding children, undergraduates in this age group have more time to receive education. At the same time, because they have a high educational level, they are more capable of accepting OHE. It has been verified that OHE can positively change the behaviour of college students [23]. Furthermore, it is relatively easy to arrange college courses for OHE. Hence, we regard undergraduates as ideal candidates to improve people's oral health behaviour. However, this group was not included in the recent national survey. Therefore, in this survey, we compared the differences in oral health knowledge and behaviours between dental and non-dental students at Sichuan University with the aim of identifying key problems and providing advice on OHE to help undergraduates better perform the role of OHE assistants.

## Methods

### Participants

Third-year undergraduate dental students (in the first year of their professional dental education) were enrolled. The inclusion criteria were a) third-year dental students at Sichuan University and b) agreement to participate in the survey. The exclusion criterion was incorrectly written answers.

Second- to fourth-year non-dental students were also enrolled. The inclusion criteria were a) students at Sichuan University and b) agreement to participate in the survey. The exclusion criteria were a) dental students and b) incorrectly written answers.

A pre-test was conducted on the toothbrushing frequency of dental and non-dental students. In order to estimate the sample size, the method “difference test of rate comparison between two groups” was chosen and the calculator was applied [24]. The sample size was estimated to be more than 110 in each group.

## **Design**

A quasi-experimental survey with a pre-test and a post-test group was conducted for the study.

## **Intervention and instruments**

The dental and non-dental students received the pre-course survey on knowledge and behaviour of oral health before the lecture. The OHE was scheduled in a 90-minute course by the same teacher. The content was designed based on the textbook “Preventive Dentistry” [6] and focused on the aetiology of common oral diseases and specific oral hygiene measures with the aim of improving students’ oral health behaviour. A post-course survey including the same items was conducted.

## **Data collection and analysis**

All the students finished the questionnaires by cell phone or by computer through “Questionnaire Star”. For the scale items in the questionnaire, we used SPSS 16.0 (IBM Corp. New York, NY, USA) to analyse the Cronbach’s alpha coefficient. Six experts (1 professor, 3 associate professors and 2 lecturers) evaluated the content validity [25], clarity, and conciseness of the questionnaires. The data are presented as percentages, means and standard deviations (SDs). The Wilcoxon signed-rank test, chi-square test and Fisher’s exact test were used for statistical analysis with SPSS 16.0.  $P < 0.05$  was regarded as a statistically significant difference.

## **Results**

In the pre-course survey, 217 third-year undergraduate dental students (86 male, 131 female; aged  $21.3 \pm 1.0$  years) and 135 non-dental students (55 male, 80 female; aged  $21.4 \pm 0.8$  years) were enrolled. In the post-course survey, 1 student in the non-dental group was excluded as a result of incorrect writing. The non-dental students were in the second to fourth years. They were from 17 departments of Sichuan University, and their majors are displayed in Fig. 1.

Reliability analysis of the scale items of a simultaneous survey showed that the Cronbach's alpha coefficient was 0.781 for the pre-course survey and 0.711 for the post-course survey. For non-scale items in this survey, the reliability was considered acceptable when the same group completed the questionnaires at the same time. A content validity index (CVI) was calculated for the questionnaire items. The item-level CVIs and the scale-level CVIs were 1.

First, we surveyed the oral health care frequency of dental and non-dental students (Fig. 2). Before the course (Fig. 2c), most students in both groups did well at brushing their teeth twice a day. Up to 71.9% of students in the non-dental group and 40.6% in the dental group never used floss (Fig. 2c). However, the dental group was still significantly better than the non-dental group ( $P=0.000$ ). There was no obvious difference between the two groups in the use of interproximal brushes or toothpicks ( $P>0.05$ ). After the course (Fig. 2d), students tended to brush their teeth twice a day, with an obvious increase in both groups ( $P=0.001$  in the dental group,  $P=0.004$  in the non-dental group). The dental group was more willing to use dental floss or to use it more often ( $P=0.000$ ). However, one-fifth of the non-dental students were still reluctant to floss. Compared to dental students, non-dental students were more willing to use toothpicks ( $P=0.016$ ). In short, the dental group performed better than the non-dental group in toothbrushing and flossing before and after the course. Table 1 shows students' knowledge about water/air flossing. Before the course, both groups were unfamiliar with these tools. The course introduced new flossing equipment to them.

Next, we surveyed the toothbrushing method (Fig. 3a). The number of dental students using the Bass method overwhelmed that of non-dental students ( $P=0.000$ ). One-fifth of the non-dental students were still using the wrong horizontal method, and one-fifth did not know the in-use methods. Table 2 shows the knowledge of the Bass method between the two groups. The results revealed that dental students performed much better than non-dental students before ( $P=0.000$ ) and after ( $P=0.000$ ) the course. Regarding brushing time (Fig. 3b), dental students performed generally better than non-dental students before ( $P=0.000$ ) and after ( $P=0.025$ ) the course. The number of students who were willing to brush their teeth for more than 2 minutes increased in the two groups after the course ( $P=0.001$  in the dental group,  $P=0.000$  in the non-dental group).

We further investigated the types and replacement frequency of toothbrushes (Fig. 4). Before the course, more than half of the students in both groups preferred electric toothbrushes to manual toothbrushes (Fig. 4a). However, the actual usage or willingness to use was lower (Fig. 4b). After the course, more dental students thought electric toothbrushes were better and wanted to use them. With regard to the softness of bristles (Fig. 4c), soft-bristled toothbrushes were favoured after the course ( $P=0.01$  in the dental group,  $P=0.012$  in the non-dental group). Toothbrushes need to be replaced regularly, and most students had a good habit of changing their toothbrushes every 3 months (Fig. 4d). There was no obvious difference in these 2 items between the two groups ( $P>0.05$ ).

Finally, we examined students' considerations when selecting toothbrushes and toothpaste (Fig. 5). Before the course, function and price were the aspects of concern for most students (Fig. 5a, b). After the

course, in both groups, more students realized the importance of function ( $P=0.000$ ), fewer students cared about popularity ( $P=0.000$ ) and fewer students were confused about choosing toothbrushes and toothpaste ( $P=0.000$ ). Regarding the function of toothpaste (Fig. 5c), non-dental students preferred Chinese herbs, whitening and fluoride toothpastes before the course, while dental students preferred fluoride, Chinese herbs and desensitizing toothpastes. After the course, more students chose fluoridated and desensitizing toothpaste in both groups ( $P=0.000$ ). Fewer dental students ( $P=0.000$ ) and more non-dental students ( $P=0.000$ ) were willing to use Chinese herbal toothpaste, and the two groups showed opposite trends.

## Discussion

The 4<sup>th</sup> Chinese National Oral Health Survey showed that people's oral health knowledge and attitudes had been greatly improved, but caries and periodontal diseases remain serious problems, and people's oral health behaviour is far from standard. Oral health behaviour education for adults might be an efficient way of addressing this issue. For some reasons, we focused on undergraduates with the aim of improving themselves and indirectly helping children and elderly people.

Previous study showed that oral health care knowledge and behaviour of dental students were better than non-dental students [26]. For dental students at Sichuan University, education for oral health started in their first year. Some clinical research or practice was open to them, such as the university students' innovation and entrepreneurship training programme. Additionally, some of them had opportunities to get in touch with seniors and obtain information. The third year is the first year of professional dental education. Preclinical education and practice can enhance dental students' knowledge and behaviour of oral health. For non-dental students who had similar general education backgrounds as dental students, the difference might come from preclinical oral health education. Therefore, we used the dental group as a reference to identify the differences or gaps in oral health knowledge and behaviour between the two groups. Additionally, we explored the role of OHE focused on oral health behaviour in both dental and non-dental students by comparing their oral health knowledge and attitudes before and after the course.

The toothbrushing frequency was well known among all the students. However, half of non-dental students did not meet the recommended brushing time of two minutes. Additionally, non-dental students had difficulty selecting a tooth brushing method. The (modified) Bass method, the Roll method, the Fones method and the horizontal method are the most widely used brushing methods [27]. Study has shown that the (modified) Bass technique is effective in controlling dental plaque and alleviating gingival inflammation [28]. The horizontal method, which could result in wedge-shaped defects, is not recommended. However, it is a common method in China. In this survey, less than one-fifth of the non-dental students used the Bass method, but more than two-fifth of them used incorrect methods. From these results, we concluded that although non-dental students had good brushing frequency, their brushing time and actual brushing methods may not be appropriate.

Interproximal cleaning was extremely overlooked by both dental and non-dental students. It was surprising that few dental students floss for daily cleaning. The findings revealed signs of ignorance about interproximal cleaning in China. Floss is so efficient that it can remove up to 80% of plaque [29]. However, floss is comparably difficult to use, which may limit its application [30]. Moreover, toothpicks have a history of more than a thousand years in China and are deeply rooted in Chinese people's minds [31]. Toothpicks are quite popular in China and can easily be found in restaurants and take-away-cutlery. Interestingly, the tendency to use toothpicks increased among non-dental students after the course. OHE on avoiding the use of toothpicks should be strengthened to minimize periodontal damage caused by improper use.

Function and price were the most important considerations when students chose toothbrushes. A study confirmed that electric toothbrushes were more effective than manual toothbrushes [32]. Before the course, more than half of the students in both groups thought electric toothbrushes were better than manual toothbrushes. However, the actual use rate was much lower, especially in the non-dental group. Furthermore, nation-wide usage is much lower. A report showed that the penetration rate of electric toothbrushes in China was only 5%, while in some developed countries, it was more than 15% and even up to 40% [33]. Price might be a possible reason. After the introduction of electric toothbrushes during the course, more students realized their advantages and intended to use them, even at a higher price. If electric toothbrushes are not popular because of their high price, we should strengthen OHE on the use of manual toothbrushes instead of emphasizing the use of electric toothbrushes.

When choosing toothpaste, function and price were also the first two considerations. Interestingly, more non-dental students than dental students were willing to use Chinese herbal toothpaste before and after the course. As a part of traditional Chinese medicine, Chinese herbal toothpaste may have some effects in alleviating gingival inflammation [34] and preventing caries [35]. Chinese have partiality for Chinese herbal toothpaste. Its correct usage should be addressed in future courses on OHE; for example, when facing gingival bleeding caused by periodontitis, relying on herbal toothpaste instead of scaling may worsen the disease.

One issue that cannot be ignored is that some students cared about popularity when choosing toothpaste and toothbrush. This suggests us a new method of OHE: new media. Recently, a large number of popular media platforms have emerged. WeChat, an interactive social media platform in China, has a wide range of young users and is used frequently every day [36]. A study showed that passive acquisition (moments, public accounts, group chat) of health information through WeChat was an important medium for college students [37]. Taobao, a large online shopping platform, is preferred by young people and carries many traditional and emerging oral care products endorsed by celebrities, which is very attractive to young people who are starstruck and pursuing popularity. At the same time, it contains a wealth of pictures, videos and instructions for the products. In addition to traditional classes, WeChat groups, WeChat public accounts and Moments can be used for regular OHE, to be a reminder of flossing and to update new knowledge that is not included in textbook. Taobao links can provide vivid information about oral hygiene products, making OHE much more convenient and cost-effective.

Overall, the majority of students realized their shortcomings in oral health behaviour and had a strong willingness to improve. Our OHE course focused on behaviour played a positive role for university students. Dental students had much better performance than non-dental students in terms of toothbrushing frequency, method, and time and floss use. This suggests that dental students know more details about oral health care. Future OHE should pay more attention to flossing, toothbrushing methods, toothpicks, Chinese herb toothpaste and modifications to adopt new media.

## **Limitations**

As a quasi-experimental study, the grades and sample numbers of dental and non-dental students were different. The post-course survey was conducted within a short period of time. The long-term change in students' knowledge, attitudes and behaviours is unknown. Furthermore, our survey did not include clinical examinations.

## **Conclusion**

According to the pre-course survey, dental students significantly surpassed non-dental students in terms of toothbrushing frequency, method, and time and floss use. Floss was overlooked by all the students. After the course, both dental and non-dental students showed strong willingness to improve their oral health behaviour. Future OHE should focus on flossing, toothbrushing methods, toothpicks, Chinese herbal toothpaste and modifications to adopt new media.

## **Declarations**

### **Acknowledgements**

The authors thank Linglin Zhang for her help in arranging the course. And we also thank all students who participated in our procedures.

### **Funding**

The study was supported by the “Innovation Training Project from SCU Training Programs of Innovation and Entrepreneurship for Undergraduates” (C2020107885) and by the “Research of Graduate Education Reform of Sichuan University (2019)” (Nos YJSJG006)

### **Availability of data and materials**

The main data used to support the findings of this study is included within the article. The datasets generated and analysed during the current study are available from the corresponding author (chengran@scu.edu.cn) on reasonable request.

### **Authors' Contributions**

RC and TH contributed to the design of the study. ML and ZW devoted to the data collection, analysis and manuscript writing. RZ, assisted data collection. RC, TH and SY contributed to manuscript revisions. All authors commit themselves to the crucial revision of the paper and supported the final manuscript for publication.

### **Ethics approval and Consent to Participate**

This study was supported by the Institutional Review Board of the Ethics Committee of West China Hospital of Stomatology, Sichuan University (WCHSIRB-D-2018-092). All the participating students had signed informed consent.

### **Consent for publication**

Written consent from the participants was obtained.

### **Competing interests**

ML, ZW, RZ, LL, SY, RC and TH state that they have no conflict of interest.

## **Abbreviations**

OHE: oral health education; CVI: Content validity index

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## Tables

**Table 1 The knowledge about water/air flossing**

	Dental students	Non-dental students	<i>p</i> <sup>a</sup>
Before lecture	2.83±1.17	2.51±1.05	0.000
After lecture	4.51±0.51	4.31±0.55	0.000
<i>p</i> <sup>b</sup>	0.000	0.000	

Wilcoxon signed-rank test; Scale: 1 (strongly unknown) to 5 (strongly knowledgeable)]

<sup>a</sup> Comparison between dental and non-dental students before and after class

<sup>b</sup> Comparison between students before and after class

**Table 2 Knowledge of the modified Bass method**

	Dental students	Non-dental students	<i>p</i> <sup>a</sup>
Before lecture	4.23±0.75	2.83±1.16	0.000
After lecture	4.75±0.44	4.35±0.49	0.000
<i>p</i> <sup>b</sup>	0.000	0.000	

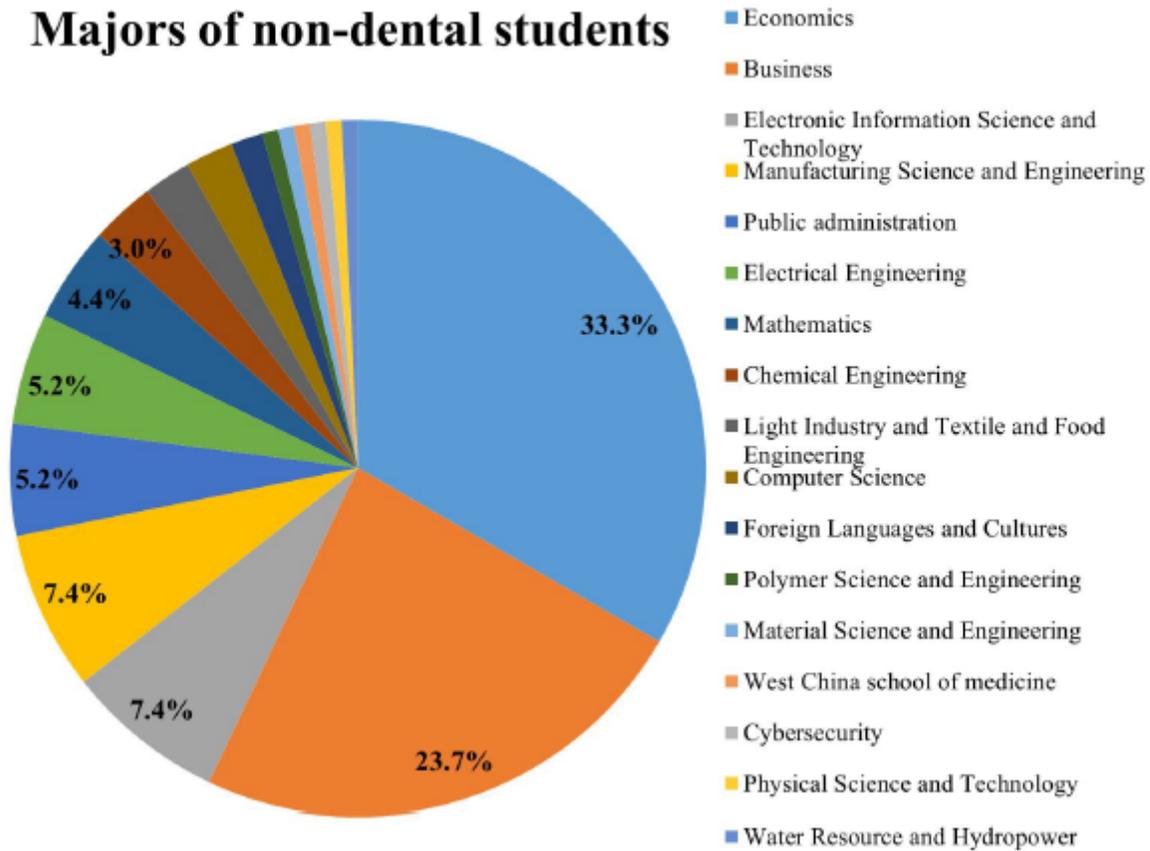
Wilcoxon signed-rank test; Scale: 1 (strongly unknown) to 5 (strongly knowledgeable)]

<sup>a</sup> Comparison between dental and non-dental students before class

<sup>b</sup> Comparison between students before and after class.

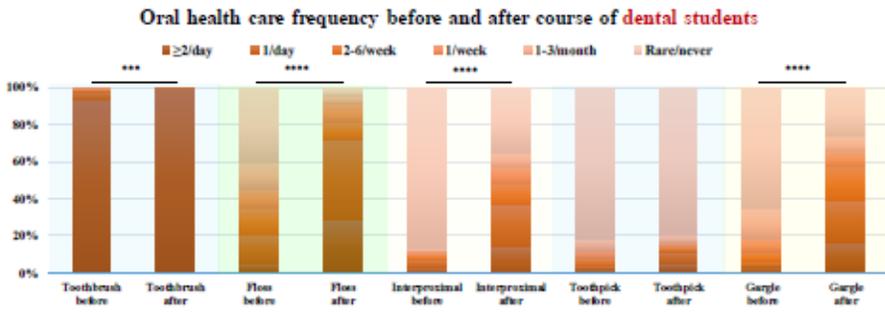
## Figures

# Majors of non-dental students

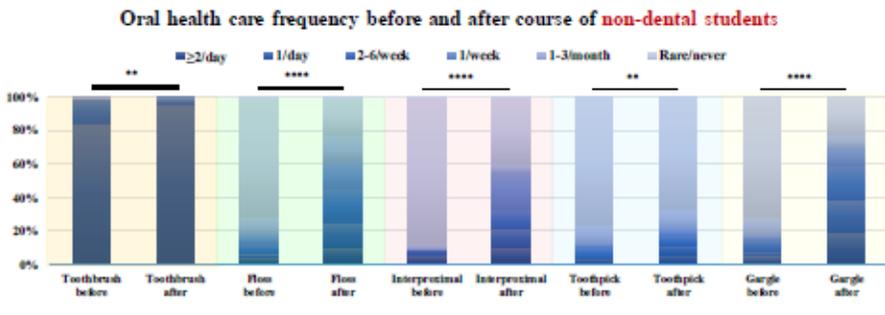


**Figure 1**

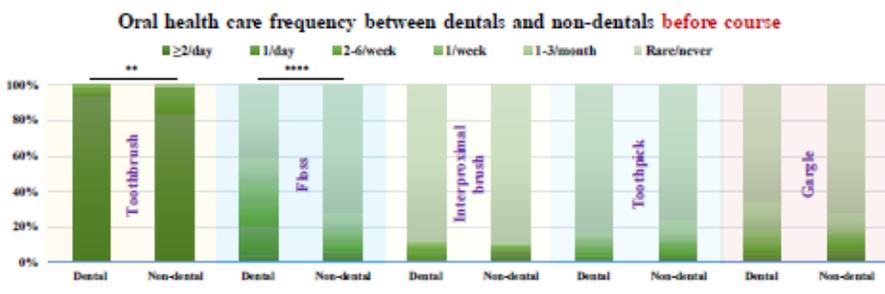
Majors of the non-dental students. The top four were the Department of Economics, Business, Electronic Information Science and Technology and Manufacturing Science and Engineering.



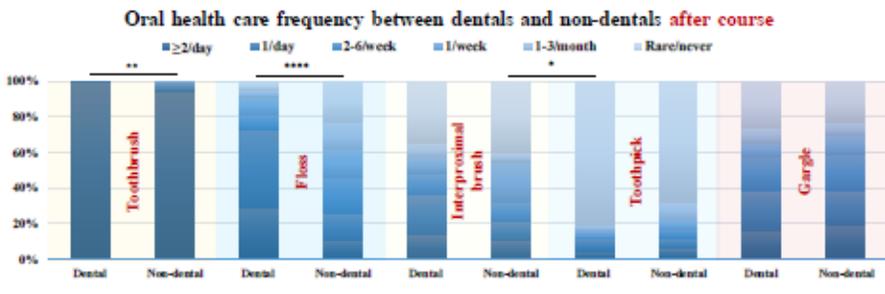
(a)



(b)



(c)

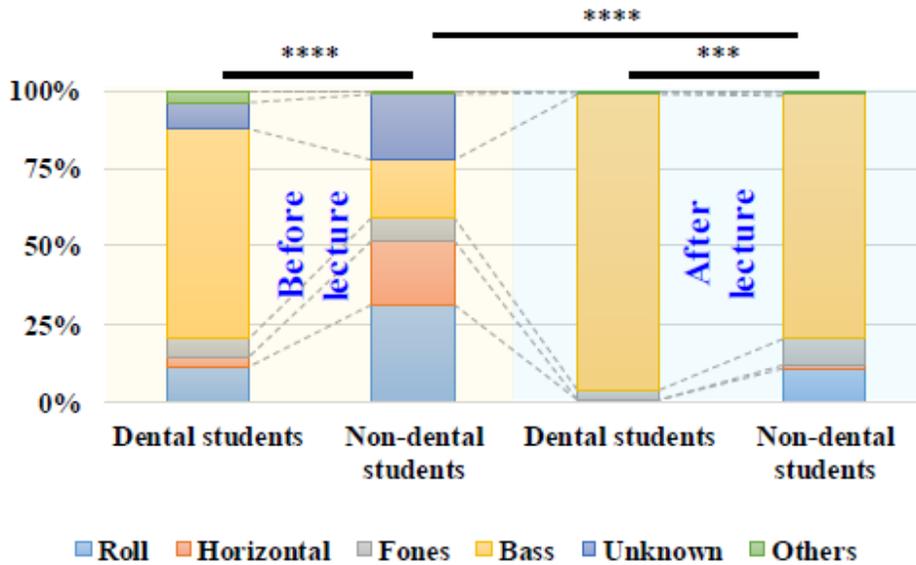


(d)

Figure 2

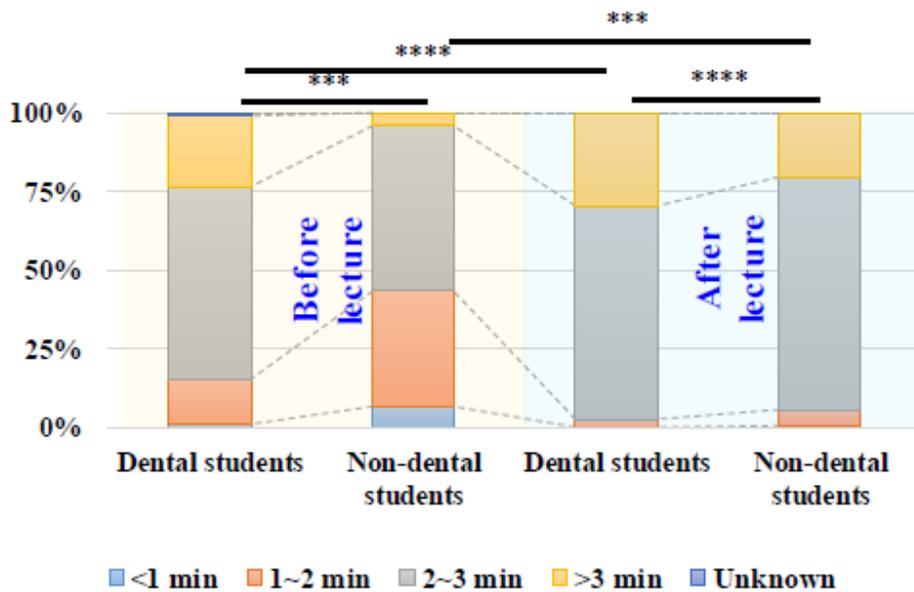
Oral health care frequency before and after course of dental students and non-dental. (a, b) Dental and non-dental students improved a lot in toothbrushing and interproximal cleaning after the OHE-related course. (c, d) Dental students surpassed non-dental students in toothbrushing ( $P=0.004$ ) and flossing ( $P=0.000$ ) before and after course. Non-dental students were more willing to use toothpicks after the course ( $P=0.016$ ). (Wilcoxon signed-rank test; \*\*\*\*,  $P=0.000$ ; \*\*,  $P=0.01$ ; \*,  $P<0.05$ )

### Toothbrushing methods



(a)

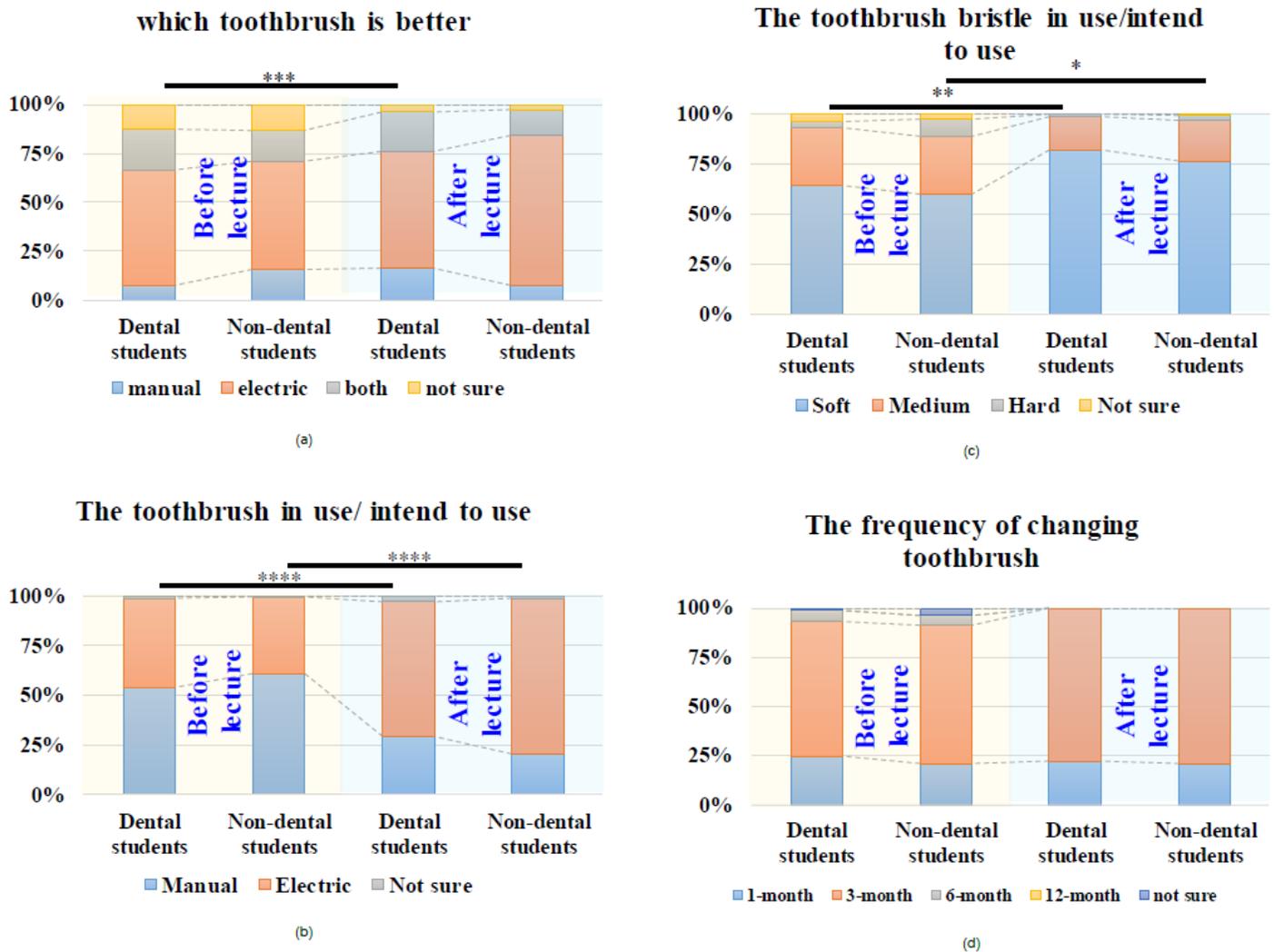
### Toothbrushing time



(b)

Figure 3

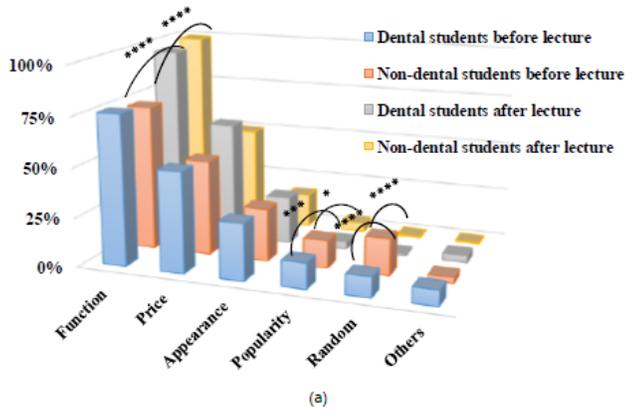
The choice of tooth brushing methods and time. (a) Dental students overwhelmed non-dental students in the use of Bass method( $P=0.000$ ). 20.7% of non-dental students were using the wrong horizontal-method. (b)Dental students performed generally better than non-dental students in toothbrushing time before( $P=0.000$ ) and after( $P=0.025$ ) course. (Wilcoxon signed-rank test; \*\*\*\*,  $P=0.000$ ; \*\*\*,  $P=0.001$ )



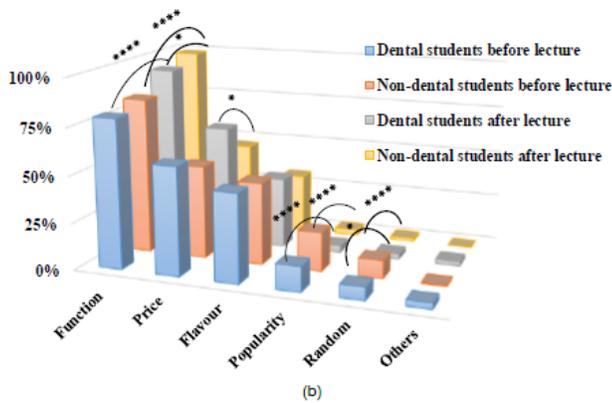
**Figure 4**

The types and replacement frequency of toothbrush of dental students and non-dental students. (a, b) Before the course, most students in both groups preferred electric toothbrush to manual toothbrush. But the actual usage of electric toothbrush was low. After the course, more dental students thought electric toothbrush was better. (c) Soft-bristled toothbrush was favored by more students after the course. (d) There was no obvious difference in the frequency of changing toothbrush between two groups ( $P > 0.05$ ). (Wilcoxon signed-rank test; \*\*\*\*,  $P = 0.000$ ; \*\*\*,  $P = 0.001$ ; \*\*,  $P = 0.01$ ; \*,  $P < 0.05$ )

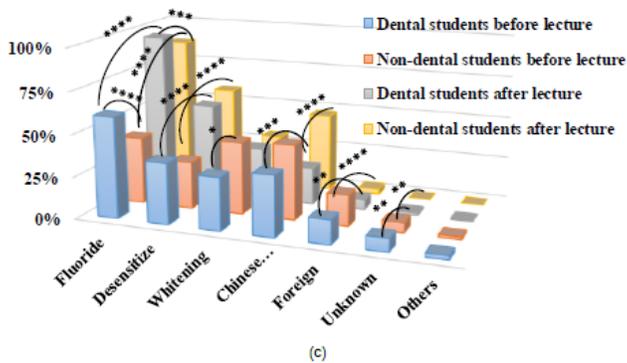
### How to choose toothbrushes



### How to choose toothpastes



### Types of toothpastes



**Figure 5**

Dental students' and non-dental students' considerations when selecting toothbrush and toothpaste before and after course. (a, b) Function and price were the first two considerations. Some students cared about popularity before the course. (c) Non-dental students preferred Chinese herb, whitening and fluoride toothpastes before the course, while dental students preferred fluoride, Chinese herb and desensitize toothpastes. After the course, fewer dental students and more non-dental students were willing to use

Chinese herbal toothpaste( $P=0.000$ ), and the two groups showed opposite trends. (Chi-square test or Fisher's exact test; \*\*\*\*,  $P=0.000$ ; \*\*\*,  $P=0.001$ ; \*\*,  $P=0.01$ ; \*,  $P<0.05$ )