



Dental Caries Prevention in the Dominican Republic.

A cross-sectional study of the application of
preventive measures among Dominican dental
practitioners in the private sector

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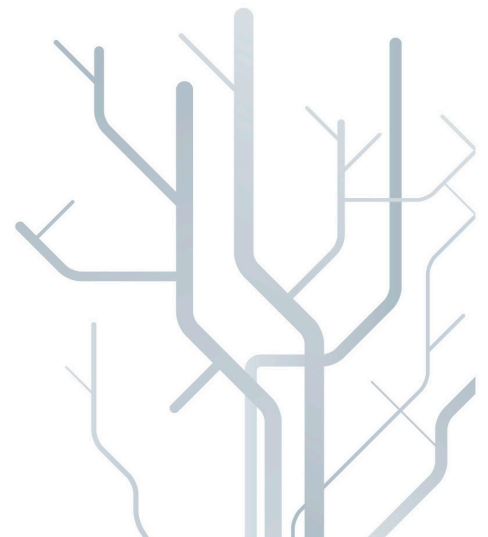
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Abstract

Title: Dental Caries Prevention in the Dominican Republic. A cross-sectional study of the application of preventive measures among Dominican dental practitioners in the private sector.

Background: Dental caries is an oral disease where bacteria damages the hard structure of the tooth, causing pain, tooth loss and infection. The prevalence of dental caries in developing countries is still high affecting mainly the low-income population. Knowledge of dental caries prevention and its application among dental practitioners is one of the main aspects for the effectiveness in the provision of preventive measures.

Purpose of study: Evaluate the application of preventive measures in regards of knowledge and impediments in dental caries prevention and the provision of oral health care services among Dominican dental practitioners in the private sector.

Methods: Cross-sectional study. Data collection from self-administered surveys to Dominican dental practitioners working for the private sector in the Dominican Republic. Interviews and opinions collected at different institutions in the private and public health sector. 308 Dominican dental practitioners participated in the study between the ages of 23-70.

Results: The majority of dentists answered positively to the application of preventive measures and the topics of knowledge of dental caries prevention. Patients' poor oral health and poor knowledge of potential caries were a great concern, as well as the use of fluorides. Oral health care is often provided in the private sector, and public provision such as preventive programs for children were services that are not always in the government's budget each year.

Conclusion: Dominican dental practitioners have the general knowledge of dental caries prevention and provide the necessary preventive measures to the Dominican population. The study had positive results even the high prevalence of dental caries in the Dominican Republic. Some weaknesses were found for the provision of preventive measures from the private sector and the Ministry of Health, but new oral health trends and policies are taken into account.

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Abbreviations

ADA	American Dental Association
AMRO	WHO Regional Office for Latin America
AOD	Asociación Odontológica Dominicana (Dominican Dental Association)
CI	Confidence Interval
COCHRANE	The Cochrane Library
DMFT	Number of Decayed, Missing or Filled Teeth in Adults
MEDLINE	US National Library of Medicine/National Institute of Health
N.A.	Not Available
NCBI	National Center for Biotechnology Information
OR	Odds Ratio
PAHO	Pan American Health Organization
PubMed	US National Library of Medicine
PUCMM	Pontificia Universidad Católica Madre y Maestra
SD	Standard Deviation
SIGN	Scottish Intercollegiate Guidelines Network
SESPAS	Secretaría de Estado de Salud y Asistencia Social-Ministry of Health
UNIBE	Universidad Iberoamericana
UNPHU	Universidad Pedro Henríquez Ureña
UASD	Universidad Autónoma de Santo Domingo
WHO	World Health Organization

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Introduction

As a disease where bacteria damages the hard structure of the tooth, causing pain, tooth loss and infection (1), dental caries has become «... *an endemic infection and a major public health problem worldwide*» (2, p.2). Three factors must be present at the same time to develop dental caries: a susceptible tooth, high consumption of fermentable carbohydrates, and mainly, the bacteria *Mutans streptococci* (3). The presence of this cariogenic bacteria in the consumption of sugar and fermentable carbohydrates in food and drinks (both in total amount and frequency of consumption), contributes for the presence and extent of dental caries (2). A good oral health indicates being free of dental caries, but a poor oral hygiene or a carbohydrate-rich diet are some factors that will increase the growth rate of oral bacteria and prone individuals to dental caries (1, 4). Good oral hygiene, low sugar intake, a well-balanced diet, and use of fluorides, are some of the known measures for dental caries prevention, but the application of these measures do not always obtain an ideal result. Previous studies on prevention have shown results that social factors affect the prevention of dental caries and its application (5). Social determinants of health, such as lack of resources and no access to oral health care services also count as potential factors to develop dental caries, especially in low-income communities. An increase of dental caries levels among developing countries is a great concern. For that reason, dental caries prevention should be considered an important factor in oral health care treatment and a major aspect in the health of the population.

However, dental practitioners' knowledge of dental caries prevention and a good provision of preventive measures also count as important for the reduction of dental caries prevention.

This thesis deals with both of these topics.

This study will try to evaluate the practices in preventive measures among Dominican dental practitioners regarding their orientation and knowledge on dental caries prevention, and the

impediments found in the application of these measures. Prevention in dental caries is seen as a good measure that all dental practitioners apply, but the question raised emphasizes on how come dental caries levels are still high in some countries even though the application of preventive measures. Since little is known about this subject, in particular for the case of the Dominican Republic, this thesis will present information on aspects of knowledge in dental caries prevention, impediments in the provision of preventive measures, and map the application of preventive measures in the clinical practice of Dominican dental practitioners in the private sector. This is to present knowledge, the first study ever made on dental caries prevention among dental practitioners in the Dominican Republic.

Through a cross-sectional study of self-administered surveys to dental practitioners in the private sector, the use of preventive measures will be the focal point in the oral health care delivery system in the Dominican Republic. This study may support inferences of cause and effect, and answers about dental caries prevention and its application. This thesis also aims to assess different factors in dental caries prevention that impede the provision of preventive measures among dental practitioners in the Dominican Republic. In terms of preventive methods applied to patients, the lack of knowledge and preventive practices in dental caries prevention, and impediments such as patients' poor oral hygiene or lack of time at the dental office, could have an effect in the application of preventive measures that may influence Dominican dental practitioners' application of preventive measures.

During the study other issues raised different concerns regarding dental caries prevention in the Dominican Republic, such as oral health policies in the country and the most common impediments perceived in the provision of preventive care. The application of preventive measures could also have an association with the dental caries status of the country. In order to provide scientific evidence on dental caries prevention, this study will provide an analysis

of the knowledge and standpoint of Dominican dental practitioners in the private sector for the provision of preventive measures in dental caries prevention in the Dominican Republic. Other factors, such as the high prevalence of dental caries and levels of sugar consumption in the Dominican Republic could also be related to dental caries prevention (see section 1.4). Additionally, the provision of preventive measures are often delegated to other members of the dental team (e.g. dental hygienists) (4), but this does not seem to be the case in the Dominican Republic. For this reason, this study will focus on the dental practitioners rather than patients and other members of the dental team. Assessing the application of preventive measures with dental caries levels is difficult, but this study will focus on the factors that may affect the application and the provision of preventive measures. A theoretical framework based on international guidelines and a survey will emphasize the evaluation of the application of preventive measures among Dominican dental practitioners. By using the case of the Dominican Republic, this thesis will point out levels of knowledge on dental caries prevention and impediment factors Dominican dental practitioners may face at their practice in the application of preventive measures. Different aspects in the application of preventive measures will also be described in this study as potential factors that may affect dental caries prevention. A general description on dental caries and background information from Dominican dental practitioners will be used. Furthermore, this study will give some general information on the Dominican Republic, describing the Dominican health care delivery system and dental caries in the Dominican Republic.

The following sections in this chapter will provide an evaluation of the dental literature and a theoretical framework. This section also comes up with a more thorough overview of dental caries concepts and preventive care, and relevant background information on oral health care in the Dominican Republic.

1.1. Evaluation of the Dental Literature

With an emphasis on descriptive epidemiology using the prevalence of dental caries (see section 1.6) and following an analytical approach, this study will try to explore the outcome variables relevant for the application of preventive measures in dental caries prevention.

The literature search was based on the idea that the lack of knowledge on dental caries prevention and application of preventive measures among dental practitioners could increase the risk of developing dental caries among patients. To explore this hypothesis, a cross-sectional study gathered a sample of private dentists in the Dominican Republic assessed at one point in time. The variables will examine the dental practitioners' knowledge and the application of preventive measures at their practice. The results will compare the occurrence of practice in dental caries prevention among dental practitioners who apply preventive measures. One could determine whether there is an association between the presence of dental caries in the Dominican Republic and the application of preventive measures in dental caries prevention. Although, the potential to contribute to a judgement of causation is limited since these results cannot determine whether the outcome occurred before the application of preventive measures or if it was developed as a result of some other cause such as patients' knowledge and poor oral hygiene, or other external factors, rather than the lack of knowledge and preventive practices in dental caries prevention. Most studies found on dental caries prevention are based on patient-treatment, and only a few articles are related to the knowledge and application of preventive measures used by dental practitioners. Nevertheless, based on a boolean search, various articles were found on dental caries prevention, such as «Dental caries trends and sugar consumption» (6, 7), «Dental caries prevention and preventive measures» (8, 9), and «Factors in caries management» (10-12). Also, a few textbooks (3, 4, 13) and a thesis (14), discuss dental caries prevention and the understanding of preventive measures among

dental practitioners. These studies, followed by the recommendations from international guidelines will be used as reference in this study.

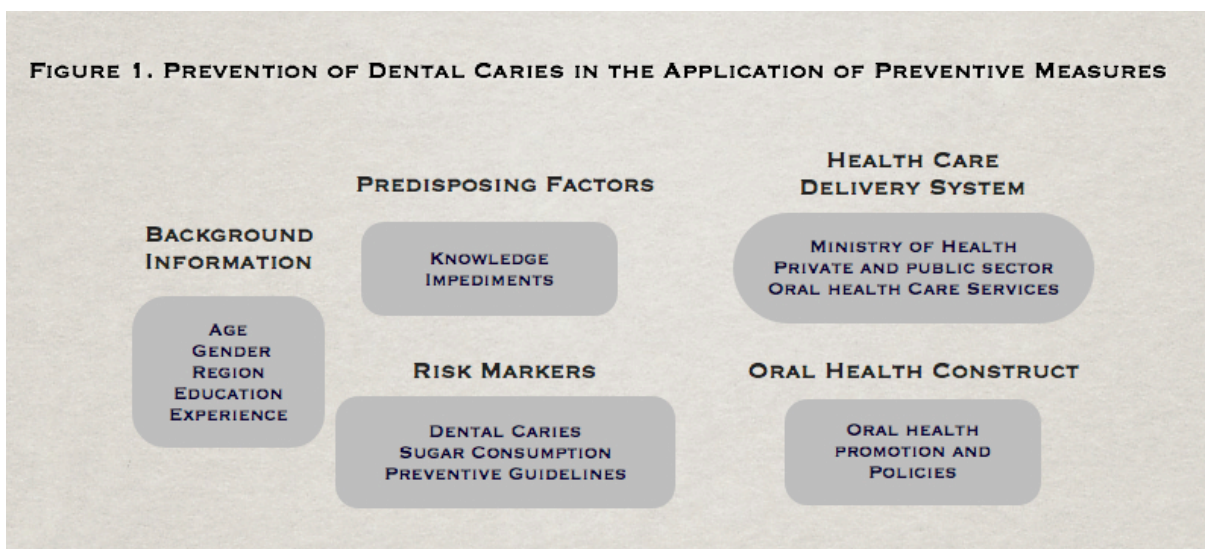
1.2. Theoretical Framework

With the help of articles and statements from international studies and guidelines on dental caries prevention, a theoretical framework will account as the starting point for this study. This theoretical framework will explain the variables used in the study and describe the different factors and determinants in the application of preventive measures. Different factors on dental caries prevention cover the preventive measures mostly used in the Dominican Republic and how guidelines are good resources for the improvement of dental caries prevention. SIGN (Scottish Intercollegiate Guidelines Network), NOKC/*Kunnskapsenteret* (Norwegian Knowledge Centre for the Health Services), and the Canadian Task Force on Preventive Health Care (CTFPHC), among others, are some of the independent organizations that deal with evidence-based dentistry and provide health technology assessments (HTA). Dental associations such as the American Dental Association (ADA), and *Den norske tannlegeforening* (Norway), are also some examples of international institutions that provide guidelines for dental caries prevention. In addition, systematic reviews have helped develop better patient-treatment decisions in different evidence-based approaches for dental practitioners. PubMed and the Cochrane Library¹ are institutions that provide good assessments for the necessary recommendations in studies on preventive care. Based on evidence-based reviews, a more reflected selection of the outcome variables was done. Factors regarding knowledge and impediments cover issues this study takes into account.

¹ PubMed: Biomedical literature form NCBI/MEDLINE: US National library of Medicine. <http://www.ncbi.nlm.nih.gov/pubmed> and the Cochrane Library-Cochrane collaboration. <http://www.thecochranelibrary.com/view/0/browse.html>

Studies on dentists' orientation on dental caries prevention (11, 14, 15) and caries management (16, 17), will provide focus on factors dentists encounter at their daily practice. As part of the application of preventive measures, certain routines for dental caries prevention cover measures that provide non-operative treatments to patients that are available and relevant to the caries process (4, 17, 18). This theoretical framework based on different reviews in dental caries prevention will give an understanding of the different factors that may be associated with the application of preventive measures.

The following figure shows factors based on the variables in this study, and why certain determinants used in this study may have an effect in the provision of preventive measures in the Dominican Republic. Some of these factors will be used in the survey as probable variables for further analysis (See chapter 3).



Notes: This figure has been modified from Mejía et al (2008) & Ghasemi (2008) (14, 19).

Figure 1. shows different factors that are important to take into account in the application of preventive measures. These factors will be used as the outcome variables. Gender, age and practice-related characteristics (e.g. private or public dental education, and region) (20-22) are used as background information of dental practitioners. Likewise, years of experience (14, 23), knowledge of dental caries prevention and impediment factors (e.g. lack of time or patients' poor oral health) (15, 24), may influence dental practitioners in the application of

preventive measures. These factors will be used for survey purposes and will be discussed further (see chapters 3 and 4). In addition, risk markers, such as high sugar intake, lack of dental materials, and patients' poor knowledge of dental caries prevention (4), are used in this framework as important factors for the provision of preventive care (25). Identifying risk factors regarding dental caries is important and part of the challenge in dental caries prevention care and caries management (4).

Regarding the structure of health in the Dominican Republic, the health care delivery system and the oral health construct are presented with preventive programs, and current and future policies, as part of the application of preventive measures (See section 1.7). Therefore, these factors are good components from the theoretical framework to use further in this study.

1.3. Dental Caries Overview

The pathogenesis and etiology of dental caries are known as «...*multifactorial*» (26).

According to Loesche (27), dental caries «... *is unique among human infections because it involves the destruction of hard acellular tissue, the enamel and dentin of the tooth, and does not provoke an inflammatory response until the decay impinges on the pulp*» (p.412). The mouth is highly susceptible for microorganisms, and with more than 300 species identified, «... *only a few are able to colonize in high numbers because of the distinct biological and physical properties of the oral cavity*» (4, p.30). Among the different bacteria colonized in the mouth, *Mutans streptococci* and *Lactobacillus* are the bacteria etiologically associated with dental caries (27), and for dental caries to develop, three factors must be present at the same time (3):

- A susceptible tooth
- High consumption of fermentable carbohydrates i.e. sugars
- Bacteria *Mutans streptococci*

On that account, dental caries is defined as «... *a chemical dissolution of the dental hard tissue by acidic bacterial products from the degradation of low molecular weight sugars*» (4, p.58). Saliva also plays a role in the regulation of growth and metabolic acidity of oral microflora (4, p. 30)² and vital for the integrity of the teeth (26). «*The secretion rate and quality of saliva are important not only in caries development but also for remineralization*» (26, p.57). pH values around 6.75-7.25 are known as optimal for the growth of many microorganisms (4), and the duration of exposure that affects the caries process. After four days, for example, an accumulation of dental plaque is a rapid process in oral bacteria growth, and dental caries demineralization occurs with loss of tooth mineral (28). «*If the acid production is reduced by removing plaque accumulation or reducing dietary sugar substrates, tooth mineral dissociation will cease*» (28, p.140). This way, the presence of fluorides will help increase a resistance to dissolution, enhancing remineralization and inhibiting the metabolism of the bacteria (28).

1.4. Sugar Consumption

Determinants of oral health care are related to sugar consumption which account for the majority of variance of dental caries rates in various countries (3, 29). Lack of good nutrients and frequent sugar intake will affect the disadvantaged population groups more than the privileged communities. The prevalence of dental caries will be higher among many low-and middle income countries (30). Basic social factors, such as no access to oral health care, lack of resources to provide the necessary oral health care services, and low socio-economic status, may contribute for the development of dental caries and potential oral health consequences (31, 32). Social determinants are therefore, strong factors to take into account in the achievement of dental caries prevention. Screebny (3) states that the greater the availability of

² Microflora: A bacteria and a microscopic algae and fungi, especially those living in a particular site or habitat. Oxford English Dictionary.

sugar, the closer the association with dental caries. But, strategies to reduce sugar consumption may be difficult to implement in many developing countries, where sugar «... *represents more than a sweetener for a population ... that provides the ... calories needed to support human activities ...* » (6, p.439). Developing countries with a high intake of sugar consumption should apply specific goals in order to reduce dental caries, for instance, preventive measures that will help decrease dental caries levels, such as fluorides in toothpastes, fluoride-rinsing, and oral hygiene improvements (33). Changes in sugar consumption may contribute less to caries decline compared to, for example, the contribution of fluorides (29). As sugar consumption and dental caries become a burden in public health, reduced caries levels in developing countries have not yet reached its goal (34). “*It is the responsibility of national authorities to ensure implementation of feasible fluoride programs for their country*” (35, p.202). Reducing dental caries levels through the provision of preventive measures will require more than economic resources and highly trained personnel.

1.5. Dental Caries Prevention

Oral health is part of the overall health of the individual and should not only focus on, for example, patients’ poor oral health. To describe the application of preventive measures, different concepts are used by dental practitioners. These concepts cover factors on evidence-based practice in dental caries prevention (4, 33, 36). Besides diagnostic techniques (e.g. patient clinical evaluation), dental practitioners should follow assessment tools for the best management in dental caries prevention. There is today «... *sufficient scientific knowledge about the etiology of caries and factors that interfere in this process in order to develop effective preventive strategies*» (37, p.91). Scientific evidence in dental caries prevention reports that factors such as diet, good oral hygiene, and the use of fluorides and fissure sealants, should be used interactively for the purpose of prevention (37). A curative treatment

is often the preferred choice among dental practitioners, and prevention is often left as a secondary choice. «*The dental profession is by tradition focused on pain relief by the extraction or restoration of severely damaged teeth*» (4, p.168). The application of preventive measures is highly recommended and active measures involving guidelines are an integral part of dental caries prevention (e.g. use of fluorides and fissure sealants in children) (38). In this case, the infant population and those from low socio-economic status will most likely present early signs of dental caries (4). Therefore, reduced levels of dental caries should be a priority, and policies should be reinforced. Political actions (e.g. sugar taxation, oral health policy reforms or school programs) will generate the possibility to prevent dental caries in a community through the application of preventive measures. Over the years, dental caries prevalence has maintained its high levels, but caries management has improved with increased awareness on dental caries prevention for dental practitioners, with new techniques and recommendations for the application of preventive measures (e.g. emphasis on the role of fluorides, new preventive policies and fluoridation programs, access to oral health care, etc.). However, establishing new programs, such as water and milk fluoridation are still debated topics in various countries, but the knowledge of dental caries prevention influences the application of preventive measures in caries management (3).

Nevertheless, the high cost of a dental caries treatment could be reduced by the use of good preventive measures and improve oral health. The following measures cover the main topics in a dental caries model for dental caries prevention:

1. *Fluorides* inhibit demineralization inside the tooth and have an anticaries effect when used topically, for example, fluoride gels in children (28). A Cochrane and a Swedish systematic review (36) concluded that the use of a fluoride toothpaste is very effective in children and young adults (except high contents of fluorides are not suitable for children under six years

of age) (36). Individuals should therefore brush their teeth with a fluoride toothpaste. The application of topical fluorides could also rely on dentists' judgement and patient preferences (14, p.16). Other fluoride-based treatments are pit and fissure sealant therapy for primary molars (36, 39). The use of different forms of fluorides (e.g. toothpastes, tablets and gels), fluoride rinsing programs and dietary fluoride supplements, has helped significantly to the decline of dental caries prevalence in many countries, especially the industrialized countries (40).

2. *Oral health education* is important for the community and increasing the knowledge of dental caries prevention provides positive improvements in oral health behavior (36). The provision of a good oral health instruction (e.g. use of dental floss and fluoride fluids, plaque control and toothbrushing techniques) should be provided to the community by a dental team (4). «*A trained, comprehensive oral health care team helps to achieve and maintain oral health*» (10).

3. *Diet* plays an important role in the contribution of dental caries development. A good dietary advice that instructs patients to the use of foods (especially those containing sugar), and restricts sugar consumption, follows good nutritional habits from for example, pregnancy diet to maternity, and from child development to the adult is important. Promoting good dietary habits for dental health is an aspect that helps influence the daily diet of individuals and the prevention of dental caries (4).

The following table is an example of individuals with increased caries risk in relation to high intake of fermentable carbohydrates, contributing to future dental caries development.

TABLE 1. INDIVIDUALS WITH INCREASED CARIES RISK IN RELATION TO HIGH INTAKE OF FERMENTABLE CARBOHYDRATES*

INFANTS AND TODDLERS

**PROLONGED BREAST FEEDING
FEEDING WITH BOTTLE AT BEDTIME OR NIGHT**

CHILDREN, ADOLESCENTS

FREQUENT INTAKE OF SOFT DRINKS OR SUGAR SNACKS

MEDICALLY COMPROMISED PEOPLE

**FREQUENCY OF INCREASED INTAKE
(DIABETES, EATING DISORDERS, GASTROINTESTINAL DISEASES)**

**INCREASED CARBOHYDRATES INTAKE DUE TO TOTAL OR PARTIAL DIETARY
SUPPLEMENTATION (CROHN'S DISEASE, CHRONIC RENAL FAILURE,
CHRONICALLY ILL, MALNUTRITION, FAILURE TO THRIVE)**

**PROLONGED CLEARANCE RATE DUE TO REDUCED SALIVARY SECRETION RATE
(SJÖGREN'S SYNDROME, IRRADIATION, MEDICATION)**

ATHLETES

SPORTS SUPPLEMENT DRINKS

WORK-RELATED

**FOOD SAMPLING
BAKERY INDUSTRY
MONOTONOUS JOB OR NIGHT SHIFT**

DRUG ABUSERS

**CRAVING FOR SUGAR
PROLONGED CLEARANCE RATE DUE TO REDUCED SALIVARY SECRETION RATE**

Notes: *This table has been modified from the original in the book: Dental Caries by Fejerskov & Kidd (4, p. 229).

1.6. Demography

Sheiham (33) states that the frequency of dental caries is greater among children in Third world countries than in industrialized countries. According to the World Health Organization (WHO), nearly 100% of adults and 60 to 90% of school children have dental caries worldwide.³ Assessing methods for caries control and understanding the importance of dental caries are part of caries epidemiology. «*The conventional method of defining dental caries in a population is to measure either the number of tooth surfaces that are decayed, missing or filled as a result of caries*» (41). This method is used to assess the means and numerically

³ World Health Organization (WHO). Oral health data for 2012. <http://www.who.int/mediacentre/factsheets/fs318/en/index.html>. Accessed: July 2012

express the dental caries prevalence in a population, known as DMFT.⁴ In 2011, the global caries burden for 12-year-old children was 1.67 from a total of 189 countries included in WHO (See table 2) (42). *“It is sometimes a surprise that the mean caries levels reported for the population in a geographical area are substantially out of line with either the subjective opinion of, or the practice logged data from, a general dentist practicing in the same area”* (4, p.141). Dental caries prevalence have declined in many countries, while in others it is still a burden. Bönecker and Cleaton-Jones (7) have stated that the dental caries trend is decreasing among children from Latin America and the Caribbean (43). Several studies have shown a decrease in dental caries prevalence, and results from international caries comparisons have demonstrated that dental caries is more prevalent in children from low socio-economic status families (36, 43, 44).

The following table shows an example of some caries prevalence (DMFT) worldwide and in some Latin American countries for the classification criteria in the treatment of dental caries among 12-year-olds.

⁴ DMFT is an index that shows the levels of caries and mean numbers in order to describe the amount of dental caries in an individual. This is obtained by calculating the number of *Decayed (D), Missing (M), Filled (F) teeth (T) in adults (permanent dentition, (or (S) surfaces -dmf(s)- for the primary dentition)*. Whereas DMFT = 0 will mean caries free, and 28 (if excluded the 4 wisdom teeth), as the total of teeth with caries.

To calculate the index: $((M+F)/DMF) \times 100$. This indicates how many teeth have caries lesions, how many have been extracted, and how many teeth have fillings or crowns.

World Health Organization. Oral Health Database. WHO 2001. <http://www.mah.se/CAPP/Methods-and-Indices/for-Caries-prevalence/> <http://www.mah.se/CAPP/Methods-and-Indices/for-Caries-prevalence/>. <http://www.mah.se/CAPP/Methods-and-Indices/for-Caries-prevalence/Significant-Caries-Index/>. Last accessed: December 2012.

TABLE 2. CARIES PREVALENCE FROM VARIOUS LATIN AMERICAN COUNTRIES AND WORLDWIDE AMONG 12-YEAR-OLD CHILDREN FOR THE YEARS 1997, 2004, AND 2011

CARIES PREVALENCE FOR SOME LATIN AMERICAN COUNTRIES			
DMFT INDEX LEVELS			
	1997	2004	2011
WORLDWIDE	N.A.	1.61	1.67
LATIN AMERICA*	N.A.	2.76	2.35
HONDURAS	3.7	N.A.	N.A.
PANAMA	3.6	N.A.	N.A.
NICARAGUA	3.6	N.A.	N.A.
VENEZUELA	2.1	N.A.	N.A.
PERU*	7.0	N.A.	N.A.
DOMINICAN REPUBLIC	4.4	N.A.	N.A.

Notes: No data available for DMFT levels in 2004 and 2011 for the Latin American countries in this table, only for the year 1997. Data from Peru is only from 1990, showing the highest levels in caries prevalence from the Latin American Region (AMRO), 1979-1997. Fewer data available for caries in adults than in children. Data extracted from WHO databank (45), Beltrán-Aguilar (46), and Fejerskov & Kidd (4).

Table 2. shows caries levels of some Latin American countries and worldwide. The world average of dental caries prevalence has increased from 1.61 to 1.67, from the year 2004 to 2011. Latin America has reduced the caries prevalence by 0.41 (from 2.76 to 2.35) in the same period. Some countries in Latin America showed much higher levels of dental caries in 1997 (no data available since then) (4). The Dominican Republic, as an example of a middle-income country of high socio-economic inequality, has caries levels among 12-year-olds three times higher than the world average (4.4 in 1997),⁵ and twice the average in Latin America of 2011 (2.35) (Table 2) (4). WHO states that DMFT levels should not be higher than 3 for 12-year-olds (47). According to the last caries prevalence result in 1997, the range of values for some Latin American countries is considerably high (from 2.0 to 7.0 DMFT levels) (4). In theory,

⁵ No data available for caries prevalence in the Dominican Republic after 1997.

the high levels of dental caries prevalence may vary by region due to access and availability to oral health care services. For example, caries prevalence in some European countries goes from 1.4 in Finland and 2.1 in Norway to 3.2 in Portugal and 5.1 in Poland (4).⁶ In developing countries, dental caries affects mostly those among the poorest populations (4), and marked discrepancies are found in the exposure of dental caries. Frequency of sugar consumption, lack of oral hygiene and access to oral health care services, are factors that continually contribute to the foundation of dental caries. As an oral disease, dental caries has an impact in the oral and general health of the individual, mainly, for children. «*Caries is both diet-dependent and fluoride-mediated and is amenable to the prevention and management at both the individual and population levels*» (29 Suppl 1:S2). Dental caries is reversible at the beginning, and risk of future restorations is a concern if caries is not considered further. «*Caries treatment among patients depends on final decisions by dental practitioners in caries management*» (31, p.51). The risk of developing dental caries also becomes greater with the lack of resources if access to oral health care services is not provided. Focusing on nutrition, plaque control, use of fluorides, and sealant therapy alone, do not guarantee a caries-free environment in the oral cavity. Preventive measures should be taken into account.

1.7. Study Background: The Case of the Dominican Republic

The Dominican Republic is the second largest country in the Caribbean, and an upper middle-income country in Latin America (48).

The following table shows some general information on the Dominican Republic (25, 49, 50).⁷

⁶ Caries prevalence in Europe shows DMFT levels at the age of 12 years from 1990-1995. From Fejerskov O, Kidd E. *Dental Caries: the disease and its clinical management*. Blackwell-Munksgaard; 2003.

⁷ General information on the Dominican Republic. *Per capita consumption of sugar (kilogrammes -raw value-centrifugal sugars for cane and beet sugars only).

TABLE 3. DOMINICAN REPUBLIC GENERAL INFORMATION

AREA	48.482 KM2
CAPITAL	SANTO DOMINGO
POPULATION	10,056,081
LIFE EXPECTANCY AT BIRTH (2010)	73 YEARS
LITERACY RATE ADULT TOTAL % (15 AND ABOVE)	88 %
GDP GROWTH (2011)	4.5%
GDP PER CAPITA (2011)	US\$ 9,400
POVERTY HEAD COUNT RATIO AT NATIONAL POVERTY LINE	34.4% OF POPULATION
HEALTH EXPENDITURE PER CAPITA (2007-2010)	323\$
LANGUAGE	SPANISH
RELIGION	CATHOLICISM
ETHNICITY	73% MULTIRACIAL, 16% WHITES, 11% BLACKS
REGIONS	31 PROVINCES (180 INHABITANTS PER KM2)
ECONOMY: INDUSTRY AND EXPORT	TOURISM, SUGAR PROCESSING, FERRONICKEL AND GOLD MINING, TEXTILES, CEMENT AND TOBACCO
CONSUMPTION OF SUGAR PER CAPITA	36.6 (IN 2009)*

1.7.1. Dental Caries in the Dominican Republic

Despite the caries challenges during the 1990's, Latin America has reduced the prevalence of dental caries up until 2011, due to new preventive tendencies, treatments and technologies (1) (51). Even though disparities in caries levels among 12-year-olds continued in some Latin American countries (42, 51), the DMFT levels for 12-year-olds in the Dominican Republic reduced from 6.0 to 4.4, the lowest since 1986 (Table 2) (47, 51). This reduction has been considered a significant improvement in oral health care, but results similar to 3 or below are still expected by WHO (51). More than 10% of the 12-year-old population in the Dominican Republic had at least 7 or more *decayed* teeth (52). This could be related to different social aspects or the lack of dental practitioners in rural areas. Communities with access to oral health care services had higher amounts of filled teeth and presented a lower caries

percentage, according to a Latin America study from Beltrán-Aguilar (46). Sadly, not enough data has been generated on dental caries status for Dominican children since 1997. WHO has started various programs in Latin America for the prevention of dental caries to achieve lower DMFT levels and caries status. Salt and water fluoridation programs started 15-20 years ago, however, data results on lower caries levels are not available for 2012. Only 16% of the population has been covered for water fluoridation in 1994 in Latin America (53) and by 2004, the Dominican Republic was still in the initial stages of a salt fluoridation program (51). As an example, one study showed high prevalence of fluorides found in the tooth enamel due to natural fluoride existence in a few Dominican communities in the South region of the country (54).⁸

1.7.2. Dental Education

Higher education in the Dominican Republic is provided both in the private and the public sector. The private provision of education has grown considerably and the «... *private institutions in Latin America account for more than 40 percent of higher education enrollment*» (55). Public education is mainly financed through taxation, yet charging tuition to students is thought to benefit the additional resources for higher education and provide some relief for the state budget (55).

There are twelve dental schools in the Dominican Republic spread in different regions in the country, but most are situated in the capital. Besides the state university, *Universidad Autónoma de Santo Domingo* (UASD), other main private universities are recognized for their dental schools and accredited abroad (e.g. *Universidad Nacional Pedro Henríquez Ureña* (UNPHU), *Universidad Iberoamericana* (UNIBE), and *Pontificia Universidad Católica*

⁸ Water supply with a concentration of fluoride higher or equal to 0.9 mg/l. may lead to Fluorosis, a disease coming from high concentration of fluorides. *Fluorosis and high content of fluor in the Dominican Republic*. This study is taken from the final Report of the Kellogg Foundation: «A Multi-Year Plan for Salt Fluoridation Programs in Latin America». PAHO 2000, Dr. Saskia Estupiñán-Day. World Health Organization. Oral health database: Fluorosis. WHO/Malmö University; 2012 [cited 2012 08]. Available from: <http://www.mah.se/CAPP/Country-Oral-Health-Profiles/AMRO/Dominican-Republic/Oral-Diseases/Fluorosis/>.

Madre y Maestra (PUCMM), among others). Most main universities are based in the capital with extensions in other cities. The other universities are also well-known and accredited in the country. Participation in continuing education and other dental specialties, as well as memberships to dental organizations are optional. Regarding preventive dentistry, each dental discipline (e.g. pedodontics, orthodontics, periodontics, etc.) focuses on related cases, new techniques and improvements for the provision of preventive measures.

1.7.3. Health Care Delivery System

All Dominican citizens are entitled to health care services, and national health services are delivered by the public and the private sector. Both sectors are regulated by the Ministry of Public Health and Social Assistance (SESPAS). SESPAS is responsible for all national policies, the organization of health care programs (e.g. promotion, preventive measures, and social assistance) in the communities in need, with a special attention to primary health care in the rural and marginal urban areas. The public sector covers an insurance that provides institutions non-profit and for-profit services, and free primary health care services to 75% of the population, of which the majority are uninsured (56, 57). However, there is no actual guarantee of access or quality, but a social security program recently established in 2005 (SeNaSa),⁹ tries to cover most basic needs for the population regarding a health security system. It is the private sector that usually provides most health care services, although, often to the insured by a working-employment pre-payment scheme, a pre-paid private health insurance or a private insurance provider. Private services are more common among the middle- and upper-economic strata, and most oral health care services are covered by these types of insurance. Recently, the legal framework has substantially changed into a new general health law (law 42-01), implemented in 2003, and aims to create a new welfare

⁹ Senasa Dominican Republic. Social Security Institution regarding provision of health services and welfare system. <http://www.arssenasa.gov.do/index/aboutsenasa.asp>. Last accessed: August 2012

system (56). Furthermore, Dominican citizens are given constitutional health rights in the new constitution from 2010 (law 87-01) (57, 58). The health reform, however, does not yet deliver on its promises since the new law has not been fully implemented in the country, by the time of this study. Thus, the Dominican health care system acts according to a neo-liberal policy contributing in favor of privatizing the health sector.

1.7.4. Oral Health Care in the Dominican Republic

Regarding oral health care in the Dominican Republic, services are delivered by the public and the private sector, and both sectors are regulated by SESPAS. In 2007, the market potential for dental services in the Dominican Republic was 378.65 US\$ million, and 401.92 US\$ million for 2012 (59). SESPAS established an Oral Health Division in 1973 in order to organize, plan, and regulate activities destined to the prevention of oral diseases and the promotion of oral health in the Dominican population (56).¹⁰ SESPAS created oral health care programs seeking the application of preventive measures, adapting oral health care services for children in public schools at the regional level. The Oral health division, based in Santo Domingo, is led by coordinators and regional dental practitioners supervising local dentists working in the public sector. Furthermore, SESPAS is responsible to give authorization to dentists who have fulfilled and obtained a dental degree with a license to practice. The main focus for the public sector is the provision of primary dental care services to children in dental units placed in different institutions enlisted in a dental preventive program. Dental practice in the public sector includes working in dental modules at public schools, hospitals and institutions (e.g. military, police, navy, etc.), following control routines, preventive measures and dental caries programs for children. Other services include also a number of mobile dental units spread regionally to provide service to children and adults, mainly where there is no

¹⁰ Regional Core Health data System: Country Profile: Dominican Republic. Review analysis of health situation. PAHO. <http://www.paho.org/spanish/sha/prfldor.htm>. Accessed: 06.09-10. Last updated: November 2012.

access to oral health care services (60). Likewise, private companies agree to provide dental health care services to their employees by also using mobile dental units at their workplace as a measure to facilitate access to dental services. Most preventive measures are caries control routines, oral health instructions, mainly given to children, with the provision of for example, toothbrushes and fluoride applications (most common fluoride type provided is gel and liquid) (60). In 2009, dental services in the public sector covered 473,500 patients (61). In the private sector, preventive measures are given at a private dental office with a private dental practitioner. In this case, parents are responsible to take their children to the dentist at an early age.

1.7.5. Dental Manpower

The delivery of oral health care services has a dental workforce made up of dental practitioners, specialists, dental assistants, a secretary or a receptionist, and probably a few dental technicians included, but the latter do not work directly with patients.¹¹ Unfortunately, no dental hygienists are part of the oral health care delivery system in the Dominican Republic, since it is not a profession or an education offered in the country. Dental manpower consists mainly of dentists, assistants, and a secretary (on occasions health workers in dental programs by SESPAS), at the place of practice. Dental technicians have their own practice and are trained in technical schools as well as dental assistants and health care providers.¹² Thus, the required services for dental assistants do not reach the standard of a dental hygienist internationally. No data is available on dental manpower distribution in the country. However, it is believed that most dental practitioners and specialists work in the larger cities, mostly in

¹¹ Dental technicians are members of the dental team, but work mainly with restorative and appliances upon prescription of the dental practitioner. http://en.wikipedia.org/wiki/Dental_technician. Accessed: October 2012.

¹² Dental technicians and dental assistants are not included further in this study. Even though they are part of the Dominican dental manpower, they do not treat patients, therefore, this study only covers the Dominican dental practitioners.

the private sector. Different sources reported different numbers of dentists in the Dominican Republic (See chapter 3).

According to WHO, there are 7000 dentists in the Dominican Republic (62). During a pilot study, conducted by the author in 2010, the Dominican Dental Association (AOD) reported having 5500 Dominican licensed dentists registered as members, but this was only an estimated population, and of those, 4000 seemed to be working for different public institutions (e.g. military, police, etc), as well as for the private sector. SESPAS had only 1531 dental practitioners registered working in the public sector (56) by the time of the study, and 1317 dental practitioners were found in the private sector, according to the national yellow pages (See chapter 3). There is great variation between the sources in the estimation of the number of Dominican dentists working in both sectors, and the exact total amount of dental practitioners is not known. Data on dental manpower is covered and explained further in the materials and methods chapter.

Chapter 2. Materials and Methods

This descriptive study aims to provide data on the dental population, and it will be used to describe for example, odds ratio from the application of preventive measures and caries prevalence. A group of dental practitioners will be looked at to see if the lack of knowledge and preventive practices in dental caries prevention are related to the high prevalence of dental caries in the country. If preventive practices among dental practitioners are correlated with dental caries prevalence, this may support the hypothesis of the lack of preventive practices and knowledge may cause dental caries. Although, since this is a cross sectional study, present data would not allow the role of past practices or other causes to be explored. Group level information will be used and even though there may be no correlation, there might be a strong relationship between the two indicators at the individual level.

This chapter covers the materials and methods for this study and builds upon the previous chapter. Each section explains the theoretical part this study is based on, the pilot study, and the process of the study design with self-administered surveys.

2.1. The Pilot Study

For the pilot study, a group of ten dental practitioners of different ages with previous and diverse dental work experience, was selected to fill in a draft questionnaire sent to them by e-mail by the time the pilot started in 2010. A draft version of the questionnaire was tested on the different respondents before different draft versions were revised, until a final version was decided. In a short visit to the Dominican Republic, in February 2010, dental colleagues were contacted for the trial survey, and dental coordinators at the Ministry of Health were interviewed. A couple of public schools that follows a dental preventive program were also

visited. The main coordinator at the oral health division¹³ presented the main activities and programs for the oral health care programs for the Dominican Republic. One of the main projects of the Ministry of Health is a dental preventive program for children in public schools. The services provided are supervised by dental practitioners following the mandatory preventive guidelines. There are statistical reports regarding these programs, that given an understanding of dental caries status, and the preventive guidelines followed in the country (e.g. 28,403 patients were treated nationally in 2009) (56). Sadly, the public sector lacks the sufficient materials and resources for several dental programs, and the Government spends little money on dental programs for the community. The preventive programs for children in public schools were established some years ago, and from the total mentioned above, not all children are covered. This could be due to the lack of resources, and the fact that services are not often provided in the rural areas. This could also explain the low improvement in oral health among children. Some NGOs (e.g. Sonrisas/Smile foundation)¹⁴ have made agreements with international aid organizations and private companies (e.g. Colgate, Kellogg foundation, etc.), in order to help Dominican communities and the public sector with several donations and projects. This help often comes from abroad where resources only cover the low-income population and not the private sector.

2.2. Study Design

The data material for this thesis is collected surveys from dental practitioners working in the private sector of the Dominican Republic. Initially, authorized Dominican dental practitioners working for both the private and the public sector were taken into account for the purpose of

¹³ Dr. César Brea. Former coordinator at SESPAS for the oral health division 2010 and professor at UASD. Spring 2012, the coordinator no longer worked for the institution, as he had retired, and the new coordinator was never available to contact. The employees encountered at the institution provided some extra information at the time of the study.

¹⁴ Sonrisas. NGO dental clinic. <http://www.clinicasonrisas.org/english/whoarewe/mission.html>

this survey targeting dentists at the national level. However, acquiring these amount data would not be feasible. 400 surveys were handed out to dental practitioners working at private dental clinics in four different regions of the Dominican Republic. Dentists were asked to fill in a questionnaire (right away or at a later appointed meeting) in the course of the two and half-month period the fieldwork lasted (March-May 2012). Interviews and some conversations with dental practitioners are sources for the qualitative part of the study, in addition to comments and opinions given in open questions in the survey to the dental practitioners. Both the draft and the final survey were translated from English to Spanish for practical purposes.

2.3. Questionnaire

Statements from dental caries prevention (4, 36) were taken into account in order to measure the application of preventive measures among Dominican dental practitioners. These statements are not standard, due to continuous changes, as scientific knowledge and preventive dentistry develop. However, all statements used for the survey design are based on systematic reviews for the prevention and management of dental caries (16, 36). Questions were given to dentists in order to measure knowledge on dental caries prevention for the purpose of this study. Knowledge on fluoride and caries-related aspects and other opinions from dental practitioners regarding dental caries prevention may have an effect in the application of preventive measures. Dental practitioners often have the last decision, however, the recommended guidelines provide the optimal outcome (4, 36).

The following table shows some of the main statements in dental caries prevention that are used in the survey regarding the variable knowledge.

TABLE 4. MAIN STATEMENTS REGARDING DENTAL CARIES PREVENTION*

- FLUOR APPLICATION AS AN IMPORTANT CONSIDERATION IN DENTAL CARIES PREVENTION.
- THE USE OF A FLUORIDE TOOTHPASTE IS MORE IMPORTANT THAN A BRUSHING TECHNIQUE IN THE PREVENTION OF DENTAL CARIES.
- THE FREQUENCY OF SUGAR CONSUMPTION HAS A GREATER ROLE IN THE PRODUCTION OF DENTAL CARIES THAN THE TOTAL AMOUNT OF SUGAR CONSUMED.
- THE USE OF A SEALANT THERAPY IN THE PREVENTION OF PIT AND FISSURE CARIES IN ERUPTED MOLARS IS EFFECTIVE.
- SOME OF THE MAIN LARGEST RISK OF FOR FUTURE DENTAL CARIES ARE: SUGAR CONSUMPTION, NO WATER FLUORIDATION, POOR KNOWLEDGE OF DENTAL PREVENTION, A POOR BRUSHING TECHNIQUE, AND NO REGULAR DENTAL VISITS, AMONG OTHERS.
- DENTISTRY SHOULD BE BASED BOTH ON TREATMENT AND PREVENTION.

Notes: *All statements are used as questions in the survey. The last two shown in the table were left out of the statistical analysis and were only commented in the discussion chapter.

2.3.1. Selection of Variables

The survey covers mainly the aspects of knowledge of dental caries prevention and

impediment factors encountered by dentists in the provision of preventive measures.¹⁵

Questions were grouped by the different aspects from the theoretical framework (see section 1.2) and covering issues on dental caries prevention, in addition to obstacles in dental practice

that may impede dentists apply preventive measures. Most dental caries facts are covered

according to statements on dental caries prevention and are used in the survey design (36) (see

appendix). Questions regarding the application of preventive measures, knowledge, and

impediment factors, had a five-point Likert scale with alternative answers ranging from (e.g.

«strongly agree» to «strongly disagree» and «much» to «not at all»). Other questions cover

basic opinions («yes» and «no» answers) and the background information from dental

practitioners (e.g. age and gender).

¹⁵ The survey is written both in English and Spanish, and was administered to dental practitioners in Spanish for practical purposes. The survey can be accessed in the Appendix section. For any inquiries, please contact the author.

Based on the theoretical framework, the survey categorized 5 questions (1-4, and 7) for the application of preventive measures in dental caries prevention, and will be used for further statistical analysis as the outcome variables (see chapter 3). Each of these questions had a five-point Likert scale with answers ranging from «always and very often» to «never»¹⁶ (see survey in Appendix). However, the analysis only covered the first four questions and are used as variables to measure the application of preventive measures. Eventually, the statistical analysis used only two of these four outcome variables. The variables *Oral health instruction at a regular consult* and *performance of preventive measures at each regular consult* (see table 5) were more relevant for the theoretical framework, and furthermore, these more suitable for the statistical analysis (see chapter 3).

The following table shows the questions and future variables covering the application of preventive measures.

TABLE 5. SELECTION OF VARIABLES FOR THE APPLICATION OF PREVENTIVE MEASURES

ROUTINELY CHECK FOR DENTAL CARIES IN PATIENTS' DIAGNOSIS	Q. DO YOU ROUTINELY CHECK FOR DENTAL CARIES IN YOUR DIAGNOSIS TO YOUR PATIENTS?
USE OF PREVENTIVE MEASURES WHEN CHECKING FOR SIGNS OF DENTAL CARIES	Q. WHEN CHECKING FOR SIGNS OF DENTAL CARIES, DO YOU USE ANY PREVENTIVE MEASURES THAT MAY FACILITATE PREVENT EARLY DETECTION OF CARIES «E.G PROFESSIONAL TOOTH CLEANING, TOPICAL FLUORIDE APPLICATION, FISSURE SEALANT THERAPY» INSTEAD OF CHOOSING A CARIES TREATMENT (EVEN IF NOT YOUR SPECIALTY)?
ORAL HEALTH INSTRUCTION AT REGULAR CONSULT	Q. DO YOU INSTRUCT YOUR PATIENTS ABOUT DENTAL PREVENTIVE MEASURES «E.G DENTAL HYGIENE (USE OF TOOTHBRUSH AND DENTAL FLOSS) AND DIETARY HABITS» AT EACH CONSULT?*
PERFORMANCE OF PREVENTIVE MEASURES AT A REGULAR CONSULT	Q. DO YOU PERFORM THE FOLLOWING MEASURES TO YOUR PATIENTS: «PROFESSIONAL TOOTH CLEANING, TOPICAL FLUORIDE APPLICATION AND FISSURE SEALANT PLACEMENT AT EACH REGULAR CONSULT?*
PROVISION OF EDUCATIONAL MATERIAL TO PATIENTS	Q. DO YOU PROVIDE EDUCATIONAL MATERIAL ABOUT PREVENTIVE DENTISTRY (E.G. PAMPHLETS, MAGAZINES, ARTICLES, ETC.) TO YOUR PATIENTS?***

Notes: Last question in this table regarding the *provision of educational material to patients* was created as a dummy variable in the analysis, and eventually, not used in the model for further analysis.

¹⁶ These variables cover the first four questions of the survey. Survey could be accessed in the Appendix section. Any inquiries regarding the survey upon contact with author.

2.3.2. The Predictor Variables

The predictor variables were created based on the theoretical framework in section 3.1, covering background information from dental practitioners, knowledge, and impediment factors in the provision of preventive care. Background information covers questions on personal information from Dominican dental practitioners (e.g. gender, age). Knowledge covers questions regarding orientation and understanding of dental caries prevention listed in ten elements. These elements were divided in caries and fluoride-related aspects ranged in a likert scale (1 through 5) from «strongly agree» to «strongly disagree» and «don't know». Only questions 8 through 11 are used in the analysis. Although, questions 12 and 13 will be commented in the discussion (chapter 4). Question 14 is based on the general concepts of dental caries risks, even though the causes may vary in different settings. Since it is expected that dentists know the meaning of dental caries as well as future risks, five answers were selected based on different references on probable risks for developing dental caries. This question is not used in the analysis, but it is also commented qualitatively (see chapter 4). Finally, the impediment factors cover some of the aspects that may impede dental practitioners in the provision of preventive measures. These factors were also ranged in a likert scale from «very much» to «not at all».¹⁷

The following table shows the predictor variables taken from the survey for further analysis.

¹⁷ Predictor variables include: Background information: Questions 17 through 25 in the survey. Those also employed by the Government, covering practices in the public sector, had the alternative to choose answers of working for the private, public, or both sectors. Knowledge: Questions 5, 6, 8, 9, 10, 11, 12, 13, 14, and 16 in the survey. Only questions 8-11 are used in the analysis (see chapter 3 and 4). Impediment factors: Question 15 in the survey agrupated 11 statements as barriers to the application of preventive measures. Only 6 statements are used in the analysis (see chapter 3 and 4). See the Appendix section.

TABLE 6. PREDICTOR VARIABLES

BACKGROUND INFORMATION FROM DOMINICAN DENTAL PRACTITIONERS	<ul style="list-style-type: none"> - GENDER - AGE - PRACTICE LOCATION/REGION -YEARS OF EXPERIENCE -DENTAL SCHOOL -YEARS SINCE GRADUATION -ACTUAL JOB AS A DENTIST*
EXPERTISE AND KNOWLEDGE	<ul style="list-style-type: none"> - SUGAR CONSUMPTION - ROLE OF FLUORIDES - USE OF SEALANTS - TOOTH BRUSHING.
IMPEDIMENTS FOR THE APPLICATION OF PREVENTIVE MEASURES	<ul style="list-style-type: none"> - PATIENTS' POOR KNOWLEDGE OF THE POTENTIAL OF CARIES PREVENTION - PATIENTS' POOR ORAL HEALTH IS AN OBSTACLE TO PREVENTIVE CARE - DENTAL INSURANCE COVERS NO PREVENTIVE CARE - DENTAL AUXILIARIES IN CHARGE OF PREVENTIVE CARE NOT DENTISTS - PREVENTIVE CARE GIVE DENTISTS NO RESPECT - NO TIME IN DENTAL PRACTICE FOR PREVENTIVE CARE - PREVENTIVE CARE HAS LOW PRIORITY IN DENTAL EDUCATION - PREVENTIVE MATERIALS NEEDED NOT EASILY AVAILABLE - PRINTED MATERIAL FOR DENTAL HEALTH EDUCATION IS SCARCE - PREVENTIVE DENTISTRY NOT PROFITABLE FOR DENTISTS - PREVENTION OF DENTAL CARIES NOT ESSENTIAL FOR THE COMMUNITY

Other questions regarding opinions on dental caries (not shown in table 6) were assessed as categorical variables, and had some variation in the responses among Dominican dental practitioners. These variables covered different issues such as future dental caries risks, comfort and awareness in preventive dentistry, among others. These variables used as opinions from dental practitioners were not included in the statistical analysis, but will be mentioned further in the discussion chapter. The questions regarding impediment factors covered 11 statements describing the obstacles dental practitioners may encounter on a daily basis (14) (63). These responses were also ranged in a five-point likert scale from «very much» to «not at all» (1 through 5), covering how much of these factors impede Dominican dental practitioners provide preventive measures.

2.4. Study Population

Data collection was carried out by self-administered surveys to private dental practitioners between the months of March and May 2012 in the Dominican Republic, but identifying the study population was a great challenge. The list from SESPAS of Dominican dental practitioners did not cover WHO's dental population report from 2000 (62), and was not reliable. Furthermore, dental practitioners from the public sector were difficult to approach and were left out.¹⁸ Consequently, the survey was responded only by dental practitioners working in the private sector. As the only reliable source that covered private dental practitioners, dentists from the private sector were found in the Dominican yellow pages, with a detailed sub-directory of health: [saludonline](http://www.saludonline.com.do).¹⁹ This directory had the total dental population registered and organized private dental practitioners by regions. A total of N=1317 dental practitioners working for the private sector were selected as the study population. 400 were invited to participate in the survey, and 310 dentists responded. Private dentists working on a daily basis at their place of practice were easier to approach in order to answer a questionnaire than dentists found in the public sector. Therefore, the study population focused only on registered dental practitioners from the private sector (See table 7). Although, some working in the private sector also worked part-time for the public (27.4%) at the time of the study (see section 3.1). Some of the dentists registered had more than one dentist working at their dental clinic, and the actual number of dentists was probably higher. The additional dentists from the dental offices that responded the survey were added as a sub-group to increase sample size.

The data collected for every dentist listed had a total of 1317 units, in this case, dental

¹⁸ SESPAS' list of the public sector had a total of N=1521 dental practitioners. The list of dental practitioners working for the public sector was difficult to obtain at the time of the study, and dentists had different schedules and different places of practice which made difficult the distribution of the surveys. Therefore, dental practitioners working in the public sector were left out of the study.

¹⁹ Dominican national yellow pages (in Spanish): <http://www.paginasamarillas.com.do/>. Salud online: <http://www.saludonline.com.do>

practitioners. This also covered the dental practitioners employed by the dental offices listed. A sample calculation from the total population of the private dental practitioners (N=1317) recommended a sample size of 298 (5% margin of error, 95% CI and 50% response distribution). 400 surveys were submitted, and the probability of 400/1317 resulted in a 0,23 probability of a dental practitioner to be chosen in the sample. From 400 self-administered surveys, 310 surveys were collected (two were taken out due to errors).²⁰ Valid N is therefore 308 (77% response rate). In terms of the numbers selected in the yellow pages, the sample size n and margin of error E are given by

$$\begin{aligned}
 x &= Z(c/100)^2r(100-r) \\
 N &= N x / ((N-1)E^2 + x) \\
 E &= \text{Sqrt}[(N - n)x / n(N-1)]
 \end{aligned}$$

where N= 1317 is the population size, r is the fraction of responses and Z(c/100) is the *critical value* for the confidence level c (Raosoft, inc 2004).²¹

2.5. Regions and Practice Locations

The Dominican Republic is divided in four regions. Santo Domingo is the capital and main district, and the rest of the regions are North, East, and South. The sample includes private dental practitioners from all regions (dental offices will also count as dental practitioners).²² With an estimated sample size of 298, a clustered sample for each region was calculated for the probability of a dental practitioner to be chosen in a systematic method (64). This means that one in every five were selected through systemic random sampling.

²⁰ Two of the surveys were taken out of the 310: one respondent was not a dental practitioner and the second did not answer the questions.

²¹ Raosoft, inc. 2004. Sample size calculator <http://www.raosoft.com/samplesize.html>. Sample done March 2012. Accessed: February and March 2012

²² Each extra dental practitioner in a dental office will be included in a sub-group. <http://www.paginasamarillas.com.do> and www.saludonline.com.do Last accessed: March & October 2012

TABLE 7. DOMINICAN REGIONAL DIVISION

REGIONS	*DENTAL PRACTITIONERS	*DENTAL OFFICES	TOTAL
SANTO DOMINGO	563	281	844
NORTH REGION	193	153	346
EAST REGION	45	33	78
SOUTH REGION	26	23	49
TOTAL	827	290	1317

Table 7 shows the distribution of the dental population in the private sector for the different regions in the Dominican Republic. From the 1317 private dental practitioners, 844 dentists were working in Santo Domingo, with an estimation of acquiring around 200 surveys. The probability of $200/844$ resulted in a 0,24 probability of a dental practitioner to be chosen for the Santo Domingo region. This means that with a systematic method, every 4th to 5th dental practitioner on the list were chosen in the capital area. A total of 473 dental practitioners were found in the rest of the regions, which around 100 will balance out the total of dental practitioners at the national level. $100/473= 0,21$. This way, a 0,21 probability of a dental practitioner were to be chosen in the sample. This means that every 5th dental practitioner were chosen for the rest of the regions. With these results, a systematic method, with every 5th dental practitioner in the directory was chosen for the sample.

A systematic option helped the selection of the respondents. If some errors appeared (for example, absence of dentist or a dental office that no longer exists), the following dentist in the directory was chosen on the list, and so on.

2.6. Potential Biases

Difficulties in survey analysis is often related to bias in sample selection (65). For a survey given out to registered dental practitioners, the use of the Dominican yellow pages was a

straightforward sampling frame, although, the list may have missed private dental practitioners that did not wish to be in the directory, leading to a possible selection bias. However, the national yellow pages are a marketing option for Dominicans, and is the optimal and most reliable source for private dentists to be approached. Failure to collect data from all questions in the survey could lead to survey errors (65). Some dental practitioners did not provide the needed data on some questions in the survey, and others did not want to participate claiming that preventive dentistry was not their specialty. Those dental practitioners absent at their place of practice, led to non-response bias. Also, potential information bias is a concern in this study since it is not known if responses from dental practitioners were true. Limitations of the study are also commented in section 4.6.

2.7. Validity and Reliability

Some related studies have been published on self-administered questionnaires regarding knowledge on dental caries prevention, caries-related treatments, but also, reviews regarding what dentists mean by prevention (11, 12, 66). In this cross-sectional study, the collected self-administered survey assesses the validity of dental caries prevention towards the application of preventive measures. This study tries to ensure good measurement (67) in order to assess good quality (68) in aspects of, for example, knowledge and impediment factors in the provision of preventive measures. This way, answers are used as «gold standard» (68) for the application of preventive measures in dental caries prevention. Some confusion among the respondents may appear on how the question is formulated and need to be clarified in order to answer it. Also, participants may not respond truthfully, for example, dental practitioners may exaggerate their practices or present themselves in a good social manner in the dental community. This could show a validity problem. «*Results from a questionnaire have a thin abstract quality, rather remote from reality's people's lives*» (69, p.81). At times, surveys do not meet the specific needs of a country, but collecting information for a set of needed

indicators or factors, in for example, the dental community, may integrate some specific markers, such as the application of preventive measures in dental caries prevention.

According to Szklo (68) on self-reported answers, characteristics of dental practitioners such as the educational level, gender and practice location, could be used for the study population in order to assess validity and reliability. Assessing a degree where items in the survey represent the measurement of the application of preventive measures, and are part of the focus of preventive dentistry (68).

Testing the same population twice may help assess reliability. However, this is a cross-sectional study, which measures the purpose of this study at one point in time. The statistical analysis is used to determine reliability (67), and the draft questionnaire sent out to a few dental practitioners during the pilot study was used as a support for the assessment of reliability (See also section 4.8).

For the analysis, a dataset was created with all selected variables, participants, and values for the different answer choices to validate the responses (likert scale and fixed-choice answers yes/no). Positive responses (e.g. «strongly agree», «always» and «often», etc.) will be distinguished from the negative responses (e.g. «never») on for example, who provides preventive measures and who does not. Consequently, negative responses are taken into account to give an estimation of the sensitivity and specificity of the study (e.g. identify dentists who have understanding or not on dental caries prevention) (68).

2.7.1. Reliability Test

Since the dependable variable is scale selected, as well as the responses from expertise and impediments, a reliability of the scale is calculated for the outcome variable, in order to see if the scales are reliable with the sample. For the outcome variable in the application of preventive measures, the variables ranged from «always and very often» to «never», were

organised to acquire a better perspective of the preventive performances from Dominican dental practitioners. The reliability of the scale showed a low coefficient (*cronbach alpha*) of .523. This result was not strong enough (optimal alpha coefficient is often above .7), but had a short 43 scale of (N=4), a value that is common. However, the mean value of the inter-item correlation was .224, a more appropriate value to use (Briggs and Cheek in Pallant 2007).

2.8. Ethical Considerations

One of the main functions of the national health authorities is to evaluate the mission and functioning of the healthcare delivery system followed by a good assessment in health quality, in this case, the oral health department in the Dominican Ministry of Health. SIGN guidelines were chosen as the main international guidelines to be followed in the survey (36). The surveys were anonymous and voluntary, although, some personal data was collected as background information (e.g. age, gender, years of experience). After contacting the Ministry of Health during the pilot study, no permission was needed to self-administer the questionnaire but the private dental practitioners' willingness to respond.

2.9. Regression Analysis

How well do measures of knowledge, background factors, and impediments, predict the application of preventive measures among dentists? How much variance in the application of preventive measures can be explained? Which is the best predictor for the application of preventive measures? How much of the application of preventive measures could be explained in the study? These questions were raised due to probable skewed answers and as an introduction of what the results might show after the analysis. In order to explore and answer these questions, ordinal logistic regression will be used for the analysis and explained further (see chapter 3 and 4). Ordinal regression is used to analyze which factors influence the

different aspects in the application of preventive measures. Two variables were chosen for the regression analysis: *oral instruction at a regular consult* and *performance of preventive measures at a regular consult*, are ordinal variables, ranged from 1 through 5. Both showed a high variation in responses with more interesting and significant results regarding the application of preventive measures. All predictor variables are based on the theoretical framework (see section 1.2.), and grouped as background factors, knowledge, and impediments. The expectation is that these predictors have an association with the application of preventive measures in dental caries prevention. The goal is to identify factors that affect the application of preventive measures. In addition, each outcome variable is analyzed in three different models, grouped by the predictor variables of background information, knowledge and impediment factors (See chapter 3).

2.10. Ordinal Logistic Regression

In order to predict ordinal responses, the usual linear regression would not work well. One could measure the outcome variable with the assumption that the variable is measured on an interval scale, but it is not recommended for ordinal outcome variables.²³ The analysis considered dichotomising the data using a linear logistic regression, but this approach is «... *inefficient and possibly biased if the point for the dichotomy is chosen by looking at the data*» (70, p.89), and the regression model would not reflect a good relation with the data (validity). Therefore, ordinal regression was the best option, for the reason that is based on the cumulative of response probabilities rather than a categorical one (70).

To interpret ordinal logistic regression, the value of odds ratio will be used (ExpB in the SPSS output), and will indicate the change in odds as a result of a unit change in the predictor

²³ Ordinal regression. © Copyright IBM Corporation 1989, 2011. http://publib.boulder.ibm.com/infocenter/spssstat/v20r0m0/index.jsp?topic=%2Fcom.ibm.spss.statistics.cs%2Fplum_table.htm. Last updated: November 2012.

variable (67). Chi-square tests will allow compare the observations with an expected chance based on the hypothesis (71). For the goodness of fit test, responses should be large in each cell, but the majority of the responses on some of the predictor variables were not evenly spread, and the variance of distribution of some responses was low (72), specially for the knowledge variables. A multicollinearity test was run to see if there was a strong correlation between some of the predictor variables. VIF results were 1 and no problem was found. Thus, the model kept all variables. For background information variables, *age* and *experience* (both in scale) were correlated and *age* was left out of the analysis since the variable *experience* was a more strong suit for the model.

The link function used was a negative log-log since most of the values of the two outcome variables were low (e.g. many dentists responding «always» and «often», values 1 & 2) (See tables 9 and 10) (72). There are also other categorical variables besides the ordinal variables (e.g. gender), and the statistics may not provide a reliable goodness of fit test (72). However, some of the observed significant levels found rejected the null-hypothesis, and the significance levels for the goodness of fit statistics were small. This way, the test of parallelism did not reject the assumption of proportional odds with such significance levels, and the regression coefficients were the same for all four models. However, a conservative method examined the data when the assumption is not met (see section 4.2, tables 12 and 13). The models show the odds ratio of the coefficient and the confidence interval. The confidence interval is «... *a statistic that estimates precision...*» (68), and mostly used in international academic research. The confidence interval will comprise the parameters 95% of the time.

Chapter 3. Results

This chapter will cover the main analysis of the data material from the survey study.²⁴

All four outcome variables measure the application of preventive measures, and as previously mentioned, only two of the outcome variables are used in the statistical analysis: *oral health instruction in each regular consult*; and *performance of preventive measures*. Second, various models of multiple regression are performed, thus, one model for each outcome variable, and will account for the different aspects in the application of preventive measures.

3.1. Descriptive Statistics

The following tables show the frequencies for all four outcome variables to the model for the *application of preventive measures*, and for all predictor variables of *background information*, *knowledge*, and *impediment factors*. All responses are based on the 308 respondents from the study. Table 8. shows all descriptive statistics for all four main outcome variables. Between 50.2% and 86.4% of all respondents answered «*always and very often*» and «*often*» to the application of preventive measures. A positive response for the great majority of dental practitioners, indicating that dentists take preventive measures seriously.

The following tables show the descriptive statistics for the variables regarding the application of preventive measures.

²⁴ All statistics were created from the statistical program SPSS, version 19.0. All tables/analysis in SPSS output available upon contact with author.

TABLE 8. VARIABLES REGARDING APPLICATION OF PREVENTIVE MEASURES

ROUTINELY CHECK FOR CARIES IN THE DIAGNOSIS TO PATIENTS		
	ALWAYS AND VERY OFTEN	86.4
	OFTEN	11.1
	SOMETIMES	2.3
	SELDOM	0.0
	NEVER	0.3
	TOTAL	100%
USE OF PREVENTIVE MEASURES WHEN CHECKING SIGNS OF DENTAL CARIES		
	ALWAYS AND VERY OFTEN	67.7
	OFTEN	20.1
	SOMETIMES	9.2
	SELDOM	1.3
	NEVER	1.7
	TOTAL	100%
ORAL HEALTH INSTRUCTION ON PREVENTIVE MEASURES AT A REGULAR CONSULT		
	ALWAYS AND VERY OFTEN	79.2
	OFTEN	17.5
	SOMETIMES	3.2
	SELDOM	0.0
	NEVER	0.0
	TOTAL	100%
PERFORMANCE OF PREVENTIVE MEASURES AT EACH REGULAR CONSULT		
	ALWAYS AND VERY OFTEN	50.2
	OFTEN	28.2
	SOMETIMES	15.7
	SELDOM	3.9
	NEVER	2.0
	TOTAL	100%

Notes: Distribution of frequencies for the four outcome variables in the application of preventive measures. Response rates are in valid % from a five-point likert scale 1 through 5 (1= highest, 5= lowest). N=308

3.1.1. Background Information

The following table shows all descriptive statistics for background information of Dominican dental practitioners.

TABLE 9. BACKGROUND INFORMATION FROM DOMINICAN DENTAL PRACTITIONERS.

AGE		
	MEAN	39.1
	MIN	23
	MAX	70
	SD	11.9
GENDER		
	MALE	28.5
	FEMALE	71.5
GRADUATION YEAR		
	1959 OR EARLIER	0.3
	1960-1969	0.9
	1970-1979	6.2
	1980-1989	18.8
	1990-1999	20.0
	2000 OR LATER	53.7
DENTAL EDUCATION		
	PRIVATE DENTAL SCHOOL	64.9
	PUBLIC DENTAL SCHOOL	35.0
EXPERIENCE		
	MEAN	14.6
	MIN	0
	MAX	52
	SD	10.9
REGION		
	CAPITAL	64.9
	NON-CAPITAL	35.1
WORKING SECTOR		
	PRIVATE	72.5
	PRIVATE & PUBLIC	27.4
TYPE OF DENTIST		
	GENERAL DENTAL PRACTITIONER	49.0
	DENTAL SPECIALIST	33.8
	UNIVERSITY PROFESSOR	17.1

Notes: Distribution of frequencies for background information variables. N=308. Response rates are in valid %. For the responses in the working sector variable, 3.6% of the private dentists were working in the public sector at the time of the study.

For the variable *age*, respondents were ranged from 23 to 70 years of age, with a mean age of 39.16 (SD=11.9). *Gender* shows that 28.5% were men and 71.5% were women. Most respondents graduated from a dental school since 1990, and in the area of *dental education*, respondents came from 11 Dominican dental schools. The majority of dental practitioners had studied at a private university, with evenly spread results between the main private

universities (e.g. Unibe 15%, Unphu 14% and Pucmm 13%). Only 33.8% of dental practitioners answered they had studied at the public university, UASD. From the question *actual job as a dentist*, those working as university professors also worked as general dental practitioners or specialists. 49.0% responded to work as a general dentist, 33.8% as specialists, and 17.1% as university professors. Most university professors had also fulfilled a masters degree in education or had followed a continuing educational course (often a requirement from some universities and the Ministry of Education).²⁵ The average *years of experience* were 14.66 years (SD= 10.9). 52 years was the longest as working experience in the field. Even though the sample population covered only dental practitioners from the private sector, some dentists also answered working for the public sector at the time of the study. From the question regarding *working sector*, 72.5% worked only for the private sector, and 27.4% responded they worked for both the private and the public sector.²⁶

²⁵ The Ministry of Education have suggested a masters' in education as a requirement for university professors. Some universities have applied this. Dominican Ministry of education. Website: <http://www.see.gob.do/Pages/default.aspx>

²⁶ This variable was ranged in 4 values that includes: the private sector, the public sector, both the private and the public, and other (e.g. NGO's). However, it was recoded into a new variable covering only the private and public sector. SPSS output available upon contact with author.

3.1.2. Knowledge

The following table shows the distribution for the four knowledge variables in dental caries prevention.

APPLICATION OF FLUORIDES IS AN IMPORTANT ELEMENT IN DENTAL CARIES PREVENTION		
	STRONGLY AGREE	65.1
	AGREE	34.2
	DISAGREE	0.7
	TOTAL	100.0
FREQUENCY OF SUGAR CONSUMPTION PLAYS A GREATER ROLE IN DENTAL CARIES THAN THE TOTAL OF SUGAR CONSUMED		
	STRONGLY AGREE	57.2
	AGREE	39.5
	DISAGREE	2.6
	STRONGLY DISAGREE	0.3
	DON'T KNOW	0.3
	TOTAL	100.0
SEALANT THERAPY IN PIT AND FISSURES FOR RECENT ERUPTED MOLARS IS EFFECTIVE		
	STRONGLY AGREE	60.9
	AGREE	33.9
	DISAGREE	4.6
	DON'T KNOW	0.7
	TOTAL	100.0
USE OF A FLUORIDE TOOTHPASTE IS MORE IMPORTANT THAN A BRUSHING TECHNIQUE		
	STRONGLY AGREE	11.3
	AGREE	13.6
	DISAGREE	59.5
	STRONGLY DISAGREE	15.3
	DON'T KNOW	0.3
	TOTAL	100.0

Notes: Distribution of frequencies for the knowledge variables. N=308. Response rates are in valid %. Respondents showed levels of agreement in a five point likert scale from «strongly agree» to «strongly disagree» (1 through 5). Not shown values in some of variables had non-response rate.

Mainly all four variables showed positive, but large response rates on (mostly, «strongly agree» and «agree»), towards knowledge on dental caries prevention. «Don't know» answers show a very low number of respondents (0.7 and 0.3%). Even though this result may be

meaningless to include in the analysis, it is presented as descriptive statistics, and this answer will be used to help present the variance in the outcome variable (see section 3.2).

65.1% answered «strongly agree» for the *application of fluorides as an important element in dental caries prevention*, and 57.2% answered that *the frequency of sugar consumption plays a greater role in dental caries than the total of sugar consumed*. For the *effectiveness of sealant therapy in pit and fissures for recently erupted molars*, 60.9% responded «strongly agree». However, the last variable, *the use of a fluoride toothpaste is more important than a brushing technique*, showed a much more varied response compared to the other variables, 59.5% in «disagree» and 15.3% in «strongly disagree». Results show more dental practitioners interested in a toothbrushing technique than in the use of a fluoride toothpaste, when the use of fluorides is a main measure in the guidelines for dental caries prevention. Other factors may be related to these results. Dominican dental practitioners may pay more attention to the social aspects of patients (e.g socio-economic factors) rather than prioritize one aspect from the application of preventive measures, in this case, the use of a fluoride toothpaste. This will be explained further in the discussion chapter.

From all results, Dominican dentists seemed to demonstrate a high general knowledge of these factors in dental caries prevention. Combined with responses of higher levels in the application of preventive measures, this seems reassuring for the quality of Dominican dental practitioners.

3.1.3. Impediments

The following table shows the variables regarding the impediments that cover questions on how much these factors impede dentists apply preventive measures to their patients. The response rates only show the highest percentages for the answers «very much» and «much», with a variation on how much these factors impede dental practitioners provide preventive care.

TABLE 11. IMPEDIMENT FACTORS IN THE APPLICATION OF PREVENTIVE MEASURES

PATIENTS HAVE POOR KNOWLEDGE OF THE POTENTIAL OF DENTAL CARIES PREVENTION	60.7
THE POOR ORAL HEALTH OF PATIENTS IS AN OBSTACLE TO PROVIDE PREVENTIVE CARE	73.7
DENTAL INSURANCE COVERS NO PREVENTIVE CARE	44.6
DENTAL AUXILIARIES ARE IN CHARGE OF PREVENTIVE CARE NOT THE DENTISTS	17.6
PREVENTIVE DENTISTRY GIVES DENTISTS NO RESPECT	41.7
NO TIME IN DENTAL PRACTICE FOR PREVENTIVE CARE	43.6
PREVENTIVE DENTISTRY IS NOT A PRIORITY IN DENTAL EDUCATION	48.3
PREVENTIVE DENTISTRY MATERIALS NOT EASILY AVAILABLE	46.9
PRINTED MATERIAL IS SCARCE	34.3
PREVENTIVE DENTISTRY IS NOT PROFITABLE FOR DENTISTS	35.2
PREVENTIVE DENTISTRY IS NOT ESSENTIAL FOR THE COMMUNITY	44.5

Note: The numbers on the table mean %.

Despite the obstacles in the application of preventive measures, dentists manage to provide preventive care to patients. *Patients' poor oral health* (73.7%) and *patients' poor knowledge of the potential of dental caries prevention* (60.7%), in comparison to the rest of the variables, were the impediments that created more concern for the provision of preventive measures. Even though a 30 to 40% response rate is still important, the majority of dental practitioners were affected by these impediments in order to provide preventive care to their patients. Regarding *preventive dentistry is not a priority in dental education* (48.3%), *preventive materials not easily available* (34.3%), and *preventive dentistry not essential for the community* (44.5%) showed high percentages in the answers of «very much» and «much». In this case, even though the high percentages, these factors do not impede the majority apply preventive measures to their patients (See tables 12 and 13). From these results, dental practitioners perform their practice from knowledge and experience in the application of

preventive measures, and that patients do not always follow dentists advice. A less serious impediment was *dental auxiliaries in charge of preventive care not the dentists* (17.6%), the lowest percentage response rate in table 11. This impediment factor will be explained further in the discussion chapter.

3.2. Ordinal Logistic Regression

The following tables show results from the ordinal logistic regression for the outcome variables: *oral health instruction on dental preventive measures at a regular consult* and *performance of preventive measures at each regular consult*. The predictor variables background information, knowledge and impediment factors are grouped in three models. Odd ratios are calculated with the formula $OR = e^{\wedge}$ in excel since SPSS does not report $\exp(B)$.²⁷

TABLE 12. DISTRIBUTION OF ODDS RATIO AND CONFIDENCE INTERVAL FROM ORDINAL REGRESSION FOR THE OUTCOME VARIABLE: ORAL HEALTH INSTRUCTION AT A REGULAR CONSULT.

BACKGROUND INFORMATION VARIABLES	MODEL 1 BACKGROUND INFORMATION	MODEL 2 BACKGROUND INFORMATION AND KNOWLEDGE	MODEL 3 BACKGROUND INFORMATION, KNOWLEDGE AND IMPEDIMENTS
	OR - (95% CI) ADJUSTED AGE AND EXPERIENCE	OR - (95% CI) ADJUSTED AGE AND EXPERIENCE	OR - (95% CI) ADJUSTED AGE AND EXPERIENCE
GENDER	0.82 (0.44, 1.54)	0.93 (0.47, 1.83)	0.74 (0.34, 1.61)
PRACTICE LOCATION	0.83 (0.47, 1.49)	0.78 (0.42, 1.47)	0.67 (0.34, 1.33)
JOB SECTOR	0.92 (0.51, 1.67)	1.05 (0.55, 2.01)	0.89 (0.42, 1.91)
EXPERIENCE	1.00 (0.97, 1.02)	0.98 (0.96, 1.01)	0.99 (0.96, 1.02)
DENTAL SCHOOL	1.17 (0.65, 2.11)	0.89 (0.47, 1.69)	0.79 (0.37, 1.65)

KNOWLEDGE VARIABLES	MODEL 2 OR - (95% CI) ADJUSTED AGE AND EXPERIENCE	MODEL 3 OR - (95% CI) ADJUSTED AGE AND EXPERIENCE
APPLICATION OF FLUORIDES IS AN IMPORTANT ELEMENT IN DENTAL CARIES PREVENTION		
STRONGLY AGREE	0.15 (0.01, 1.87)	0.21 (0.01, 3.61)
AGREE	0.19 (0.02, 2.38)	0.26 (0.01, 4.58)

²⁷ The LOG function in EXCEL presents the logit for the odds as the natural log (approx. 2.718). EXP is the inverse, therefore, the calculation is EXP (number) with the natural logarithm e (2.718) raised to the power of the number.

FREQUENCY OF SUGAR CONSUMPTION PLAYS A GREATER ROLE IN DENTAL CARIES THAN THE TOTAL OF SUGAR CONSUMED		
STRONGLY AGREE	39231870.60 (0, E)	37058192,30 (0.00, E)
AGREE	53169740.24 (0, E)	37543093.83 (0.00, E)
DON'T KNOW*	33073559716.07 (0, E)	7387092075.89 (0.00,E)
SEALANT THERAPY IN PIT AND FISSURES FOR RECENT ERUPTED MOLARS IS EFFECTIVE		
STRONGLY AGREE	1.54 (0.34, 6.90)	1.19 (0.24, 6.00)
AGREE	1.13 (0.25, 5.14)	0.96 (0.18, 4.99)
DON'T KNOW*	38.09 (2.97, 487.85)	20.80 (1.15, 375.03)
USE OF A FLUORIDE TOOTHPASTE MORE IMPORTANT THAN A BRUSHING TECHNIQUE		
STRONGLY AGREE	0.16 (0.02, 1.14)	0.10 (0.01, 0.84)
AGREE	1.01 (0.36, 2.86)	0.69 (0.22, 2.23)
DON'T KNOW*	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)
STRONGLY DISAGREE	1.26 (0.55, 2.90)	1.25 (0.50, 3.12)

IMPEDIMENT FACTORS	MODEL 3 BACKGROUND INFORMATION, KNOWLEDGE AND IMPEDIMENTS OR - (95% CI) ADJUSTED AGE AND EXPERIENCE
PATIENTS HAVE POOR KNOWLEDGE OF THE POTENTIAL OF CARIES PREVENTION	
VERY MUCH	1.45 (0.35, 5.97)
MUCH	0.56 (0.14, 2.35)
LITTLE	0.78 (0.18, 3.37)
VERY LITTLE	0.71 (0.12, 4.12)
PATIENTS' POOR ORAL HEALTH IS AN OBSTACLE TO PREVENTIVE CARE	
VERY MUCH	1.64 (0.48, 5.62)
MUCH	1.57 (0.45, 5.45)
LITTLE	1.79 (0.45, 7.14)
VERY LITTLE	0.80 (0.10, 6.44)
NO TIME IN DENTAL PRACTICE FOR PREVENTIVE CARE	
VERY MUCH	0.51 (0.14, 1.86)
MUCH	1.29 (0.51, 3.29)
LITTLE	2.25 (0.76, 6.63)
VERY LITTLE	2.38 (0.79, 7.19)
PREVENTIVE DENTISTRY NOT A PRIORITY IN DENTAL EDUCATION	
VERY MUCH	0.83 (0.26, 2.66)
MUCH	1.96 (0.68, 5.61)
LITTLE	1.90 (0.63, 5.77)
VERY LITTLE	2.37 (0.83, 6.75)
PRINTED MATERIAL FOR ORAL HEALTH INSTRUCTION IS SCARCE	
VERY MUCH	0.85 (0.26, 2.66)
MUCH	1.88 (0.67, 5.31)
LITTLE	1.16 (0.43, 3.14)
VERY LITTLE	1.09 (0.37, 3.23)

PREVENTIVE DENTISTRY IS NOT PROFITABLE FOR DENTISTS	
VERY MUCH	0.89 (0.26, 3.11)
MUCH	0.30 (0.08, 1.09)
LITTLE	0.77 (0.27, 2.20)
VERY LITTLE	0.99 (0.34, 2.82)

MODEL			
NAGELKERKE R2	.166	.112	.315
GOODNESS OF FIT (PEARSON)	.105	.402	.956
TEST OF PARALLEL LINES	.865	.937	.984

Notes: Odds ratio and estimated values for coefficient and confidence intervals. Logit link function: Negative log-log. Significance levels: .05. The threshold estimates for the outcome variable are not reported. Excluded categories: Highest value of each ordinal variable («strongly disagree» for knowledge and «never» for the impediment variables). Models are adjusted for years of experience. Age variable is left out of the analysis. Values for gender (1 =male 2= female), working sector (1=private, 2=private and public), practice location (1=capital 2=non-capital), and dental school (1=private 2=public). *Don't know answers had very low response and showed some errors, but OR and CI is presented.

Models 1, 2 and 3

Table 12 show results for all background information, knowledge, and impediment variables with non-significant values in all three models. For the variable *frequency of sugar consumption plays a greater role in dental caries than the total of sugar consumed*, the ORs and CI 95% were very high with not much variation, showing high numbers and errors, mainly, for responses «strongly agree, agree and don't know». This variable may not be applicable for the results, but it is presented in the analysis to show differences between the other variables. However, a multicollinearity test (VIF), showed no problem, and responses for «disagree» and «strongly disagree» were merged in order to increase the end of the excluded value and obtain a more reliable result. The majority of responses were positive, with answers «strongly agree» and «agree». The value of the true parameter that is estimated may not be stable given the range of values included in the confidence interval (e.g. there is a great gap between the lower bound of the confidence interval and the upper bound) (68). For example, the variable *patients' poor oral health is an obstacle for preventive care* in model 3, the CI 95% for «little»= (0.45, 7.14). The variable *sealant therapy in pit and fissures for recent erupted molars is effective* in model 2, shows also high odds ratio for CI 95% in

«strongly agree»= (0.34, 6.90) and «agree»= (0.25, 5.4), respectively. However, «don't know» responses showed significant levels 20.80 (1.15, 375.03), but this is a not a precise result due to the very high CI %95 (upper bound). Results account for the variation of the different values in the responses. The Nagelkerke R square values show an indication of the amount of variation in the dependent variable. Values suggests that between 16.6% and 11.2% of the variability is explained by the variables in this model.

TABLE 13. DISTRIBUTION OF ODDS RATIO AND CONFIDENCE INTERVAL FROM ORDINAL REGRESSION FOR THE OUTCOME VARIABLE: PERFORMANCE OF PREVENTIVE MEASURES.

BACKGROUND INFORMATION VARIABLES	MODEL 1 BACKGROUND INFORMATION OR - (95% CI) ADJUSTED AGE AND EXPERIENCE	MODEL 2 BACKGROUND INFORMATION AND KNOWLEDGE OR - (95% CI) ADJUSTED AGE AND EXPERIENCE	MODEL 3 BACKGROUND INFORMATION, KNOWLEDGE AND IMPEDIMENTS OR - (95% CI) ADJUSTED AGE AND EXPERIENCE
GENDER	1.37 (0.94, 1.99)	1.35 (0.91, 2.00)	1.31 (0.83, 2.07)
PRACTICE LOCATION	1.39 (0.98, 1.99)	1.44 (0.98, 2.10)	1.17 (0.77, 1.78)
JOB SECTOR	1.20 (0.83, 1.74)	1.22 (0.82, 1.81)	1.37 (0.86, 2.18)
EXPERIENCE	1.00 (0.98, 1.01)	1.00 (0.98, 1.02)	1.01 (0.99, 1.03)
DENTAL SCHOOL	0.82 (0.56, 1.19)	0.75 (0.51, 1.12)	0.81 (0.52, 1.27)

KNOWLEDGE VARIABLES	MODEL 2 OR - (95% CI) ADJUSTED AGE AND EXPERIENCE	MODEL 3 OR - (95% CI) ADJUSTED AGE AND EXPERIENCE
APPLICATION OF FLUORIDES AS AN IMPORTANT ELEMENT IN DENTAL CARIES PREVENTION		
STRONGLY AGREE	0.08 (0.01, 0.78)	0.07 (0.01, 0.85)
AGREE	0.09 (0.01, 0.90)	0.08 (0.01, 1.00)
FREQUENCY OF SUGAR CONSUMPTION PLAYS A GREATER ROLE IN DENTAL CARIES THAN THE TOTAL OF SUGAR CONSUMED		
STRONGLY AGREE	0.63 (0.24, 1.66)	0.48 (0.15, 1.50)
AGREE	0.72 (0.28, 1.90)	0.59 (0.18, 1.87)
DON'T KNOW	11.32 (0.97, 131.50)	12.81 (0.81, 201.74)
SEALANT THERAPY IN PIT AND FISSURES FOR RECENT ERUPTED MOLARS IS EFFECTIVE		
STRONGLY AGREE	0.57 (0.25, 1.31)	0.36 (0.14, 0.95)
AGREE	0.85 (0.37, 1.92)	0.56 (0.22, 1.45)
DON'T KNOW	0.81 (0.10, 6.29)	0.25 (0.02, 2.64)
USE OF A FLUORIDE TOOTHPASTE MORE IMPORTANT THAN A BRUSHING TECHNIQUE		
STRONGLY AGREE	0.78 (0.37, 1.63)	0.63 (0.27, 1.47)
AGREE	0.66 (0.33, 1.30)	0.39 (0.18, 0.84)
DON'T KNOW	1.98 (0.19, 20.74)	1.33 (0.10, 18.62)
STRONGLY DISAGREE	0.85 (0.52, 1.41)	0.69 (0.39, 1.22)

IMPEDIMENT FACTORS	MODEL 3 BACKGROUND INFORMATION, KNOWLEDGE AND IMPEDIMENTS OR - (95% CI) ADJUSTED AGE AND EXPERIENCE
PATIENTS HAVE POOR KNOWLEDGE OF THE POTENTIAL OF CARIES PREVENTION	
VERY MUCH	1.91 (0.59, 6.17)
MUCH	1.56 (0.49, 4.93)
LITTLE	2.20 (0.70, 6.96)
VERY LITTLE	1.97 (0.56, 6.97)
PATIENTS' POOR ORAL HEALTH IS AN OBSTACLE TO PREVENTIVE CARE	
VERY MUCH	4.35 (1.82, 10.40)
MUCH	3.02 (1.24, 7.33)
LITTLE	3.16 (1.19, 8.33)
VERY LITTLE	1.05 (0.26, 4.24)
NO TIME IN DENTAL PRACTICE FOR PREVENTIVE CARE	
VERY MUCH	0.28 (0.13, 0.58)
MUCH	0.38 (0.20, 0.75)
LITTLE	0.69 (0.33, 1.41)
VERY LITTLE	0.80 (0.38, 1.70)
PREVENTIVE DENTISTRY NOT A PRIORITY IN DENTAL EDUCATION	
VERY MUCH	1.99 (0.99, 3.97)
MUCH	1.01 (0.51, 2.02)
LITTLE	1.78 (0.86, 3.68)
VERY LITTLE	1.37 (0.66, 2.84)
PRINTED MATERIAL FOR ORAL HEALTH INSTRUCTION IS SCARCE	
VERY MUCH	1.57 (0.75, 3.28)
MUCH	1.58 (0.80, 3.12)
LITTLE	1.79 (0.95, 3.39)
VERY LITTLE	3.16 (1.68, 5.94)
PREVENTIVE DENTISTRY IS NOT PROFITABLE FOR DENTISTS	
VERY MUCH	1.25 (0.55, 2.86)
MUCH	1.29 (0.63, 2.66)
LITTLE	0.70 (0.34, 1.44)
VERY LITTLE	1.82 (0.94, 3.53)

MODEL SUMMARY			
NAGELKERKE R2	.028	.097	.287
GOODNESS OF FIT (PEARSON)	.309	.048	.990
TEST OF PARALLEL LINES	.044	.000	.000

Notes: All models were adjusted for years of experience. Table 12 is divided in three models for the predictor variables. Odds ratios are shown for the estimated coefficient and confidence interval. Logit link function: negative log-log. Significance levels: .05. Threshold estimates for the variable performance of preventive measures are not reported. Excluded categories: highest value of each ordinal variable (e.g. «strongly disagree» and «never» for knowledge and impediments). Values for gender (1 =male, 2= female), working sector (1=private, 2=private and public), practice location (1=capital 2=non-capital), and dental school (1=private 2=public).

Models 1, 2 and 3

In table 13, results for all background information also showed non-significant values in all 3 models, as well as the knowledge variables in model 2. However, some impediment factors

showed significant levels. *Patients' poor oral health is an obstacle for preventive care* showed significant levels for «very much»= 4.35 (1.82, 10.40) «much»=3.02 (1.24, 7.33) and «little»=3.16 (1.19, 8.33) as well as *printed material is scarce* in «very little»=3.16 (1.68, 5.94), as the main impediments with an effect in the performance of preventive measures. These variables have high CI 95% (upper bound). Results may also account for the variation of the different values in the responses. Previous analysis were tested for this outcome variable showing not many significant p-values. However, these models show to some extent an association with the performance of preventive measures, especially for the impediments. Probably, the lack of variance in the outcome variable causes the lack of significance for these predictor variables (too many responses in one value), thus, not easy to interpret. The Nagelkerke R square values suggests that between 2.8% and 9.7% of the variability is explained by the variables in this model.

3.3. Test of Parallel Lines

The test of parallel lines in table 13 showed significant levels (<.01), indicating that the assumption of proportional odds may not hold for the data in ordinal logistic regression. There may be too many explanatory variables for background information, knowledge and impediments, showing probable non-stable odds ratios for the estimated coefficients. To solve this further, all data from was examined in a set of separate logistic regression to explicitly see how the ORs for the explanatory variables vary in the different results of the likert scale answers (73, 74). This way, all three models could be kept in table 13. The ordinal outcome variable *performance of preventive measures* was dichotomized at five cut-off points for «always and very often, often, sometimes, seldom and never». These five new variables were put in five sets of binary logistic regression models (see table 14), one for each dichotomized response. The odds ratios for each explanatory variable were examined to determine its

consistency, and an additional check to a separate test of parallel lines for each explanatory variable in the ordinal models were completed. P-values are presented in the table.

TABLE 14. RESULTS OF FIVE BINARY LOGISTIC REGRESSIONS FOR THE LIKERT SCALE OF THE PERFORMANCE OF PREVENTIVE MEASURES: 1. ALWAYS AND VERY OFTEN, 2. OFTEN, 3. SOMETIMES, 4. SELDOM AND 5. NEVER

	Odds Ratio					Test of parallel lines
	1	2	3	4	5	P-value
Gender	1.72	2.68	1.35	6.89	-	.870
Experience	0.97	0.96	0.90	-	-	.347
Age	1.02	1.02	1.05	-	127.2	1.00
Dental school	0.53	0.99	3.80	-	-	.302
Practice location	1.22	1.06	0.33	-	-	.379
Working sector	1.57	1.66	0.80	-	-	.361
Application of fluorides	0.73	1.02	1.46	50.24	-	.256
Sugar consumption	0.82	0.53	1.93	-	-	.948
Sealant therapy	0.67	0.87	0.45	-	-	.000***
Fluoride toothpaste vs. toothbrushing technique	0.65	0.68	0.86	-	-	.387
Patients' poor knowledge	0.99	0.95	1.34	-	-	.920
Patients' poor oral health	1.41	1.85	1.24	-	1.08	.000***
No time in practice	0.70	0.52	0.74	-	0.16	.681
Low priority in education	1.03	1.46	1.00	-	-	.738
Printed material scarce	0.93	1.06	1.82	-	2.19	.456
Not profitable for dentists	1.29	1.12	0.84	-	0.00	.753

Notes: *= $p < .05$, **= $p < .01$; ***= $p < .001$. Negative Log-log. Variable names were simplified in this table.

Table 14 shows the results for the logistic regression when the test of parallel lines (p -values $< .05$) is not met in the ordinal logistic regression for the outcome variable *performance of preventive measures*. The test of parallel lines is a very conservative test, thus, failing is not uncommon (75). However, only two predictor variables showed significant levels, *sealant therapy* and *patients' poor oral health*, for which the assumption is strongly rejected ($p < .000$). These two variables are probably the factors that explain the previous rejection of the assumption in the test of parallel lines (model summary in table 12). For the majority of the variables the assumption was met and we keep the results in table 12.

Chapter 4. Discussion

This chapter provides a discussion of the results from the statistical analysis, the responses in the survey, and the theoretical framework of the study.

4.1. General Findings

Findings in this study indicate that Dominican dental practitioners have in general, a high level of knowledge and an open attitude towards dental caries prevention. The majority of positive responses in the descriptive statistics (table 10) showed that private Dominican dental practitioners in general, apply the necessary preventive measures to their patients. The impediment factors were a great concern for patient treatment decisions, but this did not affect the provision of preventive measures among most Dominican dental practitioners. In fact, most dental practitioners were in favor of the application of preventive measures, with emphasis on oral health instruction as an important measure, mainly in children.

Most results showed non-significant values in both of the two outcome variables. This does not mean that these factors of knowledge, impediment factors, and background information do not affect the application of preventive measures. Probably, the lack of variance in the outcome variables is the probable cause for the lack of significance and not easy to interpret. Let see the difference in responses for the two outcome variables and the discussion for the results presented in tables 12 and 13.

4.2. Background Variables

A higher percentage of women among all Dominican dental practitioners in the sample (See table 9) showed a non-evenly spread percentage of males and females for the dental population. However, women are often the majority in the dental profession and more women

are educated as dentists than men (14). Dentistry is a profession that women will choose more often than men and may be even more involved than men in applying preventive measures.

Nevertheless, results showed no significant difference between men and women in the application of preventive measures (See tables 12 and 13).

Practice-related characteristics for dental education and practice location were used as background information with a possible association in the provision of preventive measures.

These factors can be important, especially in developing countries with large socio-economic differences between the regions (e.g. urban and rural areas) (21, 22). However, results showed

no effect in the application of preventive measures (non-significant values for *dental school*) (See tables 12 and 13). This means that the application of preventive measures in dental caries prevention is not affected by whether the education is from a public or a private dental school.

Considering the large socio-economic differences between the regions, and public and private dental schools, this result is positive for the application of preventive measures in the

Dominican Republic. Results from the variable *experience* showed no significant levels

(Tables 12 and 13). There is no difference between recent graduates and more experienced dentists in the application of preventive measures. One could expect recent graduates may

apply more preventive measures than those with a long provision of dental care, due to for example, latest aspects in preventive dentistry education and new preventive guidelines,

however, results showed that regardless of years of experience, it does not affect the provision of preventive measures to patients. This may indicate that more experienced dental

practitioners keep themselves up to date with developments within preventive dentistry.

4.3. Knowledge Variables

Knowledge of dental caries prevention is the main important aspect for preventive dentistry education and treatment decisions from dental practitioners (38). Ghasemi (14) states that

knowledge in dental caries prevention is vital for the application of preventive measures. Thus, dental practitioners' knowledge regarding dental caries prevention could have an association with the application of preventive measures (38). Even though dental practitioners have the knowledge of dental caries prevention, it does not imply an equal provision of preventive care. However, the majority of dental practitioners answered positively to all caries- and fluoride related aspects, and results showed dentists had a high understanding of dental caries prevention. All four variables regarding knowledge,²⁸ showed positive results, even though they had varying effects on the outcome variables in the ordinal regression. The majority of responses showed high levels of agreement regarding the statements of knowledge. However, some weaknesses were found in fluoride-related aspects, for example, dentists that would rather recommend a toothbrushing technique instead of a fluoride toothpaste, indicating a strong disagreement from this statement. This result contradicts having the knowledge on the fluoride-related aspect in the application of preventive measures. However, even though most dentists *disagreed* on this aspect, the variable showed no significant effect on any of the outcome variables. It was nevertheless, very interesting that dentists' opinion on a toothbrushing technique had a stronger association in the application of preventive measures than the use of a fluoride toothpaste (especially when instructing to very low-income patients that cannot afford to buy a toothpaste). «*It does not matter the lack of toothpaste, but if patients could brush their teeth with a good technique with whatever they have, even with soap, is enough for oral hygiene*», was one of the many comments from Dominican dental practitioners regarding a tooth. In this case, socioeconomic aspects are a main concern, but they were not an impediment to provide preventive care. Considering the lack of resources in the rural areas, the provision of preventive care was interestingly enough

²⁸ Knowledge variables: Application of fluorides is an important element in dental caries prevention; Frequency of sugar consumption plays a greater role in dental caries than the total of sugar consumed; Sealant therapy in pit and fissures for recent erupted molars is effective; and Use of a fluoride toothpaste is more important than a brushing technique.

not affected by this factor. Most dentists reported applying preventive measures regardless of practice location or dental discipline. Even though some dental specialists pointed out preventive dentistry not being the most important subject in their practice, they were aware of the dental caries risks, taking action whenever possible.

Given the positive results in the application of preventive measures, one could have expected lower caries status among Dominicans, but dental caries status also depends on many other factors (See chapter 2). Knowledge correlates positively with the application of preventive measures, which supports the purpose of the study, in addition to patients' needs. One could think the result would have been different if the sample also covered the public sector or if the focus was only the public sector. This could be an interesting topic to study further. The many positive reported answers from the Dominican dental practitioners explain good knowledge and good provision of preventive measures. However, a methodological concern is that responses may not always reflect dental practitioners' practice, and dental caries status in the Dominican Republic could imply the contrary. The study is within a group of the total Dominican dental population, the private dental practitioners, and if compared with for example, first year dental students, the answers would be different. If public dental practitioners were to be included, responses could be significantly due to the different provision of oral health care in the private and in the public sector. For example, lack of resources and low-budgets from the Ministry of Health will limit the application and provision of preventive measures, in the public sector.

4.4. Impediment Factors

Most impediment factors showed having no effect in the application of preventive measures. After a statistical analysis, only six of the eleven impediments (Table 6) were used for the regression analysis. The majority showed no significant levels and only a few showed an

association to the outcome variables. Dentists with many patients reported having no time for prevention, although, results showed no significant levels and it was not an obstacle for the provision of preventive care. The variable *printed material is scarce* showed that this factor impede dentists *very little* in the application of preventive measures, showing significant results. This means that the lack of printed material is a (very little) obstacle for the provision of preventive care. Printed material is often used for oral health instruction purposes, however, this significant result was from the outcome variable *performance of preventive measures* and not *oral health instruction*. This impediment variable may be compared to the variable *provision of educational material to patients* (table 5), with positive (54.9%) and (45.1%) negative responses. This variable was not used in the statistical analysis, but some dental practitioners mentioned lacking educational material to provide their patients. Nevertheless, promotional products from dental brand industries (e.g. Colgate) often offer this type of material to dental clinics.

Similarly, *patients' poor knowledge of the potential of dental caries prevention* showed significant results in responses of *very much*, *much* and *little*. With for example, a *very much* impediment on this factor compared to *not at all*, means that dentists are less likely to provide preventive care when controlled by the outcome variable *performance of preventive measures* (Table 13). This means that if patients have poor knowledge on the potential of dental caries prevention, may lead to one of the factors of high dental caries levels, creating great concern and limitations among Dominican dental practitioners.

4.5. Other Findings

Regarding the variable *dental auxiliaries in charge of preventive care not dentists*, descriptive statistics (table 11) and some opinions from dental practitioners reported that this factor was not an obstacle for dentists to apply preventive measures. However, there was no association

with the outcome variable. This is mainly because the majority of Dominican dental practitioners carry this responsibility and not the dental auxiliaries. Therefore, the variable was taken out of the statistical analysis. Kidd & Fejerskov (4) state that the dental team could consider a more cost-effective practice by delegating, for example, preventive care to hygienists (e.g. patient instruction and education, fluoride application, etc.), in the Dominican case, to the dental auxiliaries. However, all dental practices regarding patient treatment are done by the Dominican dental practitioners, including preventive care. Only in cases of oral health care programs (for example, by the Ministry of Health), are these terms reconsidered, and health workers, auxiliaries, even dental students, are delegated the responsibility to help the dental team with preventive procedures and non-operative treatments. Furthermore, issues regarding oral health care policies from the Ministry of Health were lacking in the community, according to some comments from dental practitioners working in the private sector.

Regarding opinions on dental caries prevention, descriptive statistics showed positive opinions on dental caries prevention. Additional results showed that 98.7% of the respondents answered being comfortable talking about preventive dentistry. 51.5% answered that their patients inquire regularly on dental preventive measures, but 46.8% answered that they rarely had patients inquiring on preventive measures, and that a curative treatment was more often chosen. Of all dental practitioners, 93.7% answered they were aware of the risk of dental caries, including their dental team. The large majority 97.7% also responded it was their role to promote awareness through preventive measures. A few dentists pointed out that promoting awareness on dental caries prevention was a role for the Ministry of Health and the public health authorities, and not for the dental practitioners. Only 5.1% of dentists answered that

dentistry should rely on treatment and not on prevention. The majority responded that treatment was not the only option 94.6%, but dentists should focus on both.²⁹

These responses demonstrated high levels of orientation and understanding of dental caries prevention.

For the responses regarding future risks in dental caries, the majority of dental practitioners agreed to all statements that may develop dental caries in the future, given the fact that these statements were considered for this setting in different references.

4.6. Limitations of the Study

Some essential elements in the survey may hide dentists' real behavior and responses may be the *socially* acceptable as what is known to be done in dental caries prevention rather than reflect dental practice. This gives a very positive impression in the provision of preventive measures to patients among Dominican dental practitioners (14), but it may affect the validity of the responses in the survey. Thus, treatment decisions are often influenced by many patient-related situations and aspects in dental caries, which not necessarily follow dentists' expected decisions in practice. It is not positive for the provision of preventive measures if these decisions are not followed. In this case, different tests and methods and *hypothetical cases* could give understandable structure of patients' dental status and background information to emphasize patient-treatment decisions (14).

To refine the validity of the statements regarding knowledge, statements were taken from a scientific evidence textbook (76) and dental caries prevention guidelines (36). The respondents were participants in a sample population of Dominican dental practitioners working for the private sector in the Dominican Republic. Sadly, no data on registered dentists was available, therefore, the focus had to cover only dental practitioners working in

²⁹ These results are not shown on the descriptive statistics table and were taken out of the statistical analysis due to many variables in the study and a concern of degrees of freedom in the models.

the private sector found in the national yellow pages. An online survey was considered, but left out due to probable response bias (see chapter 3.7). The current data on background information of Dominican dental practitioners is reasonably representative. Self-administered surveys was the only reliable source for collecting data and easy to administer, although, it takes time. The concern is those more interested in preventive dentistry were more eager to respond and were more confident about the topic, which could lead to some response bias. Others were busy with patients or had no time at the time the survey was handed, but took the time later to fill in. This was a concern for a probable deviation of the results from delayed responses in interviewer and response bias (64, 68).

4.7. Alternative Methods for Data Collection

Some other methods of data collection were considered as a supplement. Data could have been collected online with an internet survey or possible via Facebook (where most of the target population could be found these days), but the sample could attract serious bias. Other internet sites also register Dominican dental practitioners (e.g. *Dentalcitydr*),³⁰ but these sites only had an estimated number of dental practitioners, and did not seem as a reliable source for the study. *Dentalcitydr* had a list, with no direct access to the public, of almost 3000 dentists. The site usually approaches users by e-mail to become listed, or dentists are found on Facebook and on Twitter. An online questionnaire was a tentative option via *dentalcitydr*, but an acquired sample from this site would most likely be biased. The internet is a current frontier for data collection and the use is still limited in the Dominican Republic. Many people lack access to the internet, specially in the rural areas (although smartphones are often used), and sampling e-mail addresses and «Facebook friends», would limit the reliability of a convenient sample and increase the risk of future biases, such as selection and information

³⁰ Dental City DR <http://www.dentalcitydr.com/> (Accessed previously March 2012, although could not be accessed October 2012. Unfortunately, the site had a malware warning). Another site: RD Livio.com <http://republicadominicana.livio.com/salud/dentistas/> covered a list of Dominican dental practitioners. Last accessed March 2012.

bias (see chapter 2) (65). Sampling strategies may evolve on the internet for survey collection, but a self-administered survey approach seemed the most reliable for this study, specially if rural areas were going to be covered. Therefore, the study rejected the use of different websites with registered dental practitioners to gather respondents and instead, a selection of the study population was chosen from the national yellow pages. As a consequence, the main focus was the private sector, whith a convenient list of dental practitioners and a greater chance to be selected.

4.8. Qualitative Analysis

For the qualitative part of the study, the study found that dental practitioners interested in preventive dentistry, public health and children, were more open to give a broader opinion on dental caries prevention and the provision of oral health care in the country. Although, most dentists expressed concern on dental caries prevention at the end of the survey (see appendix). In addition to the private sector, dental practitioners working in the public sector or for the universities gave more information on preventive programs and public policies, and even suggestions of what should be done in the Ministry of health. Curricula at some universities offered assignments and lectures to students regarding preventive dentistry and the use of preventive measures.³¹ The main topics of preventive dentistry lectures at the university included dental caries and the use of fluorides. Preventive procedures such as oral hygiene instruction, profilaxis, sealant therapy, and basic curative treatments are done by students at the university clinics and at elementary public schools for extracurricular student practices. Lately, the universities follow oral health programs provided to public schools where students collect the caries levels from children and acquire a statistical report. However, since the main

³¹ This was taken from two university curriculum: 1. Universidad Iberoamericana (UNIBE) Preventive programs in Unibe. http://www.unibe.edu.do/carreras/odontologia/odo_enterate.asp and http://www.unibe.edu.do/editorial/unibeinforma_dic_07.pdf. March 2012.

2. Universidad Pedro Henríquez Ureña (UNPHU) (courses regarding preventive dentistry: (ODO-214, 215, 216) <http://www.unphu.edu.do/sitio/pensum/medicina/odontologia.pdf> May 2012.

idea is prevention, extractions are often done in these practices at the public school, and being conservative with a preventive approach, sadly, is often not an option. Preventive dentistry is instructed mainly in theory to dental students, but in practice, results are rather different. Students acquire the knowledge and learn to apply preventive measures in dental school, but the interest is small, and treatment is of most interest and mostly done at the university clinic and extracurricular practices, according to dentist Fidelia Oviedo.³² It is always the wish of students to treat patients and participate in challenging cases instead of using preventive measures. Interesting remarks from some dental practitioners implied that preventive dentistry is a non-expertise among dentists. Dental practitioners holding this view were less likely to participate in the survey, which may have generated a non-response bias in the sample. However, very few dental practitioners shared this notion. Preventive dentistry should be considered in spite of any field in dentistry, and due to the high dental caries prevalence, used regularly in the provision of oral health care, specially in children and unprivileged communities. Other factors such as access to preventive treatments and investments in public health programs, could also contribute to new findings and further study.

4.9. Future Concerns and Recommendations

In the assessment of dental caries, a curative treatment is usually chosen instead of focusing in a preventive approach (often the case due to a damaged tooth). Dental caries as a progressive disease, requires continuous care, but the cost of dental treatment increases with time. It is the role of the dental practitioner to create awareness among patients on prevention and the risk that entails dental caries, although, it is also the responsibility of the patient to preserve this awareness. Applying active measures is an important aspect in the prevention of dental caries. Also, access to oral health care services are part of a preventive approach. With good

³² Interview during the fieldwork in 2012 to Dra. Fidelia Oviedo. University professor of preventive dentistry at Universidad Iberoamericana (UNIBE) and coordinator for student dental practices (Preventive dentistry and community practice).

preventive strategies, higher costs in dental treatments could be avoided, and both patients and dental practitioners must be aware of the risk of dental caries and the potential of prevention. Special considerations for children in the application of preventive measures is a good start. This way a curative treatment may not be necessary when becoming an adult, and patients would probably not associate dentists with pain. This is a two-way communication concerning both the patients and the dentists and «... *the apparent lack of success of communication between dentists and the public is that dental professionals had a fixed image of the public and that image was inaccurate*» (5). The possibility to prevent dental caries via dental community actions, with methods that may include the desired preventive measures, create awareness through political action (e.g. sugar taxation or reform of health policies). Although, prevention of dental caries involves other assessments, needs and improvements in caries management among populations and the dental community. Decision treatments made by dental practitioners often vary in daily routines according to patients' needs, which challenges the potential decisions in preventive dentistry. Even though dental practitioners have the general knowledge to prevent tooth decay, it is important to keep preventive dentistry simple, convenient and easy, in order to prevent dental caries. While oral health is being neglected in different areas, a rise in dental caries, mainly in developing countries, is still there, leading to potentially health consequences (32). The provision of dental treatment will consume more economic resources and will always require highly trained personnel. Other recommendations could be delegate some responsibilities on preventive dentistry to the dental auxiliaries. In order to achieve this, it will require new school programs and dental training to dental auxiliaries. However, voluntary work among dental students, dental practitioners and health workers could also be an option to keep on maintaining the preventive programs from the Ministry of Health.

Conclusion

This study has conducted an evaluation of the application of preventive measures among Dominican dental practitioners working in the private sector. There are no previous studies assessing dental caries prevention in the Dominican Republic, even though some dental practitioners and dental educators have advocated placing more attention to preventive dentistry in dental school curricula and oral health programs for children at the Ministry of Health. This thesis is the first attempt to assess levels of orientation and the provision of preventive measures in dental caries prevention among Dominican dental practitioners. The difficulties encountered in acquiring a list of all registered dental practitioners at the Ministry of Health and approaching dental practitioners working in the public sector, led the study focus only on the private sector. Self-administered surveys were the most reliable method for collecting data in this study. Although, limitations of the study and possible bias were taken into consideration (e.g. dentists' overestimation of their competencies) and some questions that could be better formulated. Nevertheless, the ease of survey administration and confidentiality were advantages for this cross-sectional study.

Many developing countries struggle to reach lower levels of dental caries and reduce the high prevalence. This cross-sectional study assembled factors of knowledge and obstacles Dominican practitioners face in the application of preventive measures. With a theoretical framework and an analysis regarding dental caries prevention, results showed that the majority of Dominican dentists have the knowledge of dental caries prevention and apply preventive measures to their patients. Although, impediments found in the lack of time for the provision of preventive care and patients' poor oral health have an association with the application of preventive measures. Dentists may find these an obstacle, but Dominican dental practitioners provide preventive care when needed and possible. Findings show high levels of orientation on dental caries prevention and dental practitioners apply the necessary preventive

measures, even though some impediment factors are the obstacles for the provision of preventive care.

The Ministry of Health also provides preventive programs and oral health instruction in the public sector, but due to low budgets, these programs are not often fulfilled. However, some private companies, international organizations and NGO's, try to provide some educational insight and material for the purposes of dental caries prevention. New policies may arise through new technologies, although, higher levels of dental caries is still a concern, and the provision of preventive measures among the population is an important factor in order to acquire a balance in the prevalence of dental caries. Even though dental practitioners have the knowledge to prevent tooth decay, it is important to keep preventive dentistry simple and easy in order to prevent dental caries.

A next step to study further could be whether dental practitioners in the Dominican Republic convert the high levels of orientation and knowledge on dental caries prevention into actual practice.

Appendix

Self-administered survey to Dominican Dental Practitioners.³³

1. Do you routinely check for dental caries in your diagnosis to your patients?
 - a) Always or very often
 - b) Often
 - c) Sometimes
 - d) Seldom
 - e) Never

2. When checking signs of dental caries, do you use any preventive measures that may facilitate prevent an early detection of caries (e.g. professional tooth cleaning, topical fluoride application, fissure sealant therapy) instead of choosing a caries treatment (even if not your specialty)?
 - a) Always or very often
 - b) Often
 - c) Sometimes
 - d) Seldom
 - e) Never

3. Do you instruct your patients about dental preventive measures «e.g. dental hygiene (use of toothbrush and dental floss) and dietary habits» at each regular consult?
 - a) Always or very often
 - b) Often
 - c) Sometimes
 - d) Seldom
 - e) Never

4. Do you perform the following measures on patients: «professional tooth cleaning, topical fluoride application and fissure sealant placements» at each regular consult?
 - a) Always or very often
 - b) Often
 - c) Sometimes
 - d) Seldom
 - e) Never

5. Are you comfortable talking about preventive dentistry to those who might be at risk of dental caries?
 - a) Yes
 - b) No

³³ This section covers the english version of the questionnaire delivered to Dominican dental practitioners. A Spanish version is also available by contacting the author. Errata: The Spanish version had two words in two of the questions (2 & 15) that were not accurately translated at the time of the study. Although, the responses did not cause any problem for the results. Any appearance of probable bias was not caused by this.

6. Do you have patients that inquire about dental preventive measures?
 - a) I regularly get patients inquiring about dental preventive measures.
 - b) I rarely get patients inquiring about dental preventive measures (often treatment).
 - c) I never get patients inquiring about dental preventive measures (only treatment).
7. Do you provide educational material about preventive dentistry (e.g. pamphlets, magazines, articles, etc.) to your patients?
 - a) Yes
 - b) No
8. Do you agree that the application of fluor is an important consideration in the prevention of dental caries?
 - a) Strongly agree
 - b) Agree
 - c) Disagree
 - d) Strongly disagree
 - e) Don't know
9. Do you agree that the frequency of sugar consumption plays a greater role in producing dental caries than does in total amount of sugar consumed?
 - a) Strongly agree
 - b) Agree
 - c) Disagree
 - d) Strongly disagree
 - e) Don't know
10. Do you think that the use of sealants is effective in the prevention of pit and fissure caries in newly erupted molars?
 - a) Strongly agree
 - b) Agree
 - c) Disagree
 - d) Strongly disagree
 - e) Don't know
11. Do you agree that the use of a fluoride toothpaste is more important than a brushing technique in preventing caries?
 - a) Strongly agree
 - b) Agree
 - c) Disagree
 - d) Strongly disagree
 - e) Don't know
12. Are you (and your colleagues) aware of the risk of dental caries?
 - a) Yes, all of our team is aware of the symptoms.
 - b) Most of our team is aware of the symptoms, but not all.
 - c) A few members of the team are aware of the symptoms.
 - d) No, we are unaware of the symptoms.

13. Do you consider it is your role to promote dental caries awareness by using preventive measures in your consult?

- a) Yes
- b) No
- c) Don't know

14. What do you think will be the largest risk factor for dental caries in the future? Select all that apply.

- a) Sugar consumption
- b) No fluoridation in drinking water
- c) Poor knowledge of potential caries prevention
- d) Poor brushing technique
- e) Ignoring regular dental visits
- f) If other, please add _____
- g) Don't know

15. How much of the following factors impede you carry out preventive measures (e.g. application of fluorides, fissure sealant therapy, oral health instruction, etc.) to your patients?

A) Patients have poor knowledge of the potential of caries prevention

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

B) Patients' poor oral health is an obstacle to preventive care

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

C) Dental insurance covers no preventive care

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

D) Dental auxiliaries are the ones in charge of preventive care

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

E) Preventive care give dentists no respect

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

F) No time in dental practice for preventive care

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

G) Preventive care has low priority in dental education

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

H) Materials needed for preventive care are not easily available

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

I) Printed material for dental health education is scarce

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

J) Preventive dentistry is not profitable for dentists

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

K) Prevention of dental caries is not essential for the community

- a) Very much
- b) Much
- c) Little
- d) Very little
- e) Not at all

16. Regarding the actual situation of dental caries in the DR, do you believe that dentistry should rely only on treatment and not on prevention?

- a) Yes
- b) No

17. Which city are you based as a dental practitioner in the Dominican Republic?

18. Which year did you become a dental practitioner?

19. Which dental school did you graduate from?

20. What is your job title? Select all that apply.
- General dental practitioner (GDP)
 - GDP with specialty. Which? _____
 - University professor
 - Certified dental hygienist
 - Dental assistant
 - Other _____
21. How many years have you been working as a dental practitioner?
22. Which organization do you work for?
- Public sector (institution, university, community service, public schools)
 - Private sector (own practice, clinic or in a team, private universities)
 - Other, please specify _____
23. How many dental practitioners work in your clinic or consult (including yourself)?
24. Year of birth
25. Gender
- Male
 - Female

*Any comments relevant to this study or dental caries prevention, please feel free to comment, we'd be happy to know your opinion.
Thank you!

Some comments given by some Dominican dental practitioners regarding dental caries prevention in the Dominican Republic.³⁴

- It is better to prevent than to cure, therefore, it is mandatory to guide the patients in the prevention of dental caries.
- Hand out imprinted material to create awareness about prevention.
- Develop preventive strategy plans in the Dominican Republic.
- Dental caries prevention and the oral health of the population rely only on dental manufacturers and dental practitioners. The Government does not do anything.
- Preventive dentistry is crucial to achieve an excellent oral health and avoid damages to the health in general.
- There should be more preventive campaigns in the media (e.g. Radio, tv, newspapers, etc.).
- There is more information regarding prevention than ever before, but the caries levels are the same.
- Dental caries prevention is essential in dentistry. If dentists provide prevention to patients, dentists won't have to rely only on treatment.
- The problem is that the majority of dentists do not take the time required for prevention on education to patients.
- Prevention in oral health at home and in schools should be revised.

³⁴ These comments were given by some Dominican dental practitioners at the end of the survey and used as their opinion regarding dental caries prevention. 10 comments are used in this thesis. The comments are translated to English from Spanish.

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