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**Faculty of Dentistry**

The University of Hong Kong

Dental Public Health

## Community Health Project Report 2013

**THE PURSUIT OF BRIGHT SMILE –**

**tooth whitening among Hong Kong young adults**



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Project Title The Pursuit of Bright Smile – tooth whitening among Hong Kong young adults

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**THE PURSUIT OF BRIGHT SMILE –  
tooth whitening among Hong Kong young adults**

**Community Health Project**

**2012/13**

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## 1. ABSTRACT

The main aims of this project were to investigate the interest in and experience of tooth whitening among Hong Kong young adults, and to find out Hong Kong dentists' views on and practice of tooth whitening.

This project was conducted in three parts. The first part involved making visits to different supermarkets and shops to find out what over-the-counter (OTC) tooth whitening products were on sale in Hong Kong. The second part was a survey on young adults aged 18-44 years through conducting face-to-face interviews in different districts throughout Hong Kong using a pilot-tested structured questionnaire. The last part was conducting interviews with a random sample of private general dental practitioners using open-ended questions.

A total of 18 OTC tooth whitening products, including toothpaste, mouth rinse, adhesive strip, varnish, and package, were found in the market. In the survey, a total of 1159 adults satisfying the inclusion criteria were approached and 693 (60%) interviews were conducted. Most (80%) of the interviewees were not satisfied with the color of their teeth. A higher proportion of the women than men were aware of the availability of tooth whitening product/service (76% vs. 58%,  $p < 0.001$ ), had a perceived need for tooth whitening (61% vs. 53%,  $p < 0.001$ ), and used the product/service (56% vs. 42%,  $p < 0.001$ ). Among the users, the most commonly used OTC product was whitening toothpaste (86%) while only 5% had tried tooth bleaching provided by dentists. Around 70% of the OTC product users were dissatisfied with the outcome, mainly not white enough; while 78% reported that their experience was different from the product manufacturers' claims. Thirty dentists were interviewed in this project and most of them did not recommend their patients to use OTC tooth whitening products and they doubted the effectiveness of these products. Both the provision of in-office tooth bleaching and prescription of bleaching agents for home-use were common.

It is concluded that the awareness and perceived need of tooth whitening among Hong Kong young adults are high. The use of whitening toothpastes is common but not the other OTC products or professional tooth bleaching. Most of the users of OTC tooth whitening products are not satisfied with the whitening outcome. Most dentists in Hong Kong provide tooth bleaching but they do not recommend the use of OTC tooth whitening products.

## **2. INTRODUCTION**

Tooth colour is one of the factors affecting a person's dental aesthetics. A study in the USA found that 34% of the adults were not satisfied with their tooth colour,<sup>1</sup> while a local study in Hong Kong showed that 42% of the interviewees were dissatisfied with the colour of their tooth and 37% expressed a need to whiten their teeth.<sup>2</sup>

Tooth discoloration is one of the most common reasons that patients seek dental care. Tooth discoloration is caused by staining and can be classified, according to the location of the stain, as either extrinsic or intrinsic.<sup>3</sup> Extrinsic discoloration is caused by stains located on the surface of a tooth. It is formed either directly by incorporation of chromogenic compounds into the dental pellicle or indirectly by chemical reaction between different compounds at the tooth surface. Factors causing direct staining include a diet rich in coffee, tea, red wine or other beverages. Another common cause is smoking. These habits are quite common among Hong Kong adults. Intrinsic stain is located deeper within a tooth, caused by either a change in the structural composition or thickness of the enamel and/or dentine, or by incorporation of chromogens into the hard tissues. Intrinsic discoloration can happen during or after odontogenesis, and can originate from the pulp or the tooth surface. Pre-eruptive causes include hereditary medical conditions (e.g. amelogenesis imperfecta), trauma to the developing tooth germ, intake of tetracycline, and dental fluorosis. Post-eruptive factors include dental caries, amalgam restorations, pulpal necrosis, and root canal treatment.

### **2.1. Tooth whitening products and services**

Tooth whitening is defined as any process that make a tooth appear whiter and this can be achieved by either physical or chemical means. Tooth bleaching is a chemical means of tooth whitening which uses peroxides to remove both extrinsic and intrinsic stains from the tooth, while non-bleaching tooth whitening utilizes mechanical and/or chemical means to remove extrinsic stain only.<sup>4</sup>

In Hong Kong, methods of tooth whitening can be broadly divided into two major categories: over-the-counter (OTC) tooth whitening products and professional bleaching by dentists. Mild extrinsic stain can be removed by polishing the tooth surface while stubborn



extrinsic stain and most intrinsic stains need to be tackled by chemical means like bleaching. Deep intrinsic stains cannot be easily removed and invasive dental procedures like partial or full coverage aesthetic crowns or veneers are commonly used. When people in Hong Kong want to have their teeth whitened, they can choose between OTC tooth whitening products or professional bleaching by dentists. The current OTC tooth whitening products sold in Hong Kong include whitening toothpaste, whitening mouth rinse, whitening adhesive strip, whitening powder, whitening varnish, and whitening package (gel and tray). These products whiten teeth by mechanical and/or chemical means, through the use of abrasives and/or peroxides, respectively. There are two types of professional tooth bleaching performed by dentists in Hong Kong: in-office chair-side bleaching and prescription of home-use bleaching agents. The two types of bleaching work by similar chemical means but use different concentrations of peroxides.

## **2.2. Mechanisms of tooth whitening**

In the mechanical approach, the extrinsic stains on tooth surface are solubilized or loosened by surface active agents and subsequently removed by abrasives.<sup>5</sup> Abrasives that have been used in toothpastes include: finely divided amorphous silica ( $\text{SiO}_2$ ), precipitated chalk ( $\text{CaCO}_3$ ), calcium phosphates (e.g. dicalcium phosphate dehydrate), hydrated silica, aluminium oxide, sodium bicarbonate, and perlite. The combination of mechanical toothbrush bristle action and abrasives not only removes plaque and dental pellicle but also the superficial layer of stained enamel (polishing action) and even the softer dentine, in some cases causing abrasive wear.<sup>6</sup> The removal of pellicle can also prevent further stain uptake. There are different formulations of abrasives. For example, the addition of perlite into silica-based or chalk-based toothpastes is said to enhance stain removal and prevention without causing excessive wear to enamel and dentine.<sup>7</sup>

While tooth brushing with toothpaste containing abrasives may help to remove mild extrinsic stain, the removal of localized areas of intrinsically stained superficial enamel is better achieved by enamel microabrasion. Examples of such tooth discoloration include mild fluorosis and/or enamel hypoplastic areas. Enamel microabrasion is a dental treatment that involves the use of dilute hydrochloric acid and pumice with either hand instrument or slow-speed handpiece.<sup>8</sup>

In the chemical approach, both the OTC bleaching products and the professional administered bleaching agents contain either hydrogen peroxide ( $H_2O_2$ ) or carbamide peroxide as the active ingredient. Usually, the professional administered bleaching agents use higher concentrations of peroxide than the OTC products. In an aqueous medium, carbamide peroxide releases 33-35% of  $H_2O_2$  as well as urea. The mechanism of tooth bleaching involves the chemical reaction of  $H_2O_2$  and urea with the organic components of enamel, including the stains. Urea degrades the organic components, creating some spaces for the diffusion of  $H_2O_2$  through the whole thickness of enamel up to the dentino-enamel junction (DEJ).  $H_2O_2$  and its derived free radicals cross the DEJ and in the subjacent dentine oxidize and decolorize the chromophores, pigments, and ions that cause staining.<sup>9</sup>

The known side effects of tooth whitening include transient post-treatment dental hypersensitivity due to increased permeability of enamel and dentine, and irritation to gingival tissues and oral mucosa. There is also evidence showing that bleaching can cause small defects at the surface and subsurface of enamel. Root resorption may be induced in the cervical area of a non-vital tooth. In addition, tooth whitening can affect existing dental restorations and cause release of mercury from amalgam fillings or alter the interface between the tooth and glass ionomer cement or resin composite. It can also cause transient gastric disturbance when a tray is poorly adapted and peroxide is ingested.<sup>9</sup>

### **2.3. Reasons for conducting this study**

Tooth whitening in Hong Kong was described in a few previous local studies.<sup>2,10</sup> However, recently a large number of tooth whitening products and advertisements appeared and we expected that there would be increased awareness, perceived need, and demand on tooth whitening among the people in Hong Kong. We also concerned whether the general public had sufficient knowledge of the side effects of tooth whitening. As indicated in a previous study, less than half of the Hong Kong people knew about gum irritation and tooth sensitivity after bleaching.<sup>10</sup> We were interested in finding out the current knowledge of the general public on the side effects of tooth bleaching and the proportion of Hong Kong people having experienced side effects after using OTC tooth whitening products or receiving professional bleaching treatments.

In a study conducted in Hong Kong around 10 years ago,<sup>2</sup> only 40% of the interviewees were satisfied with the OTC whitening products they had used. Given the increased varieties of OTC products, we expected there would have been changes in the utilization of and satisfaction with these products. A new study would be required to find out the recent situation.

In the local study conducted in 2002, dentists' recommendation was the most important factor which people would consider before purchasing tooth whitening products.<sup>2</sup> A more recent study conducted in Hong Kong in 2007 found that only 33% of the interviewees received information of OTC products from dentists.<sup>10</sup> Since professional advice can significantly alter people's choice of tooth whitening products, it would be interesting to investigate the local dentists' views towards different tooth whitening products and methods available in Hong Kong.

### **3. AIMS AND OBJECTIVES**

The main aims of this community health project were to investigate the interest in and experience of tooth whitening among Hong Kong young adults, and to find out the Hong Kong dentists' views on and practice of tooth whitening.

The objectives of this study were:

1. to describe the different methods of tooth whitening available in Hong Kong;
2. to describe the awareness and perceived need of tooth whitening among Hong Kong young adults;
3. to describe the young adults' use of and satisfaction with different methods of tooth whitening; and
4. to describe Hong Kong dentists' opinions on, provision of, and advices to patients on tooth whitening.

## **4. MATERIALS AND METHODS**

### **4.1. Methods of tooth whitening in Hong Kong**

#### **4.1.1. Over-the-counter (OTC) products**

Visits to different supermarkets, and personal health care and beauty product shops, including the main supermarket chains, were made at the end of 2012 to find out what OTC tooth whitening products were sold to the public in Hong Kong. Product information including name, ingredients, instructions for use, and manufacturer's claims were recorded. Photographs of the products were taken.

#### **4.1.2. Professional bleaching by dentists**

There are two types of professional bleaching treatments provided by dentists in Hong Kong, namely in-office bleaching and prescription of home-use bleaching agents. Local dental product suppliers were contacted through telephone to ask for the information of bleaching products used by dentists. Further information of the products available for the local dentists was searched on the Internet and publications.

### **4.2. Interview of young adults**

#### **4.2.1. Study population**

The study population was Hong Kong Chinese young adults. The inclusion criterion was that the interviewee should be aged between 18 and 44 years (both ends inclusive). Both gender groups were included. A person with major difficulties in communicating in Chinese (Cantonese) would be excluded from the interview.

#### **4.2.2. Questionnaire used in the interview**

Development of the questionnaire used in the interview started by a search on the literature about studies on tooth whitening. Questions were designed with reference to the aims and objectives of this project. A draft questionnaire was formulated and two rounds of pilot tests were carried out in late 2012 and early 2013 in different districts in Hong Kong, namely: Causeway Bay, Mongkok, and Shatin. In each round of testing, 30 interviews were conducted in each site.

In the first pilot test we used a questionnaire with only four questions. The main purpose of this pilot test was to find out how young adults in busy streets would respond to a request for a short interview and to estimate the time needed to conduct an interview. The information obtained was useful when we later decided on the sample size for the main survey. Wordings of the four questions were modified after the first pilot test, in response to the feedback obtained. The second pilot test was conducted to find out if young adults would have problems understanding the questions asked and to practice our interviewing technique. With reference to the information obtained in this pilot test, the content of the questionnaire and the wordings of each question were revised as necessary. The questionnaire for the main survey was then finalized. The approach and words used in the interview were also standardized for all the interviewers.

The final questionnaire included 20 questions divided into four parts. It was written in Chinese (Appendix 1), and an English translation can be found in Appendix 2. The first part of the questionnaire (Section A) contained five questions on the interviewees' perception of their own tooth colour, and their awareness of, interest in, and use of tooth whitening products and services. The next two parts of the questionnaire each contained six questions on the interviewees' experience of and satisfaction with the use of OTC tooth whitening products (Section B) and professional tooth bleaching services (Section C), respectively. The last part of the questionnaire (Section D) contained three simple questions on the interviewees' background: age, gender, and education level.

#### **4.2.3. Conducting the interviews**

The face-to-face interviews of young adults were conducted on different days in February and March 2013 in six districts, two each from the three main geographical areas of Hong Kong. They were Causeway Bay and Admiralty on Hong Kong Island; Tsim Sha Tsui and Mongkok in Kowloon; and Shatin and Tsuen Wan in the New Territories. The sites chosen for the interviews were in the busy streets outside large shopping malls or exits of MTR stations.

Young adult pedestrians who were not in a hurry were invited for the interview. Those satisfying our inclusion criterion, i.e. aged between 18 and 44 years, were asked about their

awareness of tooth whitening. Colour photographs of the common OTC tooth whitening products (Appendix 3) were shown to the interviewees in the interview to facilitate their understanding of the questions asked. Interviewees who were aware of tooth whitening were then asked about their knowledge of the side effects of tooth whitening. Those who had used OTC tooth whitening products and/or professional bleaching by dentists were asked questions in Part B and/or Part C of the questionnaire to further find out their experience and satisfaction.

#### **4.2.4. Sample size and data analysis**

Taking into consideration of the time and resources limitation for this project and the need to have adequate number of interviewees in different demographic background and user categories for meaningful data analysis, a sample size of 700 successful interviews was selected.

The data collected in the interviews were entered into a personal computer and analyzed using the statistical software Statistical Package for Social Sciences (SPSS) version 20. The entered data were proofread and checked for errors. All data entry errors were corrected before data analysis. Frequency tables and crosstabs were generated to summarize and analyze the data collected. Chi-square test was used to assess the statistical significance of the differences in distribution of the interviewees' answers between groups and the p-value was set at 0.05.

### **4.3. Interview of dentists**

#### **4.3.1. Study population and sampling method**

General dental practitioners with 10 to 30 years of experience and working in the private sector were selected for the interview. The list of registered dentists in Hong Kong (updated on 4<sup>th</sup> February 2013) was provided on the website of the Hong Kong Dental Council. It consisted of 2052 dentists in 261 pages. Due to time and resources constraints, the planned sample size was 40 successful interviews. A dentist fulfilling the inclusion criteria was chosen from every six pages, using a systematic random sampling procedure. Phone calls were made to the selected dentist's clinic to invite the dentist for an interview. Due to a low response rate, substitution of the refusal cases was employed, in which the first dentist satisfying the inclusion

criteria on the first, second, fifth, and sixth page of every 6 pages were selected in sequence. The order was determined by randomly drawing a numbered card from a pack of six.

#### **4.3.2. Questions used in the interview**

Six open-ended questions were used in the interviews with the dentists. The questions were on the dentist's opinions on different types of OTC tooth whitening products and their provision of tooth bleaching service. Pilot test of the questions was carried out on our part-time clinical teachers who satisfied the inclusion criteria of this study. Feedback obtained in the pilot test showed that no amendment to the questions was necessary. The interview questions in Chinese and in English can be found in Appendix 4.

#### **4.3.3. Conducting the interviews**

Options of conducting the interview face to face in their clinic or over the phone were given to the selected dentists. Each interview lasted for around 15 minutes. Color photographs of OTC tooth whitening products (Appendix 3) were shown to the dentists to facilitate their understanding of the questions. Since the questions were open-ended, the dentist's answers were recorded on paper by the interviewer. If a selected dentist could not find time to have an interview, the questions were sent to the dentist through e-mail and the dentist would give the answers in a reply e-mail.

#### **4.3.4. Data analysis**

Answers of the dentists collected in the interviews were typed into a Microsoft Word document and the information was summarized by grouping similar answers/views together. For each question, proportions of the respondent dentists with similar answers were calculated.



## 5. RESULTS

### 5.1. Methods of tooth whitening

#### 5.1.1. Over-the-counter products

A total of 18 OTC products for tooth whitening were found in our visits to the supermarkets and personal health care and beauty product shops in Hong Kong. Their names, main ingredients, manufacturer's claims, and mechanism of tooth whitening are tabulated in Table 1.

Table 1. Over-the-counter tooth whitening products in Hong Kong.

|   | <b>Product Name</b>                              | <b>Main ingredients</b>   | <b>Claims</b>  | <b>Mechanism</b>   |
|---|--|---|--|--|
| 1 | Colgate Optic White Toothpaste                   | Calcium pyrophosphate, tetrasodium pyrophosphate, silica, hydrogen peroxide | Improve 1 shade grade in 1 week  | Mechanical and chemical stain removal;<br>Chemical bleaching |
| 2 | Darlie Expert White Toothpaste                   | Silica, mica, pentasodium triphosphate, tetrasodium pyrophosphate           | No damage to enamel;<br>Can prevent up to 80% more surface stain than regular toothpaste | Chemical and mechanical stain removal                        |
| 3 | Crest 3D White Luxe Toothpaste                   | Silica  | Brighten in just 1 day;<br>Remove 90% of surface stain in 5 days                         | Mechanical stain removal                                     |
| 4 | Aquafresh toothpaste                             | Silica, mica, titanium dioxide  | Nil  | Mechanical stain removal                                     |
| 5 | Pearl Drops Gloss Tooth Whitener (Toothpaste)    | Silica, alumina, pentasodium triphosphate, 6-pentapotassium triphosphate    | Can see difference in 3 weeks  | Mechanical and chemical stain removal                        |
| 6 | Pearl Drops Replenishing White Liquid Toothpaste | Silica  | Nil  | Mechanical stain removal                                     |
| 7 | Pearl Drops Extra Whitening Toothpaste           | Silica, calcium pyrophosphate, titanium dioxide                             | Result can be seen in a few weeks  | Mechanical and chemical stain removal                        |
| 8 | White T Whitening Treatment Toothpaste           | <i>Direct Blu-ray technology Micro crystal</i>                              | Nil  | Unknown  |

Table 1 (continue). Over-the-counter tooth whitening products in Hong Kong.

|    | <b>Product Name</b>                                      | <b>Main ingredients</b>  | <b>Claims</b>   | <b>Mechanism</b>                      |
|----|--|--|---|---------------------------------------|
| 9  | Dentists' Plus White Toothpaste                          | Silica, sodium tripolyphosphate, titanium dioxide                              | Nil   | Mechanical and chemical stain removal |
| 10 | Colgate Optic White Mouthrinse                           | Tetrasodium pyrophosphate, tetrapotassium pyrophosphate                        | Nil   | Mechanical and chemical stain removal |
| 11 | White-T Professional Teeth Whitening Rinse               | Blue-ray Micro compound  | Nil   | Unknown                               |
| 12 | 3D Crest White Strip                                     | 10% Hydrogen peroxide  | Start seeing result in 3 days which lasts for 12 months   | Chemical bleaching                    |
| 13 | AMP Flesh 360° Smile Whitener (Varnish)                  | 6% Hydrogen peroxide   | Not causing damage to teeth and tooth sensitivity         | Chemical bleaching                    |
| 14 | White-T Intensive Whitening Treatment (Varnish)          | Blue-ray Polishing Compound crystal<br>Direct Blu-ray technology Micro crystal | Nil   | Unknown                               |
| 15 | Magic smile B1 teeth whitening pen and balm (Varnish)    | 6% Hydrogen peroxide   | Can whiten teeth by 5-10 shades in 7 days                 | Chemical bleaching                    |
| 16 | White-T Teeth Whitening And Polishing Kit (Powder)       | <i>BMC (Blue-ray micro compound)</i>   | Nil   | Unknown                               |
| 17 | AMP Plus Smile Whitener (Package)                        | 16% Carbamide peroxide   | Should be recommended by medical professionals before use | Chemical bleaching                    |
| 18 | DR. White – Ultra magic tooth whitening system (Package) | 22% Carbamide peroxide   | Nil   | Chemical bleaching                    |

### 5.1.2. Professional bleaching by dentists

Information of products used for in-office bleaching and bleaching on prescription was obtained from the local dental product suppliers. Their names, manufacturers, and main ingredients are tabulated below in Table 2.

Table 2. Products for professional bleaching available in Hong Kong.

|   | <b>Product Name</b>                 | <b>Manufacturer</b> | <b>Use</b> | <b>Main ingredients</b>  |
|---|-------------------------------------|---------------------|------------|--|
| 1 | BriteSmile                          | BriteSmile          | In-office  | 15% hydrogen peroxide  |
| 2 | Opalescene Boost                    | Ultradent           | In-office  | 40% hydrogen peroxide  |
| 3 | Polanight                           | SDI                 | Home       | 10/16/22% carbamide peroxide                                       |
| 4 | Opalescene Take Home Whitening Gels | Ultradent           | Home       | 10/15/20/35% carbamide peroxide with or without potassium fluoride |
| 5 | Nite White ACP                      | Discus Dental       | Home       | 10/16/22% carbamide peroxide or 6% hydrogen peroxide (Turbo)       |
| 6 | LUMIBRITE Take Home                 | Den-Mat             | Home       | 16/22/32% carbamide peroxide                                       |

## 5.2. Interview of young adults

### 5.2.1. Background of the interviewees

A total of 1159 young adults were invited for an interview on the streets in the different survey sites and 693 interviews were completed. The response rate was 59.8%.

The demographic backgrounds of the respondents are summarized in Table 3. There were more female (401, 57.9%) than male (292, 42.1%) interviewees in this survey. Most (57.6%) of the interviewees were in the age group 18-24 years, and around half (51.8%) were pursuing or had obtained a university degree.

Table 3. Background of the interviewees (N=693).

| Background               |                          | No. of subjects (%) |
|--------------------------|--------------------------|---------------------|
| <b>Gender</b>            | Male                     | 292 (42.1%)         |
|                          | Female                   | 401 (57.9%)         |
| <b>Age group (years)</b> | 18-24                    | 399 (57.6%)         |
|                          | 25-34                    | 243 (35.1%)         |
|                          | 35-44                    | 51 (7.3%)           |
| <b>Education level</b>   | Secondary school         | 109 (15.7%)         |
|                          | Post-secondary           | 225 (32.5%)         |
|                          | Bachelor degree or above | 359 (51.8%)         |

### 5.2.2. Perception of tooth colour

Regarding the colour of their teeth, most (80.2%) of the interviewees thought that their teeth were not white enough. There were no statistically significant differences regarding this perception between the two gender groups or between the three age groups. However, it was found that the percentage of interviewees who thought their teeth were not white enough decreased with the interviewee's education level (Table 4).

Table 4. Perception of tooth color according to education level of the interviewees.

| Education level          | Do you think your teeth are white enough? |             |
|--------------------------|---|-------------|
|                          | Yes<br>N (%)                              | No<br>N (%) |
| Secondary school         | 14(12.8%)                                 | 95 (87.2%)  |
| Post-secondary           | 38(16.9%)                                 | 187(83.1%)  |
| Bachelor degree or above | 85(23.7%)                                 | 274 (76.3%) |

Chi-square test,  $p=0.019$

### 5.2.3. Knowledge of tooth whitening

The relationship between knowledge of tooth whitening and gender is shown in Tables 5 and 6. Most (68.4%) of the interviewees knew what tooth whitening is. The most common source of information was from TV (45.4%), followed by newspaper and magazines (22.1%). Gender was found to be related to knowledge on tooth whitening. Proportionally more woman than men (76.1% vs. 57.9%,  $p<0.001$ ) had knowledge about tooth whitening. Significantly higher proportions of women than men had obtained information about tooth whitening from TV, newspaper and magazines, and poster in shops. Proportionally more woman than men (50.1% vs. 33.2%,  $p<0.001$ ) were aware of the side effects after using tooth whitening products or bleaching services, particularly about tooth sensitivity.

Age and education level also showed a significant relationship with knowledge of tooth whitening. It was found that 82.4% of the interviewees aged 35-44 years knew what tooth whitening is, while the corresponding proportions for the 25-34 and the 18-24 year-old groups were 74.1% and 63.2%, respectively (Chi-square test,  $p=0.001$ ). Furthermore, 33.9% of the interviewees with secondary school education level knew that tooth whitening products had side effects, and the percentage increased to 38.2% for those with post-secondary level, and to 48.7% for those with bachelor degree or above ( $p=0.024$ ).

Table 5. Interviewees' knowledge of tooth whitening and the source of information.

| <b>Do you know what tooth whitening is? If yes, where do you obtain this information?</b> | <b><u>Men</u><br/>N (%)</b> | <b><u>Women</u><br/>N (%)</b> | <b><u>Total</u><br/>N (%)</b> | <b>Sig.</b>       |
|---|-----------------------------|-------------------------------|-------------------------------|-------------------|
| <b>No</b>   | <b>123 (42.1%)</b>          | <b>96 (23.9%)</b>             | <b>219 (31.6%)</b>            | <b>p&lt;0.001</b> |
| <b>Yes</b>  | <b>169 (57.9%)</b>          | <b>305(76.1%)</b>             | <b>474 (68.4%)</b>            |                   |
| - TV  | 113 (38.7%)                 | 202 (50.4%)                   | 315 (45.4%)                   | p=0.002           |
| - Newspaper & magazines   | 44 (15.1%)                  | 109 (27.2%)                   | 153 (22.1%)                   | p<0.001           |
| - Internet  | 31 (10.6%)                  | 51 (12.7%)                    | 82 (11.8%)                    | n.s.              |
| - Posters in shops  | 9 (3.1%)                    | 34 (8.5%)                     | 43 (6.2%)                     | p=0.004           |
| - Dentists  | 44 (15.1%)                  | 49 (12.2%)                    | 93 (13.4%)                    | n.s.              |
| - Others  | 13 (4.5%)                   | 14 (3.5%)                     | 27 (3.9%)                     | n.s.              |

Table 6. Interviewees' knowledge of side effects of using tooth whitening products.

| <b>Do you think there is any side effect of using tooth whitening products? If yes, what are the side effects?</b> | <b><u>Men</u><br/>N (%)</b> | <b><u>Women</u><br/>N (%)</b> | <b><u>Total</u><br/>N (%)</b> | <b>Sig.</b>       |
|--|-----------------------------|-------------------------------|-------------------------------|-------------------|
| <b>No</b>  | <b>72 (24.7%)</b>           | <b>104 (25.9%)</b>            | <b>176 (37.1%)</b>            | <b>p&lt;0.001</b> |
| <b>Yes</b>   | <b>97 (33.2%)</b>           | <b>201 (50.1%)</b>            | <b>298 (62.9%)</b>            |                   |
| - Gum damage   | 32 (11.0%)                  | 46 (11.5%)                    | 78 (11.3%)                    | n.s.              |
| - Tooth damage   | 47 (16.1%)                  | 85 (21.2%)                    | 132 (19.0%)                   | n.s.              |
| - Tooth sensitivity  | 50 (17.1%)                  | 117 (29.2%)                   | 167 (24.1%)                   | p<0.001           |
| - Toxic/carcinogenic   | 19 (6.5%)                   | 25 (6.2%)                     | 44 (6.4%)                     | n.s.              |

#### 5.2.4. Perceived need for tooth whitening

The percentage distribution of interviewees' perceived needs for tooth whitening is shown in Table 7. Proportionally more woman than men (61.3% vs. 53.1%,  $p=0.03$ ) felt a need to whiten their teeth. Proportionally more women chose personal preference as their main reason ( $p=0.01$ ), while proportionally more men chose work requirement or social need ( $p=0.042$ ).

Table 7. Interviewees' perceived need for of tooth whitening.

| <b>Do you think you need tooth whitening? If yes, what are the reasons?</b> | <b>Men<br/>N (%)</b> | <b>Women<br/>N (%)</b> | <b>Total<br/>N (%)</b> | <b>Sig.</b>                |
|---|----------------------|------------------------|------------------------|----------------------------|
| <b>No</b>   | <b>137 (46.9%)</b>   | <b>155 (38.7%)</b>     | <b>292 (42.1%)</b>     | <b><math>p=0.03</math></b> |
| <b>Yes</b>  | <b>155 (53.1%)</b>   | <b>246 (61.3%)</b>     | <b>401 (57.9%)</b>     |                            |
| - Personal preference   | 119 (40.8%)          | 216 (53.9%)            | 335 (48.3%)            | $p=0.01$                   |
| - Work requirement  | 24 (8.2%)            | 18 (4.5%)              | 42 (6.1%)              | $p=0.042$                  |
| - Social need   | 56 (19.2%)           | 54 (13.5%)             | 110 (15.9%)            | $p=0.042$                  |
| - Dentist's recommendation  | 12 (4.1%)            | 9 (2.2%)               | 21 (3.0%)              | n.s.                       |
| - Others  | 3 (1%)               | 5 (1.2%)               | 8 (1.2%)               | n.s.                       |

#### 5.2.5. Demand and utilization of tooth whitening products

A significant relationship was found between gender and utilization of tooth whitening product (Table 8). While 55.9% of the female interviewees had tried tooth-whitening products, only 42.1% of the men had used ( $p<0.001$ ). Proportionally more woman than men had used whitening toothpaste and whitening powder ( $p<0.01$ ).

Age was also related to the utilization of tooth whitening. Among the interviewees aged 18-25 years, 46.4% had used tooth whitening products, and the percentage increased to 53.5% in the 25-34 year-olds and to 62.7% in 35-44 year-olds (Chi-square test,  $p=0.037$ ). No correlation between education level and utilization of tooth whitening was found.

The interviewees' interest in trying out various tooth whitening products and services was generally low (Table 9). No significant relationship was found between their background and their interest in the various tooth whitening products.

Table 8. Interviewees' utilization of tooth whitening.

| <b>Have you ever tried any tooth whitening?</b> | <b>Men<br/>N (%)</b> | <b>Women<br/>N (%)</b> | <b>Total<br/>N (%)</b> | <b>Sig.</b>       |
|---|----------------------|------------------------|------------------------|-------------------|
| <b>No</b>                                       | <b>169 (57.9%)</b>   | <b>177 (44.1%)</b>     | <b>346 (49.9%)</b>     | <b>p&lt;0.001</b> |
| <b>Yes</b>                                      | <b>123 (42.1%)</b>   | <b>224 (55.9%)</b>     | <b>347 (50.1%)</b>     |                   |
| - Whitening toothpaste                          | 107 (36.6%)          | 190 (47.4%)            | 297 (42.9%)            | p=0.005           |
| - Whitening mouthrinse                          | 20 (6.8%)            | 19 (4.7%)              | 39 (5.6%)              | n.s.              |
| - Whitening adhesive strip                      | 15 (5.1%)            | 27 (6.7%)              | 43 (6.2%)              | n.s.              |
| - Whitening powder                              | 6 (2.1%)             | 22 (5.5%)              | 28 (4.0%)              | p=0.023           |
| - Whitening varnish                             | 2 (0.7%)             | 8 (2.0%)               | 10 (1.4%)              | n.s.              |
| - Whitening package                             | 1 (0.3%)             | 3 (0.7%)               | 4 (0.6%)               | n.s.              |
| - In-office bleaching by dentists               | 2 (0.7%)             | 3 (0.7%)               | 5 (0.7%)               | n.s.              |
| - Bleaching on prescription by dentists         | 4 (1.4%)             | 7 (1.7%)               | 11 (1.6%)              | n.s.              |

Table 9. Interviewees' interest in tooth whitening.

| <b>Which one are you interested in trying?</b> | <b>Men<br/>N (%)</b> | <b>Women<br/>N (%)</b> | <b>Total<br/>N (%)</b> | <b>Sig.</b> |
|--|----------------------|------------------------|------------------------|-------------|
| - Whitening toothpaste                         | 51 (17.5%)           | 50 (12.5%)             | 101 (14.6%)            | n.s.        |
| - Whitening mouthrinse                         | 27 (9.2%)            | 28 (7.0%)              | 55 (7.9%)              | n.s.        |
| - Whitening adhesive strip                     | 13 (4.5%)            | 29 (7.2%)              | 42 (6.1%)              | n.s.        |
| - Whitening powder                             | 10 (3.4%)            | 13 (3.2%)              | 23 (3.3%)              | n.s.        |
| - Whitening varnish                            | 7 (2.4%)             | 11 (2.7%)              | 18 (2.6%)              | n.s.        |
| - Whitening package                            | 9 (3.1%)             | 7 (1.7%)               | 16 (2.3%)              | n.s.        |
| - In-office bleaching by dentists              | 23 (7.9%)            | 49 (12.2%)             | 72 (10.4%)             | n.s.        |
| - Bleaching on prescription by dentists        | 15 (5.1%)            | 27 (6.7%)              | 42 (6.1%)              | n.s.        |



### 5.2.6. Experience of using over-the-counter products

To further analyze the survey results, OTC tooth whitening products were categorized into two groups according to the concentration of bleaching agents they contained and their contact time with teeth. Products in Group I include whitening toothpaste, mouth rinse and powder, which contain lower concentrations of bleaching agents, if any, and have shorter contact time with teeth when used. Products in Group II include whitening adhesive strip, varnish and package (gel and tray), and they contain higher concentrations of bleaching agents and have longer contact time with teeth when used.

Interviewees were asked for their reasons for choosing the OTC tooth whitening products which they had used and the results are shown in Table 10. Most interviewees purchased the products because of advertisements (36.7%), followed by received from family members (31.5%). Dentists' recommendation accounted for only 4%.

The reasons for choosing the product were correlated to the product group. Advertisements had a greater influence on the interviewees' choice of Group II products than Group I products (52.6% vs. 34.2%,  $p=0.007$ ), and so was relatives' or friends' recommendation. On the other hand, having been brought by family members was a main reason for using Group I products but not for Group II products (35.9% vs. 3.5%,  $p<0.001$ ).

Table 10. Interviewees' reasons for choosing the Group I and Group II tooth whitening products.

| Reason for choosing the OTC tooth whitening product | Group I<br>N (%) | Group II<br>N (%) | Total<br>N (%) | Sig.      |
|---|------------------|-------------------|----------------|-----------|
| Price   | 59 (16.2%)       | 12 (21.1%)        | 71 (16.8%)     | n.s.      |
| Advertisement                                       | 125 (34.2%)      | 30 (52.6%)        | 155 (36.7%)    | $p=0.007$ |
| Dentists' recommendation                            | 13 (3.6%)        | 4 (7.0%)          | 17 (4%)        | n.s.      |
| Bought by family members                            | 131 (35.9%)      | 2 (3.5%)          | 133 (31.5%)    | $p<0.001$ |
| Relative/friends' recommendation                    | 23 (6.3%)        | 8 (14%)           | 31 (7.3%)      | $p=0.037$ |
| Others  | 43 (11.8%)       | 7 (12.3%)         | 50 (11.8%)     | n.s.      |

Whether the interviewee had read the manufacturer’s instructions before using an OTC tooth whitening product was related to the type of product used. While most (77.2%) of the Group II product users had read the instructions, only around one third (31.2%) of the Group I product users did so ( $p<0.001$ ).

Interviewees were asked about how long they had used the OTC tooth whitening products and their answers are shown in Table 11. While the vast majority (86.0%) of the Group II product users had used the product for less than a month, more than half (56.6%) of the users of the Group I products had used the product for a month or longer and 13.7% of them had used the product for more than a year ( $p<0.001$ ).

Table 11. Duration of use of the Group I and Group II products by the interviewees.

| <b>How long have you used the product?</b> | <b><u>Group I</u><br/>N (%)</b> | <b><u>Group II</u><br/>N (%)</b> | <b><u>Total</u><br/>N (%)</b> | <b>Sig.</b> |
|--|---------------------------------|----------------------------------|-------------------------------|-------------|
| <b>&lt;1 month</b>                         | 158 (43.4%)                     | 49 (86.0%)                       | 207 (49.2%)                   | $p<0.001$   |
| <b>1-6 months</b>                          | 130 (35.7%)                     | 8 (14.0%)                        | 138 (32.8%)                   |             |
| <b>6-12 months</b>                         | 26 (7.1%)                       | 0 (0%)                           | 26 (6.2%)                     |             |
| <b>&gt;12 months</b>                       | 50 (13.7%)                      | 0 (0%)                           | 50 (11.9%)                    |             |

More than half of the users in both groups of OTC tooth whitening products were dissatisfied with the outcomes, and the percentage of dissatisfied users was higher for Group I than Group II products (73.7% vs.52.6%,  $p=0.001$ ). Around three quarters of the product users who were satisfied with the outcomes also reported that the whitening effect only lasted for one to three months. There was no statistically significant difference between the two groups of OTC products in this aspect ( $p>0.05$ ).

Interviewees who were not satisfied with the OTC products were asked about their reasons for dissatisfaction and their answers are shown in Table 12. For the dissatisfied users, the main reason was that they thought their teeth were “not white enough” after using the products, 84% and 70% for the users of Group I and Group II products, respectively (Chi-square test,  $p>0.05$ ).

Table 12.Reasons given by the interviewees for not satisfying with the Group I and Group II OTC products.

| <b>Which aspect are you not satisfied with?</b> | <b><u>Group I</u><br/>N (%)</b> | <b><u>Group II</u><br/>N (%)</b> | <b>Sig.</b> |
|---|---------------------------------|----------------------------------|-------------|
| <b>Not white enough</b>                         | 226 (84.0%)                     | 21 (70.0%)                       | n.s.        |
| <b>Not long-lasting enough</b>                  | 20 (7.4%)                       | 3 (10.0%)                        | n.s.        |
| <b>Side effects</b>                             | 16 (5.9%)                       | 4 (13.3%)                        | n.s.        |
| <b>Others</b>                                   | 6 (2.2%)                        | 1 (3.3%)                         | n.s.        |

The interviewees were asked if they thought there was a difference between their own experience with the use of the OTC tooth whitening products and the manufacturer’s claimed effects. Most of the users in both groups of OTC products replied that there was a difference and the percentage of interviewees saying so was higher among the Group I product users than that of the Group II product users (81.6% vs.61.4%,  $p<0.001$ ).

Regarding the experience of side-effects after using OTC tooth whitening products, it was very uncommon among the users of Group I products, only 3.0% and 5.2% of them reported having experienced gum irritation and tooth sensitivity, respectively (Table 13). Side-effects were significantly more common ( $p<0.001$ ) among Group II products, with 15.8% and 31.6% of the users reported having experienced gum irritation and tooth sensitivity, respectively.

Table 13.Experience of side effects among the users of Group I and Group II products.

| <b>Have you ever experienced any of the following side effects after use?</b> | <b><u>Group I</u><br/>N (%)</b> | <b><u>Group II</u><br/>N (%)</b> | <b>Sig.</b> |
|---|---------------------------------|----------------------------------|-------------|
| <b>Gum irritation – yes</b>   | 11 (3.0%)                       | 9 (15.8%)                        | $p<0.001$   |
| <b>no</b>   | 354 (97.0%)                     | 48 (84.2%)                       |             |
| <b>Tooth sensitivity – yes</b>  | 19 (5.2%)                       | 18(31.6%)                        | $p<0.001$   |
| <b>no</b>   | 346 (94.8%)                     | 39 (68.4%)                       |             |

### **5.3. Interview of dentists**

#### **5.3.1. Background of the interviewees**

A total of 165 dentists were successfully contacted through telephone or via email. Only 30 dentists (18.2%) accepted the interview while 135 dentists refused. Among those who accepted the interview, 18 (60%) were interviewed face-to-face, 11 (36.7%) were interviewed over the phone, and 1 (3.3%) replied via email. The locations of the dentists' clinics were evenly distributed among the three main geographical regions of Hong Kong and three quarters (76.7%) of the interviewees were male dentists. Half of the interviewees had practiced dentistry for 10-20 years while the other half had practised for 21-30 years.

#### **5.3.2. Opinion of dentists on over-the-counter tooth whitening products**

The dentists were asked what their response would be if their patient asked about the use of OTC tooth whitening products and their answers are summarized in Table 14.

For whitening toothpaste, 21 (70%) dentists did not recommend its use while 9 (30%) dentists supported the use. Among those who supported the use, 4 dentists would recommend the reputable brands only and 4 dentists recommended for short-term use only. Most (60%) of the dentists concerned about its limited effectiveness and 4 dentists thought the toothpaste was highly abrasive. The dentists' opinions on the other OTC products were very similar to those on toothpaste, except for whitening adhesive strip with 11 (36.7%) dentists recommended its use. Possibility of having side effects like gum irritation and tooth sensitivity were mentioned for whitening adhesive strip, vanish, powder, and package. Some dentists stressed that whitening adhesive strip should be used under supervision and some thought it was more effective than other OTC products. Regarding whitening package (gel and tray), one-third of the interviewed dentists thought it had side effects due to leakage of the bleaching gel.

Table 14. Opinions of the interviewed dentists on OTC tooth whitening products.

|                      | Whitening toothpaste                   | Whitening mouthrinse  | Whitening adhesive strip   | Whitening varnish                            | Whitening powder                | Whitening package                            |
|----------------------|--|-----------------------|--|--|---------------------------------|--|
| <b>Recommend</b>     | 9 (30%)                                | 2 (6.7%)              | 11 (36.7%)   | 4 (13.3%)                                    | 2 (6.7%)                        | 2 (6.7%)                                     |
| <b>Neutral</b>       | 0 (0%)                                 | 5 (16.7%)             | 1 (3.3%)   | 5 (16.7%)                                    | 6 (20%)                         | 6 (20%)                                      |
| <b>Not recommend</b> | 21 (70%)                               | 23 (76.7%)            | 18 (60%)   | 21 (70%)                                     | 22 (73.3%)                      | 22 (73.3%)                                   |
| <b>Other comment</b> | Limited effectiveness; Highly abrasive | Limited effectiveness | More effective than other products; May have side effects; Limited effectiveness | May have side effects; Limited effectiveness | May have side effects; Abrasive | May have side effects; Limited effectiveness |

### 5.3.3. Response of dentists when asked for professional bleaching

The vast majority (90%) of the interviewed dentists replied that normally less than 10% of their patients asked for tooth bleaching. Most (around 60%) of the dentists said that the patients asking for bleaching were predominantly female and mostly were 20-40 years old.

When their patients asked for professional tooth bleaching, 12 (40%) dentists would first investigate the cause of the tooth discoloration and then provide treatments according to the case's suitability for bleaching (Table 15). Some dentists would ask about patient's expectation and make recommendation accordingly, some dentists would recommend their patients to try professional bleaching, while some dentists would recommend other treatment options such as to try OTC tooth whitening products first or to have dental crown/veneer.

Table 15. Response of dentists when asked for professional bleaching.

| Response to patient   | No. of dentists (%) |
|---|---------------------|
| Conduct examination; then provide tooth whitening treatment for suitable case and provide other treatment options for unsuitable case | 12 (40%)            |
| Ask for patients' expectation and make recommendation accordingly   | 6 (20%)             |
| Recommend to try bleaching treatment  | 8 (26.7%)           |
| Recommend other treatment (e.g. crown, veneer) or try OTC products first  | 4 (13.3%)           |

### 5.3.4. Provision of professional bleaching

Nearly all (93.3%) of the interviewed dentists provided professional bleaching services. Around half of the dentists provided both in-office bleaching and bleaching on prescription while around half of the dentist only provided the latter. A few dentists only provided in-office bleaching. For in-office bleaching, the dentists used either laser or blue light for activation.

Before provision of tooth bleaching treatment, slightly more than half of the interviewed dentists would inform their patients about the possible side effects, risks and outcomes of the treatment (Table 16). Less than half of the dentists would provide information on the treatment procedures or post-operative care. Few dentists would educate their patients about the causes of tooth stain or give examples of tooth shade changes.

Table 16. Information provided by the interviewed dentists to their patients before providing bleaching treatment.

| Information provided to patients  | No. of dentists (%) |
|---|---------------------|
| Possible side effect and risk   | 16 (57.1%)          |
| Treatment outcome (e.g. unpredictable result, possible shade reversal, longevity) | 15 (53.6%)          |
| Procedures of the treatment   | 12 (42.9%)          |
| Post-operative instruction (e.g. dietary advice, stop when sensitivity occurs)    | 10 (35.7%)          |
| Cause of tooth stain  | 4 (14.3%)           |
| Example of shade change (e.g. showing photo of previous cases)                    | 3 (10.7%)           |

## **6. DISCUSSION**

### **6.1. Various methods of tooth whitening**

In 2002, the OTC tooth whitening products available in Hong Kong were mostly whitening toothpastes and there were only four OTC bleaching products.<sup>2</sup> Eleven years later in 2013, people in Hong Kong have many more options to choose from. Besides whitening toothpastes, there are mouthrinse, adhesive strip, varnish, powder, and package (bleaching gel and tray) from various brands. This invariably diversifies the potential pathways in pursuing whiter teeth. However, on the other side of the coin, a dilemma on how to choose the most appropriate, safe and effective product is faced by the public.

In this study, it was found that incomplete information of different OTC tooth whitening products was disclosed to the consumers. For example, proprietary names of ingredients were substituted for the actual chemical names and the concentrations of bleaching agents were omitted. This would hinder the public from making informed choices. In addition, the claims stated on the package are often exaggerated and misleading. Some products claimed to provide improvement of a large number of shade grades within a short time. Shade guide charts might be included in the product package, but they were inconsistent in grading among various brands and were not identical to the Vita Shade Guide commonly used by dentists. This makes it difficult for the consumers to compare different products. Moreover, some products claimed that there would be no damage to teeth and/or no tooth sensitivity. Not all products stated the potential side effects on the package. Some only put down: “only use as directed by medical professionals” in very small prints. This is a worrying condition as the layman purchasing these products normally will not be aware of the potential side effects. Clear warning should be provided. To maximize benefits and minimize risks, individuals should seek professional guidance to determine if bleaching is suitable for their specific conditions. Products with high concentration of hydrogen peroxide should not be used without gingival protection. For night-guard home vital bleaching, the use of minimal amounts of low-dose hydrogen peroxide or carbamide peroxide is preferred. Also, it should be facilitated by the use of custom made trays which reduce both the amount used and swallowed.<sup>11</sup>

Recently, the Australian government announced new regulations on the sale of OTC tooth whitening products to ensure the safety of users.<sup>12</sup> Only those products containing 6% or less hydrogen peroxide and/or 18% or less carbamide peroxide can be sold over the counter. High concentration products may only be sold to customers by registered dental practitioners.

According to the FDI (International Dental Federation) policy statement of dental bleaching materials, peroxide-containing tooth bleaching products are safe and effective when used under the supervision of a dentist and according to the professional directions for use.<sup>11</sup> This treatment should not be performed by persons who are not in the dental profession. On the grounds of public safety, the OTC sales of such products are not supported.

Hong Kong, being an international metropolis, should not lag behind international standards. The government should consider imposing similar regulations or at least consider regulating the disclosure of product information to include all the ingredients and warnings of the potential side effects to safeguard consumers' right and safety.

## **6.2. Interviews with young adults**

In this project, young adults were chosen as the target subjects for the street interviews. The survey was conducted at six sites in different districts of Hong Kong on different days. Although the interviewees were not selected through any probability sampling procedures, with such a diverse recruitment of interviewees, and the use of a combined purposive and quota sampling method, we believe that the study findings can represent, to some extent, the general views of the young adults in Hong Kong. The upper cut-off age limit in this study was selected with reference to the median age of the Hong Kong population which was 42 years in the 2011 population census.<sup>13</sup>

Young adults were chosen for this study because it was expected that they had higher demand for tooth whitening. They were targeted to allow for a better investigation of the consumers' experience and satisfaction with various means of tooth whitening. However, this leads to an inherent limitation in that the survey subjects cannot represent the entire Hong Kong adult population. The results obtained are confined to young adults and cannot be extrapolated



to the older population. Despite this, we believe that our results can better pinpoint the views of the potential consumers of tooth whitening products and services in Hong Kong.

Satisfaction with one's own tooth colour is a subjective evaluation. In our survey, 80% of the interviewees felt that their teeth were not white enough. This was significantly higher than the result from previous local studies which was around 40%,<sup>2,10</sup> and some non-local studies. In the UK, 50% of the adults perceived themselves to have tooth discolouration,<sup>14</sup> and in Chengdu, China, 53% of the adults were dissatisfied with their tooth colour.<sup>15</sup> This may be due to the age group selection in our survey which aimed at studying the young adult population with higher demand for tooth whitening.

It seems that the young adults in Hong Kong nowadays are generally aware of tooth whitening as the majority of our interviewees reported that they knew what tooth whitening is. However, when compared to the findings of a previous local study conducted in 2002,<sup>2</sup> the young adults' knowledge of the potential side effects of tooth whitening has not improved much in the past 10 years despite the surge in the availability of tooth whitening products. This indicates that more health education for the public in Hong Kong on tooth whitening, including the pros and cons of various means of tooth whitening, is needed.

An important finding of this study is that most (58%) of the interviewees had a perceived need for tooth whitening, more so among the women. This is consistent with the common belief that women are more concerned with their dental aesthetics. Most interviewees in this study, both men and women, thought that such a need was attributed to personal preference but proportionally more men regarded it as a social or occupational need. This may reflect that men are more practical towards dental aesthetics. Compared to a local study conducted in 2002 which reported that only 37% of its interviewees perceived a need for tooth whitening,<sup>2</sup> there has been a significant rise in the perceived need over the past ten years. This may be a result of the increased advertising of tooth whitening products in the various media in Hong Kong.

Half of the interviewees in this study had used OTC tooth whitening products, mostly whitening toothpaste. Use of toothpaste with tooth whitening claims do not demand extra time and effort and is just slightly more expensive. The other OTC products are generally more expensive, more difficult to use, and more technique demanding than the whitening toothpastes. Significantly more women than men had used OTC products, which suggests that they have a

greater demand for OTC tooth whitening products and are more willing to pay extra cost for aesthetics. Results of a local study in 2002 showed only 22% of the Hong Kong young adults had used whitening toothpaste and 1 % had used OTCbleaching agents.<sup>2</sup>In the current survey, 43% of the interviewees had used whitening toothpaste and 8% had used OTC bleaching agents (adhesive strip, varnish, and package). This substantial increase may be due to a rise in demand for OTC tooth whitening products in the past decade resulting from increased availability and advertising, and decreased prices of the OTC products. The market for tooth whitening has been continuously growing and we expect a rising trend of demand in the future.

In contrast to the large increase in the utilization of OTC tooth whitening products in Hong Kong, over the past decade, the utilization for professional tooth bleaching has remained very low. In this study, only 2% of the interviewees had received professional bleaching services which is comparable to that found in a previous study conducted in 2002.<sup>2</sup>Cost barrier may have preventedthe increase in utilization of professional tooth bleaching services in Hong Kong. It can be seen from the findings of a local study conducted in 2007that there is a large discrepancy between the mean acceptable maximum cost of professional tooth bleaching to the public and the actual treatment cost, around HK\$2500 vs. \$6500.<sup>10</sup>Facing the high cost for professional tooth bleaching, many people may turn to use OTC tooth whitening products as an alternative and this may explain the large difference in the utilization of OTC products and professional service among the interviewees of this study. Besides, the Dental Council of Hong Kong, the regulatory body of local dentists, does not allow dentists to promote their services in public. On the demand side, this study found that 16% of the interviewees were interested in trying out professional tooth bleaching. There seems to be a need for the dental profession in Hong Kong to promote the tooth bleaching services dentists can offer and to take actions to lower the barrier for accessing these services.

It is interesting to note that many of the interviewees in this study who were users of Group IOTC tooth whitening products(low concentration of bleaching agents, if any, and short contact time) were probably passive users because the products they used were mostly purchased by their family members. However, the very same reason "bought by family members" was less significant in influencing the users of the Group IIproducts. The primary reason for choosing the Group IOTC products among the interviewees was advertisements. We can conclude that people who actively seek to improve the shade of their teeth would have a greater tendency to select Group IIOTC products (higher concentration of bleaching agent

and longer contact time), and that advertisements play a major role in influencing their choice. Furthermore, in this study less than 7% of the users of both groups of OTC products mentioned dentists' recommendation as a reason influencing their choice of product. This is in stark contrast to the results of a previous local study in 2002, which found that dentists' recommendation was the most important factor.<sup>2</sup> There seems to have been a great decline in the dentists' influence on the public's choice of tooth whitening products in Hong Kong who now depend less on professional advice and that the advertising and marketing efforts of commercial companies have greater influence on consumers' choices.

Another important finding of this study is that only around a quarter of the users of Group I OTC products and less than half of the Group II products users were satisfied with the tooth whitening results. The higher percentage of satisfied users among the Group II products may be taken to suggest that these tooth whitening products containing higher concentrations of bleaching agents and having a longer contact time with teeth have greater effects on tooth whitening than the Group I products. This finding is in agreement with those of a number of prior studies on the effectiveness of tooth whitening products, which is the higher the concentration of peroxide, the greater the whitening efficacy, and lower concentrations may approach the efficacy of higher concentrations with extended duration of application/contact.<sup>16</sup> Although whitening toothpastes can prevent extrinsic tooth stains, the whitening effect seems not to be clinically significant.<sup>17</sup> A study by Gerlach et al. compared the effectiveness and safety of a 18% carbamide peroxide paint-on gel, a 5% carbamide peroxide tray system, and a 1% hydrogen peroxide dentifrice.<sup>18</sup> The group treated with the tray system had the greatest colour improvement while the dentifrice group experienced no significant colour change from baseline. Another study evaluated the efficacy and safety of a 2% hydrogen peroxide whitening mouthrinse and a 10% hydrogen peroxide whitening strips that were used twice daily for one week. The results showed that the group treated with the whitening strips experienced a significantly greater tooth colour improvement than the whitening mouth-rinse group.<sup>19</sup>

A reason for the high percentage of dissatisfied users of the OTC tooth whitening products found in this survey is their possible low compliance with product instructions.<sup>17</sup> This is related to the finding that most of the users, more than two thirds of the users of Group I products and around one quarter of the users of Group II products, did not read the manufacturer's

instructions prior to using the products. The disparity between the users of the two groups of products is likely because people are usually more cautious when they use novel products (in this study: whitening adhesive strip, varnish, gel applied in trays) that are relatively new and unfamiliar to them. On the contrary, toothpaste and mouthwash are common products of daily oral hygiene practice which the adults in Hong Kong are familiar with, and hence most of them think they need not read the manufacturer's instructions.

Another possible explanation for the high level of dissatisfaction among the OTC product users is that they might want to whiten teeth that had stains which were not amenable to the actions of OTC products. We recommend that people who want to have their teeth whitened should consult a dentist before starting to use OTC products, and to use them under supervision. A related finding of this study is that a large proportion of the OTC products users felt that there was a difference between product manufacturer's claims and their experience of the outcomes after use. Either the manufacturer's claims are exaggerated and they promise more than what is possible, or that the Hong Kong consumers have an unrealistic expectation of the whitening effect of OTC products.

Despite the generally low effectiveness of the Group I OTC tooth whitening products, the prevalence of reported side effects among the interviewees of this study was low, only a few per cent. The prevalence of having experienced gum irritation and tooth sensitivity among the users of Group II products in this study was much higher, and is comparable to the findings of an earlier study by Kugeland co-workers which found a prevalence of 33% of gingival irritation in patients using adhesive strips containing 6.5% hydrogen peroxide.<sup>20</sup> A systematic review reported that transient mild to moderate tooth sensitivity could occur in up to two-thirds of the users during the early stages of bleaching treatment.<sup>21</sup>

In the literature, gingival irritation was more frequently reported after the use of whitening gels in trays compared with using whitening strips.<sup>22</sup> Many users of OTC whitening packages may have used ill-fitting trays that irritate the gingival tissues and/or allow bleaching agents to leak onto the gums or soft tissues. Also improper use of whitening strips may allow direct contact of the bleaching gel with the soft tissues.

In view of the potential side effects associated with the use of OTC whitening products containing bleaching agents, we recommend the users of these products to carry out this

treatment under the supervision of their dentist. This can avoid selection of inferior products, ensure correct usage and application, prevent product abuse, and allow earlier detection and better management of any adverse effects.<sup>17</sup> The European Scientific Committee on Consumer Products considers the proper use of tooth whitening products containing 0.1 to 6% hydrogen peroxide to be safe if there is consultation with and approval by the consumer's dentists.<sup>26</sup>

### **6.3. Interviews with dentists**

A major problem we encountered in conducting the survey of private dentists in Hong Kong is the low response rate, over 80% of the selected dentists refused to be interviewed. There are many possible reasons for the refusals, such as the dentists being too busy in their practice, some dentists did not provide tooth whitening treatment, and some may have a negative attitude towards tooth whitening. Private general dental practitioners with more than 10 years of experience were chosen to be the target population for this survey because they constitute more than half of the dentist population in Hong Kong. The final sample of interviewed dentists showed a diverse background and there is no obvious bias in their profile when compared to that of the dentists in Hong Kong.<sup>24</sup> Despite this, we acknowledge that there is non-response bias in our results and the findings should be interpreted with caution.

Since we wanted to explore the views of the dentists on OTC tooth whitening products and how they would respond to patients' request for tooth bleaching, open-ended questions were used in our interviews with the dentists. The dentists were not restricted in anyway when they gave their answers to the questions but because of this, it was not easy for us to summarize and to present the interview findings.

A main finding of the dentist interviews is that the majority of the interviewed dentists did not recommend their patients to try OTC tooth whitening products and the dentists had reservations in the effectiveness of these products. This is in contrast to the findings of the interview with young adults in this study which show that half of them had used OTC tooth whitening products. The seemingly low influence of the dentists' views on the public's use of OTC products in Hong Kong may be related to their relatively infrequent contacts. In fact, the utilization of private dental care service in Hong Kong by the general public has been low. In

the latest published government oral health survey, it was found that only 26% of the Hong Kong middle-aged adults were regular dental attendees.<sup>25</sup>

The interviewed dentists in this study indicated that their patients who requested for tooth bleaching were mostly young women. This reaffirms the notion that females and young adults are more concerned with aesthetics, including the colour of their teeth.<sup>14</sup> It is reassuring to find that the dentists in Hong Kong do not provide tooth bleaching treatment indiscriminately upon request from their patients. Many of the interviewed dentists would conduct an examination to investigate the causes of tooth discolouration before drawing up treatment plans for the patient concerned. They would only provide bleaching treatment to suitable patients. A considerable number of dentists would also assess patient expectations before provision of tooth bleaching. We believe it is important to put patients in the right perspective and prevent unrealistic expectations. All these actions of the dentists are crucial as some tooth discolourations are not amenable to bleaching alone, and may result from a disease or condition which requires endodontic therapy, restorations or dental surgery.<sup>16</sup>

Most of the interviewed dentists in this study would provide some information to their patients before carrying out tooth bleaching treatment. However, it seems that the information provided is not complete. Some dentists would explain the treatment procedures, some would provide information about anticipated treatment outcome, while some would mention the possible side effects and relapse of tooth shade. It should be noted that it is the duty of a dentist to provide all necessary information to each patient before obtaining informed consent to provide tooth bleaching treatment. Otherwise, there will be high risk for argument between the dentist and the patient regarding compliance with the treatment, unrealistic patient expectations, and experience of adverse side effects.

## **7. CONCLUSIONS**

Based on the results of our study and with reference to the study objectives, the following conclusions were drawn:

1. There is a variety of over-the-counter tooth whitening products available in the market in Hong Kong.
2. The awareness and perceived need of tooth whitening among Hong Kong young adults are high.
3. The use of whitening toothpastes is common among Hong Kong young adults, but not the other OTC products or professional tooth bleaching.
4. Most of the users of OTC tooth whitening products are not satisfied with the whitening outcome.
5. Most dentists in Hong Kong do not recommend the use of OTC tooth whitening products and they doubt the effectiveness of these products.

## **8.RECOMMENDATIONS**

After the conduction of our project, we would like to make the following recommendations:

1. For general oral health education purpose, the dental profession in Hong Kong should provide more information to the public on tooth whitening, including the appropriate and possible use of over-the-counter tooth whitening products, their contents, expected outcomes, and possible side effects.
2. To obtain the appropriate treatment and to optimize the treatment outcomes, people should visit a dentist for a clinical examination and seek professional advice if they want to whiten their teeth.
3. To protect the rights and safety of the consumers, appropriate authorities such as the Consumer Council and the Hong Kong government should look into possible regulations on the disclosure of information for the over-the-counter tooth whitening products, their advertisements, and the claims on their effects.



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香港大學牙科學院公共口腔學系問卷調查

對牙齒美白的觀感及經驗

---

1. 你覺得自己的牙齒夠白嗎?  
 是  
 否
  
2. 你知道甚麼是牙齒美白嗎?  
 知道 → 請回答 2A  
 不知道 → 請回答 4  
2A. 你從哪種途徑得知?  
 電視  
 報章雜誌  
 網上  
 商店海報  
 牙醫  
 其他
  
3. 你認為使用牙齒美白產品／療程有副作用嗎?  
 有 → 請回答 3A  
 沒有  
3A. 如有：(可選擇多項)  
 傷害牙肉  
 牙齒破損  
 牙齒敏感  
 有毒／致癌  
 其他：

4. 你認為有沒有需要美白自己的牙齒？

有 → 請回答 4A

沒有

4A. 有需要的原因：

個人喜好

工作需要

社交需要

牙醫建議

其他：

5. 你有沒有使用過牙齒美白產品／接受過牙齒美白療程？

有 → 請回答 5A

沒有 → 請回答 5B

5A. 使用過哪種？

5B. 對哪種產品／療程有興趣使用？

|             | A.使用 | B.興趣 |
|-------------|------|------|
| <b>市面產品</b> |      |      |
| 美白牙膏        |      |      |
| 美白漱口水       |      |      |
| 美白牙貼        |      |      |
| 美白牙粉        |      |      |
| 美白塗劑        |      |      |
| 美白套裝        |      |      |
| <b>專業牙醫</b> |      |      |
| 藍光美白        |      |      |
| 牙醫處方漂白劑     |      |      |
| <b>美容中心</b> |      |      |
| 牙齒美白療程      |      |      |
| 其他：_____    |      |      |

市面產品 (產品種類: \_\_\_\_\_)

---

1. 為何選擇該產品 (可選多項)  
價錢                      廣告  
牙醫推薦                  家人購買  
親友推薦                  其他：
  
2. 使用牙齒美白產品前，你有沒有細閱該產品的說明？ 有 沒有
  
3. 你用了多久？              日/星期/月/年
  
4. 你滿意美白效果嗎？  
滿意→請回答 4AI & 4AII  
不滿意→請回答 4B  
4AI. 如滿意，美白效果持續多久？  
1-3 個月  
3-6 個月  
6-12 個月  
超過一年  
4AII. 效果減退後，有沒有重用該產品？  
不適用  
有(次數: \_\_\_\_\_)  
沒有  
4B. 如不滿意，哪一方面不滿意？  
不夠白                      不夠持久  
副作用                      其他
  
5. 你覺得效果與產品聲稱的有出入嗎？  
有                      沒有
  
6. 使用產品後，有沒有出現以下不良反應？  
刺激牙肉              有 沒有  
牙齒敏感              有 沒有

## 專業牙醫

---

1. 為何選擇該療程（可選多項）  
價錢                      廣告  
牙醫推薦                  親友推薦  
其他：\_\_\_\_\_
  
2. 接受療程前，牙醫有沒有向你解釋清楚  
2a) 整個療程 有      沒有  
2b) 副作用 有      沒有  
2c) 預期效果 有      沒有  
2d) 價錢 有      沒有
  
3. 你滿意美白效果嗎？  
滿意→請回答 3AI & 3AII  
不滿意→請回答 3B  
3AI. 如滿意，美白效果持續多久？  
1-3 個月  
3-6 個月  
6-12 個月  
超過一年  
3AII. 效果減退後，有沒有重用該療程？  
不適用  
有(次數:\_\_\_\_\_)  
沒有  
3B. 如不滿意，哪一方面不滿意？  
不夠白                      不夠持久  
副作用                      其他
  
4. 你覺得效果與牙醫聲稱的有出入嗎？  
有                              沒有
  
5. 你認為是否物有所值？  
是                              否
  
6. 使用產品後，有沒有出現以下不良反應？  
刺激牙肉      有 沒有  
牙齒敏感      有 沒有



## 個人資料

---

1. 性別： 男 女

2. 年齡：

<18

18 – 24

25 – 34

35 – 44

>44

3. 學歷：

中學程度

大專程度

大學學位

FACULTY OF DENTISTRY  
COMMUNITY HEALTH PROJECT FOR BDS IV

*Perception and experience towards toothwhitening*

---

1. Do you think your teeth are white enough?

- Yes  
 No

2. Do you know what tooth whitening is?

- Yes → Please answer 2A  
 No → Please answer 4

2A. Where do you obtain this information?

- Television  
 Newspaper and magazine  
 Internet  
 Posters in shop  
 Dentists  
 Other

3. Do you think there is any side effect of using tooth whitening products?

- Yes → Please answer 3A  
 No

3A. If yes: (Can select more than one option)

- Gum damage  
 Tooth damage  
 Tooth sensitivity  
 Toxic/carcinogenic  
 Other : \_\_\_\_\_

4. Do you think you need toothwhitening ?

Yes → Please answer 4A

No

4A. Reason (Can select more than one option)

Personal Preference

Work requirement

Social need

Dentists' recommendation

Others: \_\_\_\_\_

6. Have you ever used any tooth whitening products or received any tooth whitening treatment?

Yes → Please answer 5A & 5B

No → Please answer 5B

5A. Which one have you used ?

5B. Which one are you interested in?

|                                    | A.Use | B.Interest |
|------------------------------------|-------|------------|
| <b>OTC Tooth Whitening product</b> |       |            |
| Whitening toothpaste               |       |            |
| Whitening mouthrinse               |       |            |
| Whitening strips                   |       |            |
| Whitening powder                   |       |            |
| Whitening varnish                  |       |            |
| Whitening package                  |       |            |
| <b>Profession bleaching</b>        |       |            |
| In-office                          |       |            |
| Bleaching on prescription          |       |            |
| <b>Beauty parlor</b>               |       |            |
| Tooth whitening treatment          |       |            |
| <b>Other :</b> _____               |       |            |

*OTC product (Type: \_\_\_\_\_)*

---

7. Why did you choose that product (can select more than one option)
- Price
  - Advertisement
  - Dentists' recommendation
  - Bought by family members
  - Relatives' recommendation
  - Others: \_\_\_\_\_
8. Did you read the instructions before using the product?  Yes  No
9. How long have you used? \_\_\_\_\_ Day/Week/Month/Year
10. Do you satisfy with the results?
- Yes → Please answer 4AI & 4AII
  - No → Please answer 4B
- 4AI. If yes, how long have the effect lasted?
- 1-3 months
  - 3-6 months
  - 6-12 months
  - Over than 1 year
- 4AII. Have you reuse the product after the effect diminished?
- Not applicable
  - Yes (No. of Times: \_\_\_\_\_)
  - No
- 4B. If not, which aspect do you dissatisfy?
- Not white enough
  - Not long-lasting enough
  - Side effects
  - Others
11. Do you think if there is any difference when compared with the claimed effects?
- Yes
  - No
12. Have you ever experienced any of the following side effects after use?
- Gum irritation  Yes  No
- Tooth sensitivity  Yes  No

***Professional bleaching***

---

7. Why do you choose this treatment (can select more than one option)
- Price
  - Advertisement
  - Dentists' recommendation
  - Relatives' recommendation
  - Others: \_\_\_\_\_
8. Did the dentist explain the following before the treatment?
- 2a) Procedure  Yes  No
  - 2b) Side effects  Yes  No
  - 2c) Expected outcome  Yes  No
  - 2d) Price  Yes  No
9. Do you satisfy with the results?
- Yes → Please answer 3AI & 3AII
  - No → Please answer 3B
- 3AI. If yes, how long have the effect lasted?
- 1-3 months
  - 3-6 months
  - 6-12 months
  - Over 1 year
- 3AII. Have you reuse the product after the effect diminished?
- Not applicable
  - Yes (No. of Times: \_\_\_\_\_)
  - No
- 3B. If not, which aspect do you dissatisfy?
- Not white enough
  - Not long-lasting enough
  - Side effects
  - Others
10. Do you think if there is any difference when compared with what the dentist claimed?
- Yes  No
11. Do you think the treatment is worthy?
- Yes  No

12. Have you ever experienced any of the following side effects after use?

Gum irritation Yes No

Tooth sensitivity Yes No

***Personal information***

---

4. Gender: Male Female

5. Age group:

<18

18 – 24

25 – 34

35 – 44

>44

6. Education level:

Secondary school level

Post-secondary level

Bachelor degree or above

美白牙膏



美白漱口水



美白牙貼



美白塗劑



美白牙粉



美白套裝





### Questions for Dentist Interview

1. 如果你的病人問你有關下列牙齒美白產品的意見，你會如何回應？

When your patients asked for your opinion on the following tooth whitening products, how would you respond?

- |          |                      |
|----------|----------------------|
| A. 美白牙膏  | Whitening Toothpaste |
| B. 美白漱口水 | Whitening Mouthrinse |
| C. 美白牙貼  | Whitening Strips     |
| D. 美白塗劑  | Whitening Varnish    |
| E. 美白牙粉  | Whitening Powder     |
| F. 美白套裝  | Whitening Package    |

2. 如果你的病人要求美白牙齒，你會如何回應？

What would be your response if your patients asked for tooth whitening?

3. 在你的病人中，有幾大比例要求牙齒美白？

How much percentage of you patients asked for tooth whitening?

4. 多數是什麼類型的病人要求美白牙齒？

What are the types of patients requesting tooth whitening?

5. 你有沒有提供漂牙療程？如有，會提供哪種療程？

Do you provide any bleaching treatment? If yes, which type do you provide?

6. 如有提供漂牙療程，你在進行漂白牙齒前，你會提供什麼資訊給病人？

What information would you provide before the bleaching treatment?