GRADUATION PROJECT

Degree in Dentistry

TITLE

ACCESSIBILITY OF FLUORIDATED DENTAL PRODUCTS FOR PATIENTS IN THE MARKET: AN ANALYSIS.

Madrid, academic year 2024/2025

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RESUMEN

Introducción: La caries dental es una enfermedad crónica que afecta a la población a nivel mundial. Países como Noruega y España deben contar con productos dentales fluorados como pastas de dientes, colutorios, geles y barnices en el mercado para la prevención de la misma, ante la ausencia de agua fluorada. El flúor tiene tres mecanismos de acción: remineralización, evitar desmineralización y reducción de placa bacteriana. Existen varios tipos y concentraciones de pasta dental. Un dentífrico de 1450 ppm se considera la concentración terapéutica mínima y es de venta libre, mientras que una de 5000 ppm solo está disponible con receta en la mayoría de los países. **Objetivos**: Analizar la accesibilidad de los productos dentales fluorados entre los mercados de Noruega y España. **Métodos**: Este estudio adopta un enfoque cuantitativo, observacional y transversal mediante el análisis de 339 productos existentes en el mercado y que contienen flúor. **Resultados**: La mayoría de los dentífricos estaban por debajo del rango de 1450 ppm en ambos países, los enjuagues bucales con 910 ppm eran más habituales en Noruega y los enjuagues bucales con 225 ppm en España. La pasta de dientes de 5000 ppm estaba disponible con receta en España, pero estaba disponible sin ella en Noruega. No se encontraron geles ni barnices en el mercado **Conclusiones**: Ambos países suministran un elevado número de productos fluorados, la diferencia se ve claramente en la distribución, el mercado noruego vende gran cantidad de productos fluorados en farmacias, mientras que el mercado español vende más productos fluorados en supermercados.

PALABRAS CLAVE

Odontología, Fluoride, Prevención, Caries, Mercado.

ABSTRACT

Introduction: Dental caries is a chronic disease that affects the public globally. Countries such as Norway and Spain must rely on fluoridated dental products such as toothpaste, mouthwash, gels and varnishes in the market for the prevention of dental caries, since water fluoridation is non existent. Fluoride has 3 mechanisms of actions that include, remineralization, inducing demineralization and reducing plaque bacteria. Fluoride toothpaste consists of 2 main ppms, 1450ppm and 5000ppm. A 1450ppm toothpaste is available over the counter (OTC) and widely seen as the minimum therapeutic concentration in the market, whereas a 5000ppm is a remedial toothpaste that is available only by prescriptions in the market in most countries. **Objectives**: the objective of this study was to analyze the accessibility of fluoridated dental products and compare the results between the markets in Norway and Spain. **Methods:** This study takes a quantative, observational and cross-sectional approach by analyzing 339 dental products that contain fluoride in the market. **Results:** Most toothpastes fell under the 1450 pm range in both countries, mouthwashes with 910ppm were more prominent in Norway and 225ppm mouthwashes were more prominent in Spain. 5000ppm toothpaste were accessible with prescription in Spain but available without in Norway. No gels and varnishes were found in the market. **Conclusions:** Both countries provided a high number of fluoridated products, the difference is clearly seen in the distribution, Norwegian market retails vast number of fluoridated products in pharmacies, whereas the Spanish market retails more fluoridated products in supermarket.

KEYWORDS

Odontología, Fluoride, Prevention, Caries, Market.

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1. INTRODUCTION

1.1. Theoretical Framework

1.1.1 Importance

As of 2024, dental caries is the most prevalent disease among children and adolescents, affecting roughly 60-90% of all schoolchildren and 2.4 billion individuals(1–3). This number has slightly decreased in the past 3 years in developed countries, nonetheless still remains a public health issue(1).

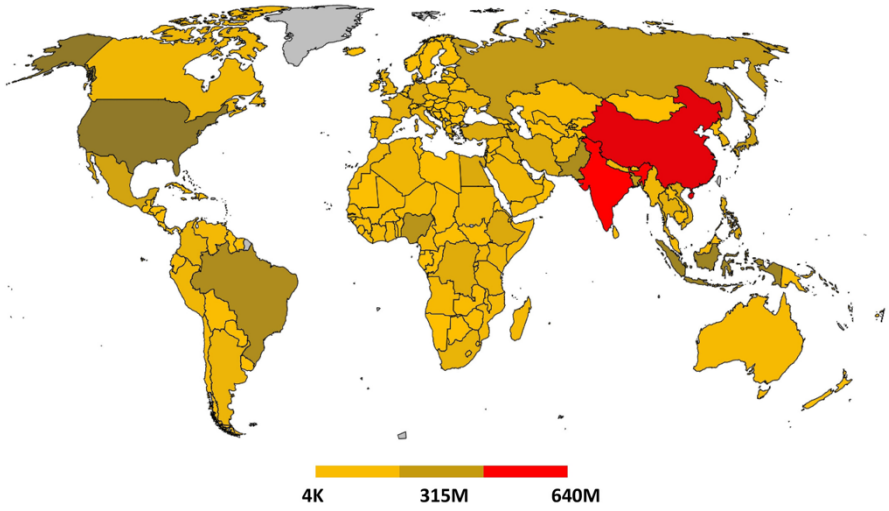


Figure 1 exhibits a major high caries prevalence count worldwide with an emphasis on India and China (4) data accessed from Institute of Health Metrics and Evaluation Global Burden Disease Database, available from ttps://vizhub.healthdata.org/gbd- results/; (accessed 14th January 2025).

The current preventative measure, given by the FDI in 2002, advocates for the preservation of a healthy tooth structure, by identifying and monitoring caries in an early stage as opposed to waiting for a cavity to be formed(5). This restorative model has gradually taken over the outdated surgical technique, consequently increasing the number of individuals that receive preventative oral health care(5). One such care is the use of fluoride, which is a form of fluorine, found within nature and air(6). At first the use of fluoride was assumed to be limited to tooth development, however later research has highlighted the importance of topical fluoride in the prevention of dental caries(6).

In this study, we will examine the accessibility of fluoride, elaborate on the different applications, whilst comparing the affordability between different regions.

1.1.2 Dental caries

Dental caries is defined as a chronic multifactorial infectious disease, that may affect parts of the teeth such as the crown and/or root of permanent and deciduous dentition, the fermentation of carbohydrates into acid by plaque bacteria is the primary reason for the promotion of this dental decay(7).

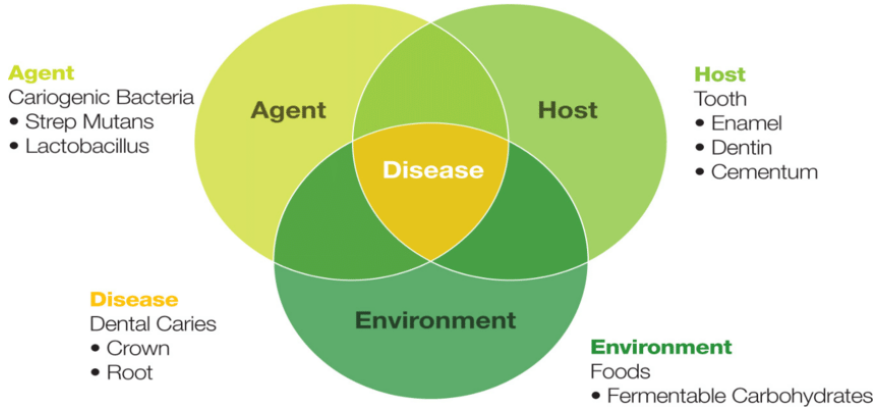


Figure 2 exhibits 3 leading factors that promote the progression of caries(8). Adapted from Keyes, Arch Oral Biol 1960;1:304-320.

The prevention of dental caries may be accomplished by several cost-effective methods, yielding greater benefits for the individual(1). As stated above, one of these cost-effective methods suggested by experts, such as WHO, whom sanctioned in 1969 as an important preventive measure, is the use of fluoride (9–12).

This leading cost-effective method, when applied topically, demonstrates its ability to enhance the inhibition of dental caries supplemented with correct oral hygiene practice by inducing a cariogenic and cariostatic mechanism(9,11,13).

1.1.3 Mode of Action

The 3 main functions of fluoride include reducing demineralization, allowing remineralization and inhibiting plaque bacteria(14). Tooth remineralization by fluoride works by accelerating the growth of hydroxyapatite crystals on partially demineralized sub surfaces crystals in carious lesions, thus providing resistance(9). In addition, phosphate and calcium have been added to fluoride to enhance remineralization(15). The effectiveness of fluoride is key for preserving good oral health and increasing the longevity of mineralized and demineralized surfaces.

Many individuals across the globe suffer from dental caries, its prevention is superior to its treatment(1,2). Therefore in recent years, fluoride based dental products in the market such as mouthwash and toothpaste have gained tremendous popularity as a preventive measure (16).

1.1.4 Mouthwash:

For a prolonged period, toothbrushes have been the golden standard in mechanically removing dental plaque and minimizing the risk of mouth-related diseases(17). Meanwhile, mouthwashes acts as an enhancement, it functions as an chemical agent facilitating the protection against bacteria and optimizing the oral flora (17). It includes ingredients such as cetyl-pyridinium chloride, chlorhexidine, essential oils and fluoride (17).

For the past 40 years, the use of fluoride mouthwashes has been key in maintaining upright oral health(16). Public health programs regarding fluoride mouthwash have been implemented in order to spread knowledge and prevent dental caries(16).

Fluoride mouthwash advocates as a cost effective method for treating dental caries(16). This is due to the argument that, a change in behavior from the use of non-fluoride mouthwash, to fluoride mouthwashes is considered to be a minimum change economically accompanied by additional health benefits(16).

One of the most common mouthwashes available for consumers today is the 0.2 sodium fluoride mouthwashes, in addition to 0.05 sodium fluoride mouthwash(18). It is proposed to utilize 0.05% sodium fluoride containing 230 ppm daily, commercially available over the counter (OTC) in majority of countries, though there happen to be 100ppm mouthwashes that may be used twice a day(16). 0.2% sodium fluoride contains 900ppm and is advised to use on a weekly basis since it contains a higher concentration(16). The latter method, is usually only available for consumers with high risk of caries over the age of six (16). This is due to the fact that infantile or children under the age of 6 are more susceptible to ingest small amounts of fluoride causing dental fluorosis during tooth formation(16).

Table 1. Refers to distribution of mouthwash ppm and target population(16).

Sodium Fluoride Concentration	PPM (Parts per Million)	Recommended usage	Target population	Notes
0.05%	230 ppm	Daily usage (OTC in most countries=	General population	Safe for daily use, commonly available over-the counter
0.2 %	900ppm	Weekly usage	High risk of caries and older than 6 years	High concentration, risk of ingestion and fluorosis restricts to 6 years and olde
100ppm	100ppm	Twice daily usage	General population	Lower concentration for more frequent applications

Various clinical tests have been conducted to test the efficiency of fluoride mouthwash in regards to caries during the past 5 decades(16). In recent years, two systemic reviews, among others, have been put forth pertaining to the effectiveness of fluoride mouthwash against dental caries, (Twetman 2004; Weyant 2013). From these conducted reviews, among others, there is substantial evidence confirming that fluoride based mouthwashes effectively inhibit the development of dental caries(16).

1.1.5 Toothpaste

As stated above, mechanically removing plaque together with fluoride toothpaste has been a key part in maintaining and preventing dental caries(19–21). The general rule differs concerning the concentration, amount and type of toothpaste, however the use of fluoride has been agreed upon to be the most efficient(3). Currently distributors use a variation of different fluoride compounds embedded in toothpaste that are available in the market, the most common being sodium fluoride, stannous fluoride, amine fluoride and sodium monofluorophosphate(3).

Over the counter, OTC, cosmetic fluoride toothpaste are available in many countries. These are recommended and regulated to around 1000-1500ppm, on the contrary, a more concentrated remedial toothpaste may contain up to 5000ppm (10,14,19,21).

Recent studies conclude that, applying fluoride toothpaste 2 times a day with a ppm of 1000ppm-1500ppm achieve respectable efficiency available for most ages(1,10,12,21). Whereas, toothpaste containing 5000ppm, exclusively prescribed by health care professionals in some countries, are specifically targeted at patients that fall under the category high risk of caries over the age of 16(3,14,19).

Table 2. Exhibiting the distribution of ppm in toothpaste and indications(22).

Fluoride toothpaste type	**Parts per million**	**Recommended usage**	**Target population**	**Notes**
Cosmetic toothpaste OTC	1000-1500ppm	Twice daily usage	Most ages	Widely available and effective for general population
Remedial toothpaste	Up to 5000ppm	As advised by health care professionals	High-risk caries patients 16 years and above	Concentrated formula, risk of cavities and prescription only in some countries.

Currently, there is no regulation for a minimum fluoride concentration however a maximum concentration must be regulated due to health risks such as fluorosis(3). The norm of using fluoride-based toothpaste has increased in the past decade, in comparison to other fluoride based products due to increased knowledge, consequently decreasing the prevalence of dental caries in developing countries(22).

1.1.6 Gels and varnishes

Gels and varnishes are a highly concentrated form of fluoride used as a preventive measure against dental caries(23). The main indication for the use of varnishes are moderate and high

risk individuals, in addition to children in communities where risk of caries is prevalent (23). Varnishes are usually applied with small brushes between two to four times a year by health care professionals (23). Evidence show 3 main compositions that are widely used across clinics, a fluoride varnish containing 5% NaF or 2.5% and 0.9% difluorosilane (23,24). Just like varnishes, fluoride gels are also applied in dental clinics for children over the age of six that are at risk for caries (24). The most common composition consists of NaF 1.23% in a 5mL solution applied in a tray for 4 minutes (24).

1.2 Justification

Caries is the number one leading chronic disease in the world right now, affecting 2.4 billion people worldwide (3,25). Approximately 60-70% of primary children are affected whereas the adult population is slightly higher (1,25). Dental caries and fluoride are essential matters of oral public health (9). Together, these topics affect the lives and well-being of individuals and communities across the globe. Applying fluoride has been an essential part of dental policy and public oral health as it a cheap cost-effective method in reducing dental caries, specifically in communities where access to dental health may be limited (3). It is well documented that fluoride significantly rebuilds tooth enamel, through toothpaste, mouthwash or community water fluoridation(16). These products are accessible globally in the market through supermarkets, dental offices or pharmacies, sustaining a healthy life.

1.3 Research question

The research question of this thesis will be established around fluoride in the market, we will examine closely different products and review the availability. The research question will be as follows, are there differences in accessibility of fluoridated dental products for consumers in the market in Spain and Oslo? We are confident that this research will allow us to gain knowledge on fluoridated products and show a distinctive comparison between two international markets.

PICO Question: Are fluoridated dental products more accessible and affordable in Norway compared to Spain, and how does this impact usage among the population?

1.4 Hypothesis

1.1.4 Alternative hypothesis (H1)

The accessibility of fluoridated products in the market varies greatly between Madrid and Norway.

1.1.5 Null hypothesis (H0)

The accessibility of fluoridated products in the market does not vary greatly between Madrid and Norway.

2. OBJECTIVES

2.1. Primary objective

2.1.1. To evaluate and compare the affordability and accessibility of fluoridated dental products in Spain, Madrid and Norway Oslo.

2.2. Secondary objective

2.2.1 To demonstrate the benefits and importance of using fluoridated dental products.

2.2.2 To compare the amount and demand of ppm´s in fluoridated dental products in different supermarkets in Madrid and Oslo.

2.2.3 To illustrate consumer awareness and knowledge of fluoridated dental products in the market.

3. MATERIAL AND METHODS

3.1 Design of the research protocol

3.1.1 Study type and design

The purpose of the study was to find the accessibility of fluoridated dental products in the market. The selected methodology, which takes a quantitative, observational and cross sectional approach, is in line with the nature of the selected research question.

3.1.2 Sample size

A total of 339 different fluoridated dental products were obtained and analysed throughout markets such as Mercadona, Dia, Alcampo, LIDL, Farmacia, Parafarmacia, Kiwi, Rema 1000, Meny, Coop Extra and Spar. Since this study wants to ensure that it obtains adequate results to identify the accessibility of dental products whilst maintaining resources that are manageable, we chose the sample size of 339. This sample size also represents a balance of reliability and viability with a low margin error thus allowing for a suitable analysis.

3.1.3 Inclusion and Exclusion criteria

This study chose to include criteria's that would ensure correct analysis in line with the selected research question. These criteria are, dental products containing fluoride, fluoridated dental

products specifically in Spain and Norway, fluoridated dental products commercially available over the counter and available through prescription, fluoridated dental products approved and regulated by the Royal Legislative Decree 1/2015 Guarantees Law in Spain, fluoridated dental products approved and regulated by the Norwegian Folkehelse Instituttet, fluoridated dental products for ages over 6 years old. This study excluded, dental products that did not contain fluoride.

3.1.4 Method of Data collection

The design of this research consists of two parts. In the first part, we obtained results by seeking out different products in the market in different supermarkets. An excel spreadsheet with the following criteria's was created, brand of product, name of product, price of product and quantity of product. Each item was analyzed separately. In addition, we examined how easily accessible these products are. Lastly, the results were compared between the two countries, Spain and Norway.

Secondly, books, scientific articles and online journals, using Biblioteca CRAI, Pubmed, Medline and Dentistry & Oral Science Source were used.

The scientific articles that were used are mostly published within the last 10 years however a few minimum articles that I have used date prior to this.

3.1.5 Ethical issues

No ethical issues were made during this investigation.

4. RESULTS

We aimed to identify toothpastes containing fluoride in the market and how easily accessible these products are. A total of 5 supermarkets and 2 pharmacies were analyzed in Madrid Spain, whereas a total of 6 supermarkets and 2 pharmacies were analyzed in Oslo Norway and total of 26 articles were reviewed. The results were obtained from the following supermarkets in Madrid, Mercadona, Día, Al Campo and Carrefour. On the other hand, our results from Oslo were obtained from the following supermarkets, Kiwi, Meny, Rema 1000 and Oda. We categorized our results into 4 sections

1. Amount of dental fluoride products in each supermarket
2. Different brands for each toothpaste that were found in each supermarket
3. How many toothpastes and mouthwash contain a specific ppm
4. How many gels and varnishes are available in the supermarket

Firstly, we attended each supermarket in turn, and gathered the amount of toothpaste and mouthwash that we were able to retrieve into a bar graph. This allowed us to depict a visualization of the sum of fluoride dental product in each supermarket.

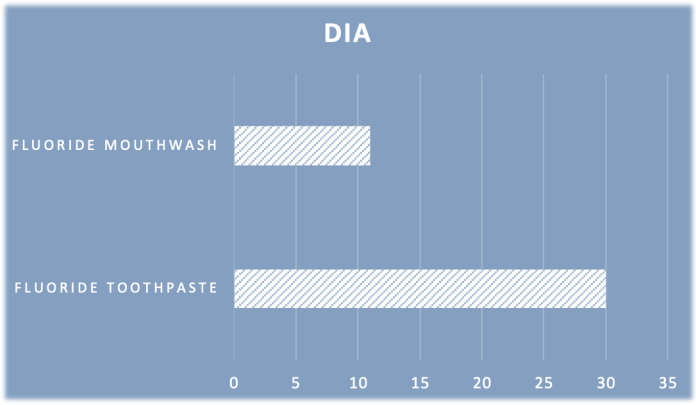


Figure 3 graph showing number of mouthwash and toothpaste in Dia.

A total of 10 mouthwash and 30 toothpastes were obtained

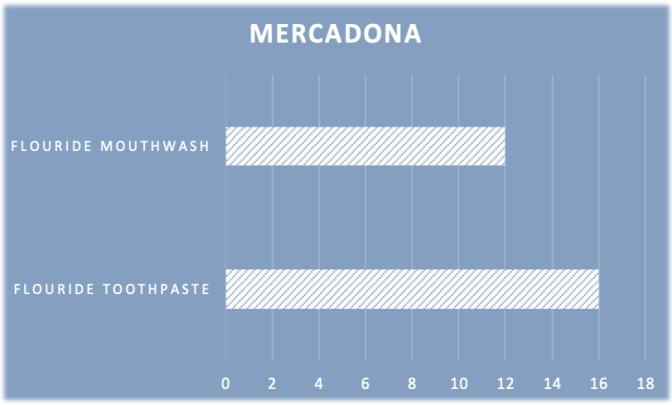


Figure 4 graph showing number of mouthwash and toothpaste in Mercadona.

A total of 12 mouthwash and 16 toothpastes were obtained

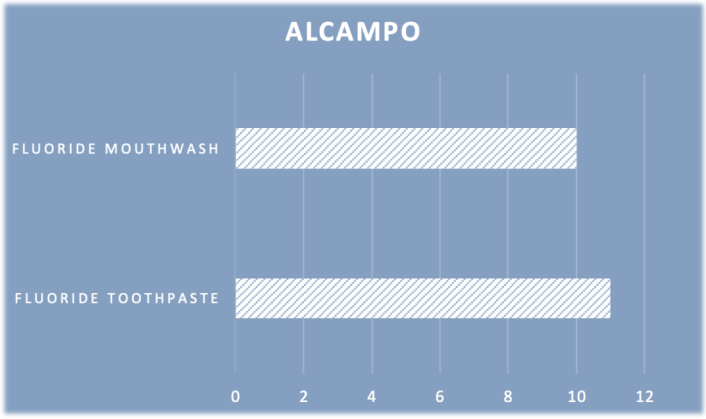


Figure 5 graph showing number of mouthwash and toothpaste in Alcampo.

A total of 10 mouthwash and 11 toothpastes were obtained.

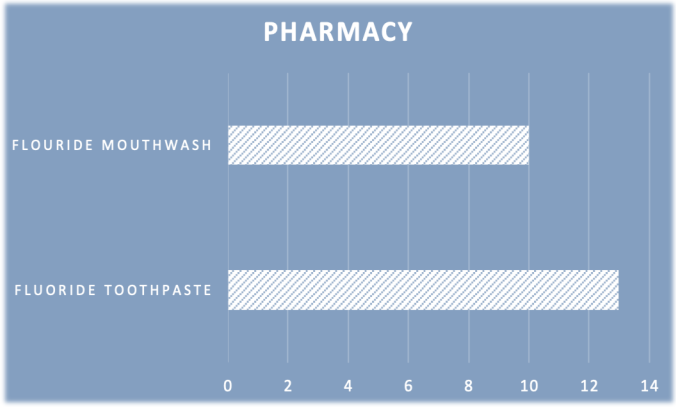


Figure 6 graph showing number of mouthwash and toothpaste in the Pharmacy.

A total of 10 mouthwash and 13 toothpastes were obtained

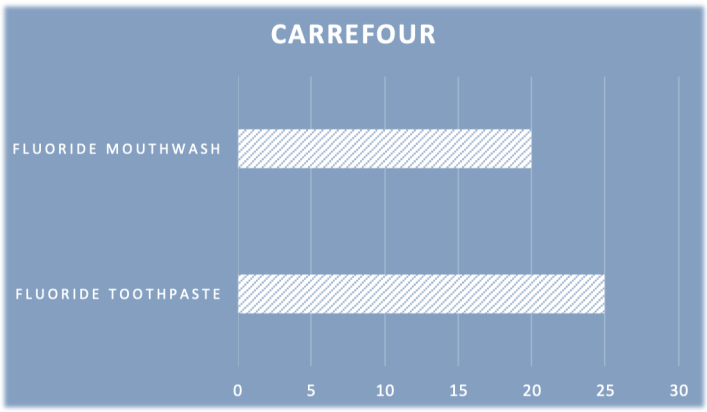


Figure 7 graph showing number of mouthwash and toothpaste in Carrefour.

A total of 20 mouthwash and 25 toothpastes were obtained

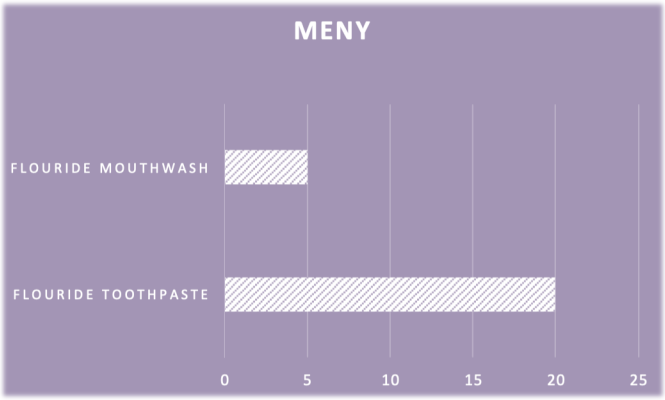


Figure 8 graph showing mouthwash and toothpaste in Meny.

A total of 5 mouthwash and 20 toothpaste were obtained.

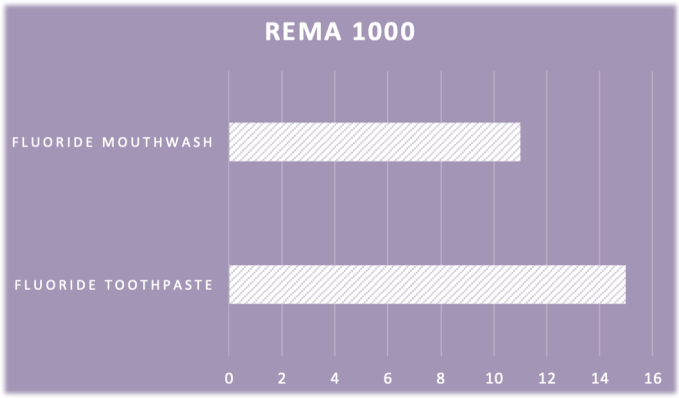


Figure 9 graph showing mouthwash and toothpaste in Rema 1000.

A total of 11 mouthwash and 15 toothpaste were obtained.

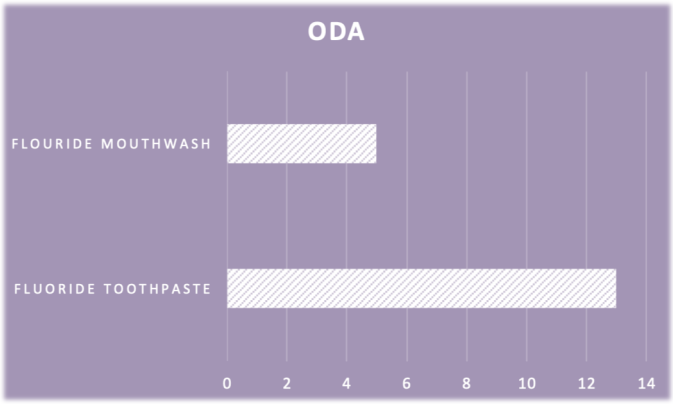


Figure 10 graph showing mouthwash and toothpaste in Oda.

A total of 5 mouthwash and 15 toothpaste were obtained.

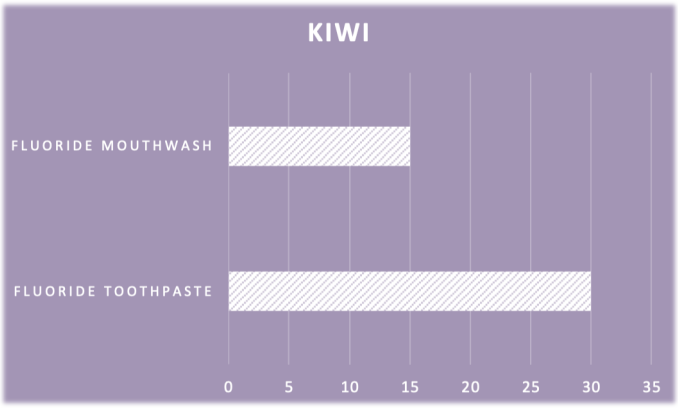


Figure 11 graph showing mouthwash and toothpaste in Kiwi.

A total of 15 mouthwash and 30 toothpaste were obtained.

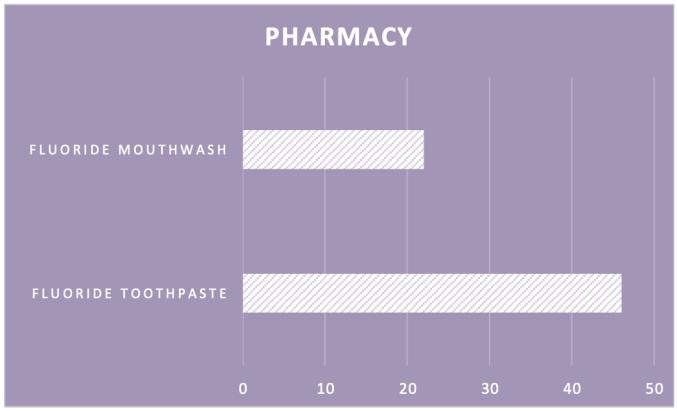


Figure 12 graph showing mouthwash and toothpaste in the pharmacy.

A total of 21 mouthwash and 45 toothpaste were obtained.

Furthermore, we analyzed different types of toothpaste brands in the market in Madrid, such as Sensodyne, Colgate, Deli-plus and Kin. We conducted a deeper analysis and investigated the sub-brands that each brand produces, for instance Colgate produces sub-brands such as Advanced White and Colgate Triple Action. Each brand was examined and a bar table was created showing the distribution of sub-brands in the market. The same was done with mouthwashes from the supermarket.

Figure 14 graph showing brands of mouthwash

A total of 7 mouthwash brands were analyzed, Lacer and Listerine were the most abundant, up close with Mercadonas own brand, Deliplus.

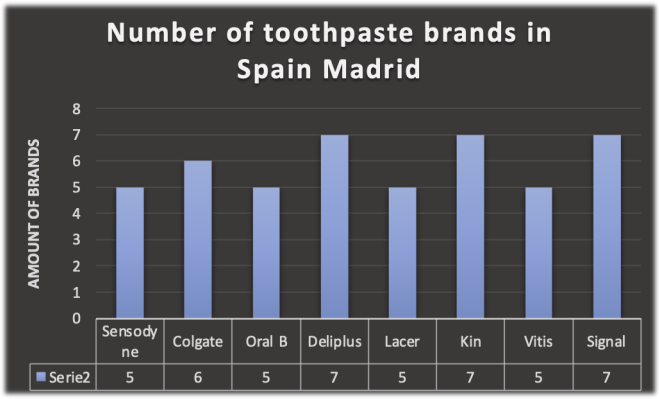


Figure 15 graph showing brands of toothpastes

A total of 8 toothpaste brands were analyzed, Signal, Kin, and Colgate highly available with Deliplus being the most common in Mercadona.

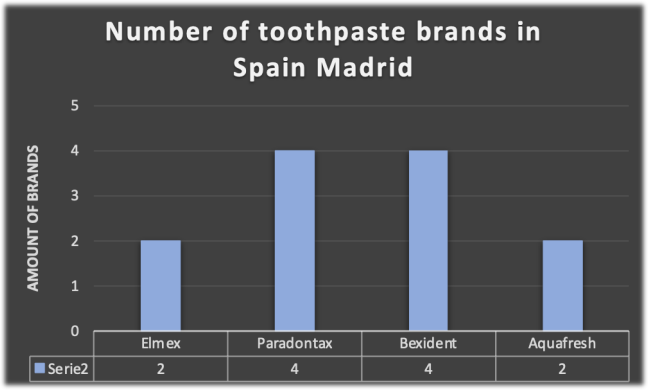


Figure 16 graph showing brands of toothpaste

The least common toothpaste brands with sub brands available in the market in Spain.

The same investigation was conducted with mouthwash and toothpastes obtained from Oslo, Norway.

Figure 17 graph showing brands of toothpaste

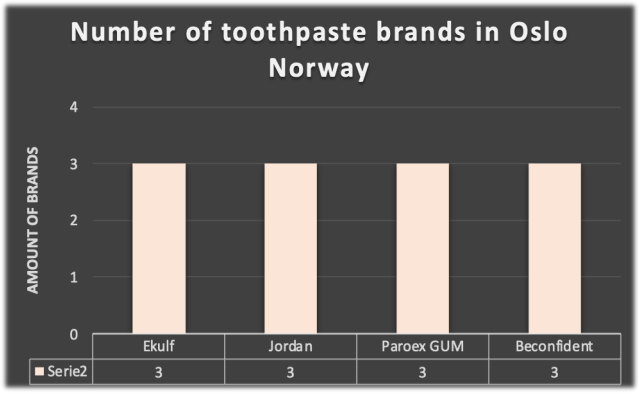


Figure 18 graph showing brands of toothpaste

Sensodyne was the most common toothpaste with the most sub brands from all the markets that were analyzed, close to Zendium and Hissmile in Oslo.

Toothpaste with the least sub brands and shelves placement in the market in Oslo.

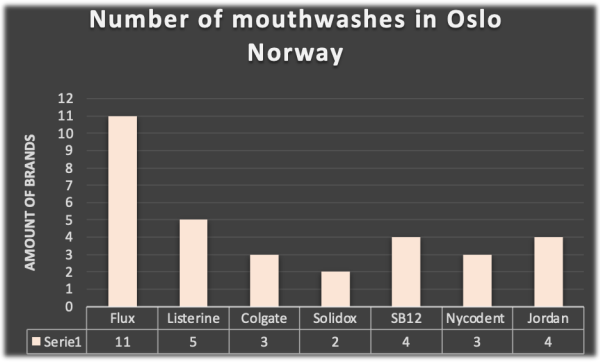


Figure 19 graph showing brands of mouthwashes

Flux was the most common mouthwash in the market in Oslo

Thirdly, we decided to focus on the distribution of ppm´s in the supermarket, analyzing how many toothpastes that we had collected contain 1400ppm, 1450ppm, 2500ppm and 5000ppm.

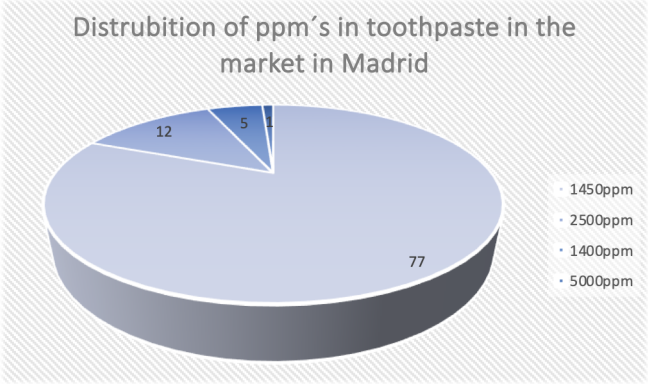


Figure 20 graph showing frequency of different ppm in the market for toothpaste

In Madrid, a total of 95 toothpastes were analyzed, from a total of 95 products, 77 contained 1450ppm, 12 of them have 2500ppm, 5 of them 1400ppm and 1 contained 5000ppm.

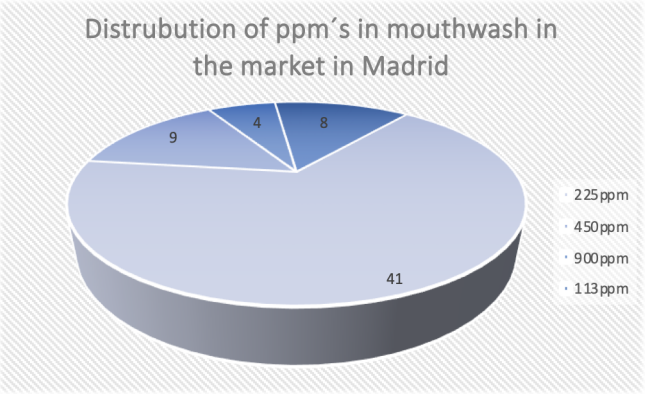
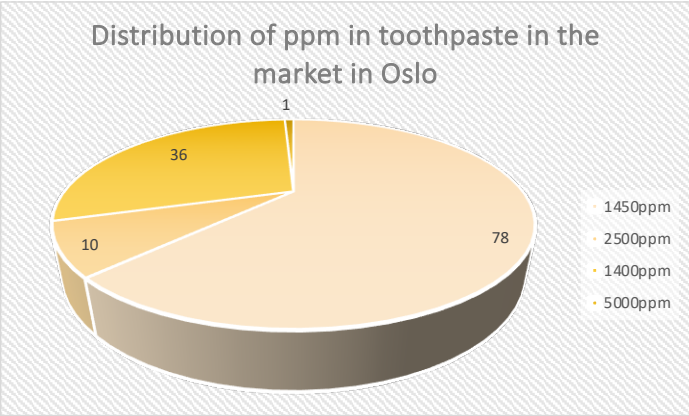


Figure 21 graph showing frequency of different ppm in the market for mouthwash

The same was done for mouthwashes, a total of 62 mouthwash were analyzed, the majority contained 225 ppm, 9 contained 450ppm, 4 of them have 900 ppm and 8 contain 113 ppm.

Figure 22 graph showing frequency of different ppm in the



The market in Norway was somewhat similar to the market in Spain, 78 products contained 1450ppm, 10 contained 2500ppm, 36 had 1400ppm and 1 contained 5000 ppm.

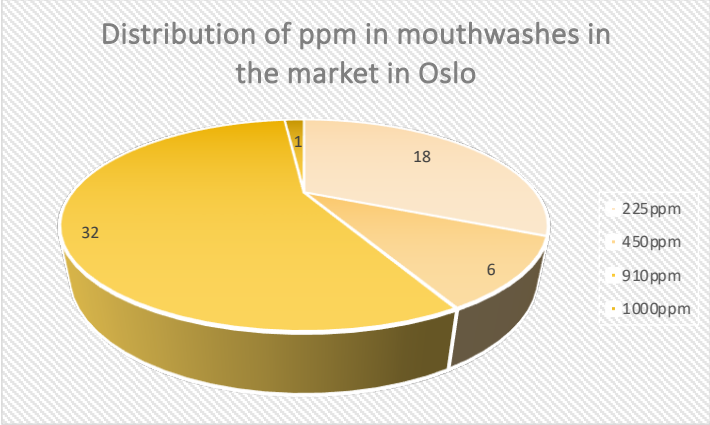


Figure 23 graph showing frequency of different ppm in the market for mouthwash

The market in Oslo was somewhat different to Madrid 18 mouthwashes contained 225, 6 with 450pp, 32 with 910ppm and 1 with 1000ppm.

5. DISCUSION

The study investigated the accessibility of fluoride products in the market by assessing the markets in both Norway (Oslo) and Spain (Madrid). The null hypothesis stated that the accessibility between latter markets will not vary greatly. Our goal is to evaluate and compare the affordability and availability of these products.

5.1 Fluoride toothpaste

Our findings suggested that fluoride toothpastes were highly accessible in Madrid and Oslo. The main difference between both cities is the distribution of these products. In Madrid, major supermarkets offered a wide variety of different brands of toothpastes. For example, one supermarket that we analyzed, Carrefour, provided 25 different toothpaste products, and another supermarket that we had sought out our results from, such as Dia, presented 30 different toothpaste products. Mercadona offered 16 different products, including its own low-cost brand (Deliplus), whilst on the other hand, Al Campo displayed only 11 products, the least amount on shelves from all the supermarkets that were analyzed. This implies that toothpaste products in Madrid are primarily sold and distributed by large supermarkets for Spanish customers. On the other hand, pharmacies that were investigated contained a smaller number of products than supermarkets, 10-13 products. Our findings suggest that in Spain, pharmacies play a reduced role in retailing toothpaste, perhaps emphasizing specialized or prescription-strength toothpaste, whereas supermarkets sell an extensive range of ordinary toothpaste, including the typical 1000-1450 ppm formulation for adults. In Oslo, on average, supermarkets offer fewer toothpaste products on shelves compared to the Spanish supermarkets, however still provide a respectable variety of different toothpaste products. Markets such as Kiwi offered around 30 fluoridated toothpastes, and other supermarkets like Oda and Meny provided between 15 and 25 choices. In contrast, pharmacies showed a significant number of products on shelves in Norway, around 45 different toothpastes, which is 3x more toothpaste products than pharmacies in Madrid. This discrepancy indicates that pharmacies may be the leading approach for buying fluoridated toothpastes in Norway. As a result, for fluoridated toothpaste products not available in supermarkets, consumers may have to rely on pharmacies instead of supermarkets. The market for toothpastes in Spain is predominantly focused in supermarkets, a contrast to the market in Norway; nevertheless, the total number of products accessible to consumers in the market between the two cities, was near an equivalent quantity and scale.

Regarding different types of brands and sub-brands, our study found a great number in Oslo and Madrid, such as Colgate, Sensodyne, and Oral-B. In Spain, local and retail brands such as Kin and Deli Plus (a low-cost brand) from Mercadona were widely available, enhancing the options for Spanish consumers. These local brands often target general needs for consumers while at the same time providing economic benefits. In Norway, local brands are less common to be found, the market focuses itself more on domestic and international brands such as Paradox, Zendium, Colgate, and Sensodyne, to name a few. In both markets, sub-brands were extensively present, displaying a variety of formulas, such as different sensitivity formulations, different flavors, different herbal variations, and an extensive spectrum of whitening pastes. The wide variety of

different sub-brands of fluoride toothpaste in both markets is an effective approach allowing a diverse selection on shelves for customers. Our study identified that the only element in both markets that did not vary greatly was the ppm of toothpaste products. On average, from all the toothpaste that was analyzed and collected, our study suggested that the majority of toothpaste fell under the range of 1400-1450. This range is a maximum allowed for distribution over the counter in most European countries(10). The prevalence of 1450-1500ppm toothpaste products in our results are consistent with studies that suggest it is the range that allows for the diminishing and reduction of dental caries (10). A 5000ppm Colgate Duraphat toothpaste was found in both markets which is a prescription only product specifically for high-risk caries patients. Typically available in pharmacies without a prescription in Oslo, Norway. On the contrast, a prescription from the dentist or a doctor is essential in Madrid, Spain to acquire such product. Such high concentrations are uncommon and therefore are not widely distributed everywhere due to a limited demand and regulatory classification.

5.2 Mouthwash

The market accessibility in both markets for mouthwashes were somewhat comparable to the market for toothpastes. On average, around 5-12 mouthwashes were found in each supermarket that were analyzed in Madrid. Colgate, Listerine and Lacer were a few that were quite abundant in the market. Pharmacies in Spain play as an additional role to the market for mouthwashes, approximately 10 mouthwashes were surveyed, the vast majority including a special formulization, such as periodontitis prevention or sensitivity prevention.

On the other hand, in Oslo, Norway, mouthwashes in supermarkets were in less numbers. Domestic brands such as B12 and Flux were quite abundant in the market compared to brands such as Colgate and Listerine. Pharmacies showed great variety and more diverse in their collection, from standard daily rinses to curative rinses aimed at gum care, plaque prevention and sensitivity. 910 ppm mouthwashes were the most common and available in the market, with a 1000ppm with fluoride and chlorhexidine specifically in pharmacies in Oslo, whereas Madrid offered a majority of 225 ppm mouthwashes.

Regarding accessibility of mouthwashes in the market, both Madrid and Oslo offer a wide range of different mouthwashes. The market in Oslo focuses more in the pharmacy sector which might indicate a behavior of asking professional health care personal before buying fluoride products, whereas the market in Madrid relies on supermarkets offering wide range of mouthwashes, with pharmacies playing an auxiliary role providing more niche brands.

In both countries, 0.05% NaF mouthwashes were highly available. Usually applied daily and seen as the golden standard for standard oral health routine(16). These mouthwashes are sold over the counter and with no age restriction. Another subset of mouthwashes with 900ppm 0.2% NaF are mostly retailed in pharmacies in both markets. These specific products are weekly uses, since they contain a higher percentage of sodium fluoride and therefore usually targeted at high-risk caries patients(16).

Our study suggests that 0.2% NaF mouthwashes are usually purchased in pharmacies than supermarkets in both markets. Hence, general consumers tend to obtain 0.05% NaF daily rinses instead. Our data revealed both markets offered 0.05% NaF mouthwash and 0.2% mouthwashes, however the availability for the latter in supermarkets is observed as less due to regulatory classifications compared to pharmacies.

5.3 Gels and Varnishes

Our study clearly identified the lack of gels and varnishes in the supermarket. We analyzed both international markets, including supermarkets and pharmacies, and obtained zero findings of gels and varnishes. This outcome was anticipated and highlights a significant impediment in accessibility, fluoride gels and varnishes are exclusively obtainable through dental clinics and health care professionals. This is due to the high fluoride level it contains which may inflict a health hazard for the consumer. Varnishes are composed of 5% NaF and are applied by dentist in an dental clinics, whereas gels typically contain 1.23% NaF and are also offered by health care professionals in dental offices(24). Since, both of these methods include applying a high level of fluoride to the patient, both countries, including all of Europe, maintain a strong opinion of restricting the sale of gels and varnishes with regulation. On one hand, the application of gels and varnishes may be seen as a barrier in the market, allowing only professionals to provide such care for patients who might find gels or varnish as a necessity and might profit from these products outside dental visits greatly but must visit a dental clinic every time limiting their accessibility. Such a restriction implies that preventive care for individuals at elevated risk is solely achievable in offices and clinically.

On the other hand, since both of these techniques contain a level of fluoride that may be toxic, it is important that the regulation, application are done correctly allowing a beneficial advantage for the consumer and target only those patients that require it, such as children with rampant caries, warranting a correct dosage.

5.5 Comparative Analysis

Our study has highlighted key differences and similarities both markets share in affordability and accessibility. Regarding the market in Spain, fluoridated dental products have been incorporated into the market effortlessly, relying heavily on supermarkets across the country. In addition to providing an extensive range of niche brands, such as Colgate, Sensodyne or Oral B, the market in Madrid has done an excellent in including store-brand alternatives for consumers for a low cost. Products such as Deli-Plus or Carrefours store-brand are examples of low-cost and offer a satisfactory level of fluoride beneficial for the consumer. This may indicate that all consumers in Spain, regardless of their economic situation or restricted income, have easy access to fluoridated products at a reasonable price. The reasonable price of fluoride-containing products are in line with WHO´s list, labelling it has a low cost essential health products(10). On the contrary, our study suggests that the market in Norway emphases more on niche products with a higher cost of goods, with little focus on low cost alternatives brands and products. This may be due to the high income and higher average salary compared to Spain. In addition, our discovery for a low cost fluoride alternative in 4 different supermarkets came as inconclusive, due to the fact the Norwegian markets largely stock known brands, consequently decreasing the availability for any low cost brands. In majority countries in Europe, including Spain and Norway, the accessibility of fluoridated dental products in the market is not seen as an impediment, it is only seen as a barrier once the cost of a year's supply toothpaste is above a day's work of an average salary for an average worker, this is not the case for most countries in Europe(10). This is crucial from a public health perspective. Norway and Spain have a restricted or non-existent distribution of water fluoridation; therefore, these countries rely on fluoridated dental products in the market as their primary method for prevention, ensuring easy accessibility for every socioeconomic group.

Our study clearly indicates a few differences the two markets. Such as the emphasis on pharmacies for a broad variety of products in Oslo, whereas Spain utilizes its supermarkets more. These complexities specify that we must take into culture, behaviorism and environment to asses a consumer's accessibility to products in the market.

6. CONCLUSIONS

Our objective for this study was to analyze the accessibility of fluoridated dental products in the market and compare them between two markets in Oslo, Norway and Madrid Spain. 339 products were investigated and our study indicated that both international markets guarantee a wide accessibility to standard fluoridated products for the public. Both Spain and Madrid offer

toothpastes, typically containing 1400ppm to 1500ppm, the recommended range. Distribution varies between the two markets, in Spain these are generally provided at supermarkets whereas in Norway, these products are mostly found in pharmacies. On the other hand, a 5000ppm demands regulatory guidelines in Spain, with less demanding guidelines in Norway. Moreover, products such as gels and varnishes were unavailable for consumers to purchase in markets due to a significant high fluoride concentration, hence it is only applied by professional dentists in a dental clinic. These results underline the importance of how easily available fluoridated products in the market should be, given the fact that water fluoridation merely exists in countries such as Spain and Norway. Both Norway and Spain rely on the availability of fluoridate products in the market to improve public oral health and prevent caries on a national scale. This comparative study highlighted different models that markets may utilize, thus achieving public access to an essential product within the affordability and standard fluoride range aspect.

7. SUSTAINABILITY

This thesis engages in numerous aspects, 3 to be specific, from the United Nations Sustainable Development Goals. Firstly, it underscores Objective 3: Good Health Well Being by exploring the prevention of dental caries and encouragement of fluoride in the public market. In addition, it addresses the importance of fluoride and its advantages that the public may gain knowledge from and use on a daily basis. This thesis includes Objective 10: Reduced Inequalities. This is in regard to the inequality and difference in affordability or accessibility of fluoridated dental products in the market between Norway and Spain, this thesis highlights different methods of accessibility that consumers are customary to. Lastly, Objective 12: Responsible Consumption and Production is indicated in this thesis by the fact that it explains the ecological effect of fluoride as a whole for the public in regards to distribution and consumption by the public. Moreover, it explains the methods of consumption.

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