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Factors Influencing the Choice of Toothpaste and Investigation of Those Most Commercialized by Students in Settat, Morocco

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Abstract

Background: This study aimed to determine the factors influencing the choice of toothpaste by students in Settat, Morocco and investigate the characteristics of those most commercialized in this region.

Methods: A close-ended questionnaire was developed and filled out. This was a cross-sectional study of 429 students who agreed to participate. Based on questionnaire data, the 15 most commercialized toothpaste by respondents were purchased, and their packaging was investigated.

Results: After analysis using Excel 2019, the results revealed that the major factors influencing the choice of toothpaste are brand 55%, family choice 48%, and media advertisements 40%. Moreover, about 57% of respondents chose toothpaste brands with monofluorophosphate as a therapeutic fluoridated agent, whereas 41% chose those with NaF. In addition, 85% of respondents chose a toothpaste brand that has silica abrasive. Moreover, only 44% chose toothpaste with production and expiration dates. Finally, the total fluoride and total soluble fluoride were lower compared with the quantity of fluoride expected from the packaging.

Conclusions: The present study indicated that the respondents selected their toothpaste primarily based on brands, family choices, and media advertisements. Incomplete labeling was encountered in toothpaste used by 58% of the respondents.

Keywords: dental caries, fluoride, Morocco, students, toothpaste

INTRODUCTION

Dental caries is a chronic disease recognized as the leading cause of oral pain and tooth loss. It is considered a major public health problem worldwide for all age groups,¹ with a prevalence rate varying from 49% to 83%. In addition, dental caries is defined as the acidic by-product of bacterial fermentation of dietary carbohydrates, which causes localized damage to sensitive tooth hard tissues.² On the contrary, several other factors can contribute to the progression of dental caries, including inadequate salivary composition, people's standard of living, behavior, hygiene, dietary habits, social status, and socio-demographic factors.³ For example, a study conducted among children of Transcarpathia-Ukraine, a region known to have fluorine and iodine deficiencies, showed that the intensity of caries is increased because of many risk factors such as lack of hygiene care, frequent stressful conditions, vitamin

deficiency in the diet, and low frequency of food consumption per day.⁴

Fluoride plays an important role in reducing the prevalence and severity of dental caries⁵ through several mechanisms such as reducing enamel demineralization in the presence of acids produced by cariogenic plaque-degrading bacteria from fermentable carbohydrates, remineralization of early enamel caries, and inhibition of bacterial activity in dental plaque.⁶ Therefore, the use of fluoride toothpaste has been recommended for more than five decades as a strategy to prevent and control dental caries.⁷ Moreover, several factors influence the effectiveness of toothpaste, including the therapeutic fluoridated agent and their concentrations.^{8,9} The commonly used therapeutic fluoridated agents are sodium fluoride (NaF) and monofluorophosphate (MFP).¹⁰ Furthermore, another factor that is involved in this process is the type of abrasive used, which constitutes 25% to 60% of a typical toothpaste.^{10,11} Hence, the relationship between these factors and caries prevention has been widely studied in the literature.⁸ For example, toothpaste containing NaF as a therapeutic fluoridated agent has good compatibility with silica abrasive.¹² However, toothpaste containing sodium MFP is more

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compatible with calcium abrasivity.¹³ In addition, the levels of fluoride in toothpaste may not only provide greater protection against dental caries, but also increase the risk of dental fluorosis¹⁴ in endemic fluorosis countries, including Morocco.¹⁵ Furthermore, WHO recommended the use of effective fluoridated toothpaste at 1000 to 1500 ppm.¹⁶ Nevertheless, many consumers do not have enough data about the criteria for selecting a suitable toothpaste because of the lack of oral health knowledge^{17,18}. Consequently, the factors influencing consumers' choice of toothpaste in many countries include brand, media advertisements, family choice, cost, design, and/or packaging criteria.¹⁹ Morocco is known for its high prevalence of dental caries.²⁰ However, at present, no study has been conducted on the factors affecting toothpaste choice by consumers. Therefore, this study aimed to determine the factors influencing the choice of toothpaste among students in Settatt City, Morocco and investigate the characteristics of toothpastes most commercialized in this region.

METHODS

Ethical approval

This study was conducted under the conditions and recommendations of the University of Hassan First, Settatt, Morocco.

Factors influencing the choice of toothpaste

In determining the factors influencing the choice of toothpaste among consumers in Settatt City, Morocco, a close-ended questionnaire was developed and validated in the presence of the research team and then filled out by respondents. This was a cross-sectional study on students ranging between 20 and 30 years of age and studying at the University of Hassan First, Settatt, Morocco. After exclusion of those who had not given their consent and those who did not use toothpaste, the study sample was formed out of 429 participants.

The questionnaire was designed in English, translated into French, and finally retranslated back. Factors that were considered for their choice of toothpaste included brand, cost, media advertising, family choice, advice from the dentist, flavor, presence of fluoride, and effectiveness. Moreover, this questionnaire included the different points of sale of toothpaste, which are frequently used by these respondents (pharmacy, supermarket, or grocery store).

Toothpaste's investigation

Based on the questionnaire, 15 of the most marketed toothpastes in the Settatt region were selected and purchased, and their packaging was investigated. The information on the packaging has been checked for the type of fluoride ingredient, its concentration, and the type of abrasive used. The marking was also checked for

information on the production and expiration date. The samples were coded using alphabets.

Sample preparation

The fluoride ion (FI) form was considered to prepare the samples for further analysis. The form could be a total soluble fluoride (TSF), which is FI and fluoride as sodium MFP. In addition, the total fluoride (TF) is the sum of TSF and insoluble fluoride (IF), which can be bound to the abrasive. In brief, 100 mg of each toothpaste was weighed and homogenized vigorously in 10 mL of deionized water. Then, an aliquot of 0.25 mL of the suspension was transferred from each toothpaste tube to TF-labeled test tubes, and 0.25 mL of HCl (2 M) was added. The tubes were heated to 45 °C and maintained at this temperature for 60 min to hydrolyze the MFP ion to the FI and to dissolve the IF bound to the abrasive. The resulting acid suspension was neutralized with 0.5 mL of NaOH (1 M) and buffered with 1 mL of TISAB (14.7 g of tri-sodium citrate dihydrate and 29.25 g of sodium chloride in 400 mL of deionized water, pH 5.5). The suspension was centrifuged for 10 min to 3000 g at room temperature to remove the IF, and the supernatant was used to determine the TF. Thereafter, 0.25 mL of the supernatant was transferred to tubes labeled as TSF and treated as described for TF.^{11,21}

Potentiometric measurements of TF, TSF, and IF

After sample preparation, the concentrations of fluoride as TF, TSF, and IF were determined. The TSF and TF contents were measured using a fluoride electrode (Thermo Scientific Orion 96-09, Orion Research, Cambridge, MA, USA) coupled to an analyzer ion (Star A214, Thermo Scientific Orion). The electrode was calibrated with standard fluoride solutions from 0.4 to 2 ppm and prepared with the same reagents used for the samples. Analysis of each tube of toothpaste was carried out in triplicate. Finally, the IF percentage was calculated using the following equation:¹³

$$\text{IF (\%)} = ((\text{TF} - \text{TSF}) / \text{TF}) * 100.$$

Statistical analysis

The data from the questionnaires were entered and analyzed using Excel 2019. The values were presented as percentage. Data of potentiometric fluoride measurement collected were analyzed using JMP11.0 (SAS Institute Inc., Cary, NC, USA) and presented as a frequency table and means \pm standard deviation.

RESULTS

Questionnaire Data Analysis

Factors influencing the choice of toothpaste

A total of 429 questionnaires were fully completed with 73% (313) filled by females and 27% (116) males, and the results showed that the major factors influencing the

choice of toothpaste are brand 55% (236), family choice 48% (206), media advertisements 40% (170), and effectiveness 36% (155) (Table 1). Furthermore, other factors are less considered by consumers when selecting their toothpaste, such as the price (16%, 69), dentist recommendation (11%, 49), the presence of fluoride (9%, 37), and flavor (7%, 32).

Regarding purchase points of toothpaste, 56% of the respondents indicated supermarket, 35% indicated pharmacy, and only 9% indicated grocery stores. On the contrary, 56% of respondents (241) checked the packaging for instructions before purchasing the toothpaste, whereas 63% of them (150) thought that they had enough information about their toothpaste.

TABLE 1. Factors influencing the choice of toothpaste by respondents in Settat City, Morocco

| Factors | Rate at which factors influenced respondents' choice | |
|----------------------|--|-------------------------|
| | Influenced N (%) | Not influenced N (%) |
| Brand | 236 (55) | 193 (45) |
| Family | 206 (48) | 229 (52) |
| Media | 170 (40) | 259 (60) |
| Advice of dentist | 49 (11) | 380 (89) |
| Price | 69 (16) | 360 (84) |
| Flavor | 32 (7) | 397 (93) |
| Presence of fluoride | 37 (9) | 392 (91) |
| Effectiveness | 155 (36) | 274 (64) |

Toothpaste's investigation

Based on the results of the questionnaire, the 15 most commercialized toothpastes were purchased, and their packaging was investigated (Table 2). The amount of fluoride expected in the toothpaste package varied between 1,000 and 1,500 ppm. In addition, 57% of respondents chose toothpaste brands with MFP as the therapeutic fluoridated agent, whereas 41% chose those with NaF, and the remaining respondents (2%) chose brands with no declaration as a therapeutic fluoridated agent. Moreover, 85% of respondents chose toothpaste brands that declared silica abrasive (silica or hydrated silica), whereas 15% chose brands with no declared abrasive. Furthermore, only 44% chose toothpaste with declared production and expiration dates.

Determination of various forms of fluoride content in toothpaste

The concentrations of different forms of fluoride such as TF, TSF, and IF of the most marketed toothpastes in Settat City, Morocco are summarized in Table 2. The results showed that among the 15 toothpastes analyzed, 14 showed a TF concentration between 1,000 and 1,500

ppm, whereas the remaining toothpaste presented a concentration slightly lower than 1,000 ppm. Furthermore, 11 toothpastes showed a concentration of TSF ranging from 1,000 to 1,500 ppm. However, the remaining four toothpastes presented a concentration slightly lower than 1,000 ppm. With regard to IF, 15 toothpastes presented a percentage varying between 1.29% and 4.07%.

DISCUSSION

A wide variety of toothpastes are available on the market to prevent dental caries in humans. However, the criteria for selecting a more effective oral care product remain a major concern. In this regard, perception's choice of toothpaste among consumers is influenced by cultural, social, family, and personal factors.¹⁹ Hence, these factors vary from one country to another.^{18,22,23} Dental caries is a frequent pathology in Morocco,²⁴ particularly in families with low socioeconomic status. In addition, the renunciation of dental carries constitutes a major public health problem because of its impact on quality of life and high cost of dental care.²⁵ Accordingly, a recent Moroccan study showed a low level of knowledge, unfavorable attitudes, and practices related to oral health and regular use of toothpastes.²⁶ Thus, we have determined the factors influencing the choice of toothpaste among consumers in the studied region and investigated the characteristics of those most commercialized. Our findings showed that the majority of respondents used the same brand of toothpaste, and their choice was primarily influenced by family recommendation. These results are similar to several previous studies that have reported a high influence of family choice of toothpastes.¹⁸ This influence could be explained by socioeconomic status,²³ as a single toothpaste is used by the whole family. Moreover, media advertisements (40%) were reported as another important factor among people who used the same brand. This result is in concordance with that reported by Sharda and Sharda²⁷ who obtained a similar percentage of people (40%) who were influenced by media advertisements. However, Sivadasan *et al.*²⁸ reported a higher percentage of people (59%) who were influenced by this factor. Apart from audiovisual media, electronic media are also available,²⁹ which influence consumer behavior through awareness, interest, conviction, purchase, and post-purchase.³⁰ Several studies have shown that advertisements claim that their toothpastes are preferable and effective over others,³¹ which leads a large percentage (36%) of respondents in this study to think that they choose their toothpastes based on their effectiveness.

TABLE 2. Characteristics of the most commercialized toothpastes in Settat City, Morocco (N = 429)

| Code | Users (%) | Therapeutic Fluoridated agent | Abrasive | Date | Expected F (ppm) | TF (ppm) | TSF (ppm) | IF (%) |
|------|------------|-------------------------------|-----------------|-----------|------------------|-----------------|-----------------|--------|
| A | 100 (23.3) | MFP | Hydrated silica | PD and ED | 1,450 | 025.44 ± 9.37 | 984.13 ± 8.40 | 4.02 |
| B | 58 (13.5) | NaF | Hydrated silica | ED | 1,450 | 1041.87 ± 6.76 | 999.38 ± 10.26 | 4.07 |
| C | 56 (13.0) | MFP | N.A. | ED | 1,450 | 1035.30 ± 5.28 | 1018.16 ± 8.99 | 1.65 |
| D | 54 (12.5) | MFP | Hydrated silica | PD and ED | 1,450 | 1040.93 ± 5.98 | 1024.97 ± 8.46 | 1.53 |
| E | 22 (5.1) | NaF | Hydrated silica | N.A. | 1,400 | 1034.36 ± 3.52 | 1016.52 ± 6.54 | 1.72 |
| F | 21 (4.8) | NaF | Hydrated silica | ED | 1,490 | 1040.00 ± 3.22 | 1025.21 ± 3.92 | 1.42 |
| G | 20 (4.6) | NaF | Silica | ED | 1,500 | 1050.56 ± 4.92 | 1036.94 ± 7.22 | 1.29 |
| H | 20 (4.6) | NaF | Hydrated silica | PD and ED | 1,450 | 1056.66 ± 6.07 | 1038.35 ± 3.54 | 1.73 |
| I | 19 (4.4) | NaF | Hydrated silica | ED | 1,450 | 1014.88 ± 7.39 | 1001.26 ± 10.51 | 1.34 |
| J | 14 (3.2) | MFP | Hydrated silica | ED | 1,450 | 1045.16 ± 10.59 | 1005.72 ± 9.56 | 3.77 |
| K | 11 (2.5) | MFP | Hydrated silica | ED | 1,500 | 1005.02 ± 7.75 | 980.37 ± 15.20 | 2.45 |
| L | 10 (2.3) | NaF | Hydrated silica | ED | 1,450 | 1049.62 ± 2.84 | 1028.96 ± 6.69 | 1.96 |
| M | 9 (2.0) | MFP | N.A. | N.A. | N.A. | 1055.72 ± 3.47 | 1039.76 ± 3.87 | 1.51 |
| N | 8 (1.8) | N.A. | Silica | PD and ED | 1,450 | 1058.30 ± 6.45 | 1040.00 ± 10.37 | 1.73 |
| O | 7 (1.6) | NaF | Hydrated silica | PD and ED | 1,000 | 997.04 ± 7.84 | 982.25 ± 9.15 | 1.48 |

On the contrary, about 16% of respondents in this study are influenced by cost, which is similar to other previous studies.^{32,33} However, only 9% of respondents preferred the presence of fluoride in their toothpaste. A study showed a relationship between the cost and presence of fluoride in toothpaste. Therefore, toothpastes containing fluoride may not be affordable,³⁴ which may indicate that respondents are already purchasing cheap toothpastes. In addition, approximately 11% of respondents chose their toothpaste based on dentist advice. This result is similar to those obtained by Sharda and Sharda²⁷ and Cote *et al.*,³⁵ which is due to poor knowledge, attitude, and practices regarding oral hygiene. Moreover, only 23.2% of Moroccan people visit a dentist.²⁴ Furthermore, a study conducted in Casablanca–Morocco reported that people primarily use *Juglandaceae* and *Syzygium aromaticum* medicinal plants recommended by traditional herbalists to treat oral pathologies.³⁶ Interestingly, another study reported that most people in developing countries still use traditional products such as neem twigs, ash, and salt to clean their teeth.³⁷ The high demand for purchasing toothpastes from supermarkets in this study could be due to the adopted marketing tools to encourage consumers to buy the products impulsively.³⁸ In addition, customers' affinity for the ease of shopping at supermarkets represents a significant factor.

Regarding the characteristics of different most marketed toothpastes, the findings of this study showed that 98% respondents use toothpastes containing a therapeutic fluoridated agent with concentrations varying between 1000 and 1500 ppm. This result is in discordance with another study carried out in Lima Peru, which reported that 4/23 of toothpastes marketed in this region have no fluoride.¹³ Another study carried out in Brazil reported that 95.6% of children use toothpaste containing fluoride.¹¹ Walsh *et al.*¹⁴ notified that toothpastes containing therapeutic fluoridated agents are recommended to prevent dental caries, and the use of fluoridated toothpaste containing 1,000 to 1,500 ppm of the fluoridated agent is more efficient.^{16,39} Several studies have reported the importance of purchasing toothpastes with the therapeutic fluoridated agent, its concentration, the abrasive used, and the production and expiration date mentioned in their packaging.^{8,16,39,40} However, incomplete labeling was encountered in toothpastes used by 58% of the respondents. Moreover, 10/15 toothpastes used by 55.4% respondents do not declare the production and expiration dates in the packaging; 1/15 toothpastes used by 2% of respondents do not declare therapeutic fluoridated agent, and 2/15 toothpastes used by 15% of respondents do not declare abrasive. Furthermore, our findings showed that the main therapeutic fluoridated agents used were NaF (presented in eight toothpastes used by about 41% of respondents) and MFP (presented in six toothpastes used by 57% of respondents). These findings are in

accordance with other studies achieved in several countries, which reported that toothpastes containing NaF and MFP are the most commercialized.^{11,13,41} Furthermore, both toothpastes with either NaF or MFP contain silica or hydrated silica as abrasive. This result indicates the interaction between the therapeutic fluoridated agent and the type of abrasive used. Therefore, silica abrasive is more compatible with NaF,⁴² whereas MFP is more compatible with calcium carbonate, dicalcium phosphate dihydrate, and alumina abrasives.¹³

With regard to different forms of fluoride in toothpaste, this study revealed that the amount of biologically active fluoride (TF and TSF) did not correspond to the claims and indications given in the packaging. These results are in agreement with those obtained in South Africa.⁴³ However, our findings are contrary to those of Cury *et al.*¹¹ and Loureiro *et al.*,⁴⁴ who found a 84.4% and 83.3% similarity between the fluoride declared and the fluoride found in Brazilian toothpastes. The reduction of biologically active fluoride may be due to manufacturing errors during production, the replacement of expensive ingredients with cheaper alternatives, high storage temperature, and interaction between therapeutic fluoridated agent and abrasive used.^{45–47} Moreover, storage time may be an important reason for reduced fluoride levels. Matias *et al.*⁴⁸ observed that the anticaries potential of toothpastes was reduced (TSF < 1000 ppm) after 9 months of storage, which were obliged to declare production and expiration dates in the packaging.

CONCLUSIONS

The main factors influencing the choice of toothpaste by students in Settat City, Morocco include the brand, the family choice, and the media advertisements. Furthermore, incomplete labeling was encountered in toothpastes used by 58% respondents. Therefore, implementing stricter control of the quality and safety of fluoridated toothpastes in Morocco through regulations, good manufacturing practices, education, research, and adverse event reporting is necessary to promote better oral health for the population and increase the prevention of dental caries. Furthermore, dentists should train and integrate oral health behavior to promote oral health in patients.

CONFLICT OF INTEREST

The authors report no declarations of interest.

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