

*Dairo Javier Marín Zuluaga*

**Oral Health in Institutionalised Elderly:  
Relationship between Cognitive Impairment, Mortality,  
Oral Health Related Quality of Life, and Oral Health.  
Effect of an Oral Health Educational Program to Caregivers**



Thesis

Department of Stomatology, Faculty of Dentistry  
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Autor: Dairo Javier Marín Zuluaga  
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Are you afraid of old age?  
Why I could be? Old age is one of the most pleasant phases of life;  
Surrounded by those who love us, we live our memories again.  
But this time without either uncertainty, or unease, knowing that the past has passed.

The shadow of cypress is elongated, Miguel Delibes.

¿Teme a la vejez?  
¿por qué voy a temerla? La vejez es la etapa más agradable de la vida;  
rodeado de los que nos quieren vivimos otra vez nuestros recuerdos.  
Pero esta vez sin incertidumbre ni desasosiego, sabiendo que lo pasado ya pasó.

La sombra del ciprés es alargada, Miguel Delibes.

*To my family, who have shown me what love is.  
To my friends, who have included me in their family.  
To the National University of Colombia,  
who received me as an adolescent,  
have helped make me a man, and one day  
will let me go as a happy old man.*

**José Antonio Gil Montoya**, Profesor Titular de Pacientes Especiales de la Universidad de Granada, Director de la Tesis Doctoral titulada: **“Oral Health in Institutionalised Elderly: Relationship between Cognitive Impairment, Mortality, Oral Health Related Quality of Life, and Oral Health. Effect of an Oral Health Educational Program to Caregivers”**, de la que es autor D. **Dairo Javier Marín Zuluaga**, realizada dentro del programa de Doctorado “Investigación en Estomatología” desarrollado en el Departamento de Estomatología de la Universidad de Granada,

**AUTORIZA** la presentación de la referida Tesis para su defensa y mantenimiento de acuerdo con lo previsto en el real decreto 56/2005, de 21 de enero, emitiendo el siguiente informe:

“Los trabajos efectuados en la elaboración de esta memoria han sido realizados bajo mi supervisión y dirección, reuniendo las condiciones académicas necesarias para optar al grado de doctor”.

Y para que conste y surta efectos en el expediente correspondiente, expido la presente en Granada a 3 de marzo de dos mil once.

Fdo.: Dr. José Antonio Gil Montoya

**Ramona Rubio Herrera**, Catedrática del Departamento de Psicología Evolutiva, de la Universidad de Granada, Codirectora de la Tesis Doctoral titulada: **“Oral Health in Institutionalised Elderly: Relationship between Cognitive Impairment, Mortality, Oral Health Related Quality of Life, and Oral Health. Effect of an Oral Health Educational Program to Caregivers”**, de la que es autor D. **Dairo Javier Marín Zuluaga**, realizada dentro del programa de Doctorado “Investigación en Estomatología” desarrollado en el Departamento de Estomatología de la Universidad de Granada,

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Y para que conste y surta efectos en el expediente correspondiente, expido la presente en Granada a 3 de marzo de dos mil once.

Fdo.: Dr. Ramona Rubio Herrera

**Tiril Willumsen**, Associate Professor of the Gerodontology Unit of the Cariology and Gerodontology Department of the Faculty of Dentistry, University of Oslo, Norway, Third Supervisor of the Doctoral Thesis: **“Oral Health in Institutionalised Elderly: Relationship between Cognitive Impairment, Mortality, Oral Health Related Quality of Life, and Oral Health. Effect of an Oral Health Educational Program to Caregivers”**, the author of which is **Dairo Javier Marín Zuluaga**, working on the “Research in Stomatology” Phd Programme of the Department of Stomatology of the University of Granada, Spain,

**AUTHORISES** the presentation of that Thesis to be defended according to Royal Decree 56/2005, from January the 21<sup>st</sup>, delivering this report:

“The work carried out to perform the studies which are part of this dissertation has been done under my supervision and direction, fulfilling the academic conditions to apply for the title of PhD”.

Signed: Dr. Tiril Willumsen

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## PREFACE

This dissertation is based on the following original papers, which are introduced in the chapters II – V.

- I The Association Between Cognitive Impairment and Oral Health-related Quality of Life.
- II Oral Health and Mortality in Institutionalized Elderly
- III Oral health in institutionalised elderly people in Oslo – Norway and its relationship with dependence and cognitive impairment. *Gerodontology, in press.*
- IV Change in carer’s knowledge and in oral health of institutionalised elderly after carers training in oral health.

*Partial results of the studies, were presented in academic meetings:*

- Relationship between oral health and cognitive impairment in institutionalized elderly. 88th General Session and Exhibition of the IADR. Barcelona, Spain. *Poster presentation. July 2010.*
- Institutionalised Elderly’ Oral Health, After a Carers Oral Care Training-Program. 89th General Session & Exhibition of the IADR. San Diego, Calif., USA. *Oral presentation. March 2011.*



*Published abstracts derived from the results of the studies:*

- Marín DJ, Gil JA, Rubio R, Infante, C. Relationship between cognitive state and oral health in institutionalized elderly. J Dent Res. 2010; 89 (Spc Iss B): 2405.
- Marín DJ, Gil JA. Institutionalised Elderly' Oral Health, After a Carers Oral Care Training-Program. J Dent Res. 2011; 90 (Spc Iss A).

## ABBREVIATIONS

MCI	Mild cognitive impairment
OH	Oral health
OHI-S	Oral hygiene index – simplified
OH-QoL	Oral health related quality of life
OHTP	Oral health training program
QoL	Quality of life
SS	sub-denture stomatitis

## **PREAMBLE**

Today I am middle aged man, and I have been working with elderly people for about 22 years. Often people have asked me, why I decided to work with elderly, even to this day, I do not have the entire answer. Searching for it, I found in my personal photograph album, some photographs that I took when I was a teenager, of old people that lived in my little town; on reflection, with the help of the photos, there are many old women and men that have been a role model for me, and this still happens today. I decided while working with elderly trying to learn from them, hoping one day, to become like one of the elderly that were a role model for me when I was just starting my life.

In my work as a Prosthodontist in my office and as a professor in the National University of Colombia, I mainly work with elderly. With my students we used to work with community and institutionalised elderly, and we noticed many oral problems among them, but mainly, we have noticed that we are not able to solve these problems by our selves, and that we need to work with the people who live with, or take care of the elderly, and with the institutions where they live. That is the motivation of my current work, and this dissertation is part of that work.

## ACKNOWLEDGEMENTS

The present work was carried out at the Department of Stomatology, Faculty of Dentistry, University of Granada-Spain, and at the Gerodontology unit, Cariology and Gerodontology Department, Faculty of Dentistry, University of Oslo, Norway. I do thank these institutions for supporting my work with their resources.

I say a huge thanks to the Geriatric Institutions, in Granada and Oslo, which kindly decided to participate in the project, especially to all the nurses, nurse assistants and staff who participated and supported the study, and especially to the residents, the unique motivation for this project.

I am greatly indebted to

- My main supervisor, Professor José Antonio Gil Montoya, who since the very first minute, showed his interest in the Project, and has guided my work sharing with me all his experience and knowledge in Gerodontology.
- My second supervisor, Professor Ramona Rubio, who opened not only her office but also her heart, and has done everything to make this experience as positive as possible.
- My third supervisor, Professor Tiril Willumsen, for her full involvement and invaluable help in this Project, it has been fun, effective and constructive working with her, thank you Tiril.
- Cristina and Daniel, for their friendship, company and invaluable help on the linguistic revision.

Dairo Javier Marín Zuluaga

- My friends in Colombia, and Juan Manuel, Vicente and Ramón in Spain, for their company, friendship and support.
- My family, who have supported me with their unconditional love, reminding me how fortunate I am, for having them.

The National University of Colombia has given me a study commission to do this Doctorate, I am grateful because of that.

## **INTRODUCTION TO THE DISSERTATION**

This dissertation is based on two samples (Oslo and Granada; figures 1, 2, and table 1), and four studies presented in papers (papers I-IV). Because oral hygiene was a very important variable for us, and the indices that we used to measure this variable requires being more than one natural tooth or a denture, we decided, for both samples, to include people with at least three natural teeth and or who were denture wearers. The study reported in paper III was carried out at the Gerodontology Unit of the Cariology and Gerodontology Department, of the Faculty of Dentistry, University of Oslo, Norway. The reason for carrying out part of the thesis in Norway was because the author wished to apply for the European Doctorate at the University of Granada.

The dissertation comprises six chapters. The first chapter is a general introduction describing the relationship between oral health, oral health related quality of life, and cognitive impairment, as well as the role oral health training programmes delivered to caregivers play in improving the oral health of institutionalised elderly. This chapter also presents the aims and hypothesis of this dissertation and introduces the studies that we have conducted in order to address those aims. Chapters II to V introduce each one of the studies carried out. The last chapter summarises the studies, concludes the dissertation, and makes suggestions for futures studies.

*Figure 1. Population in paper II: The Oslo's sample.*

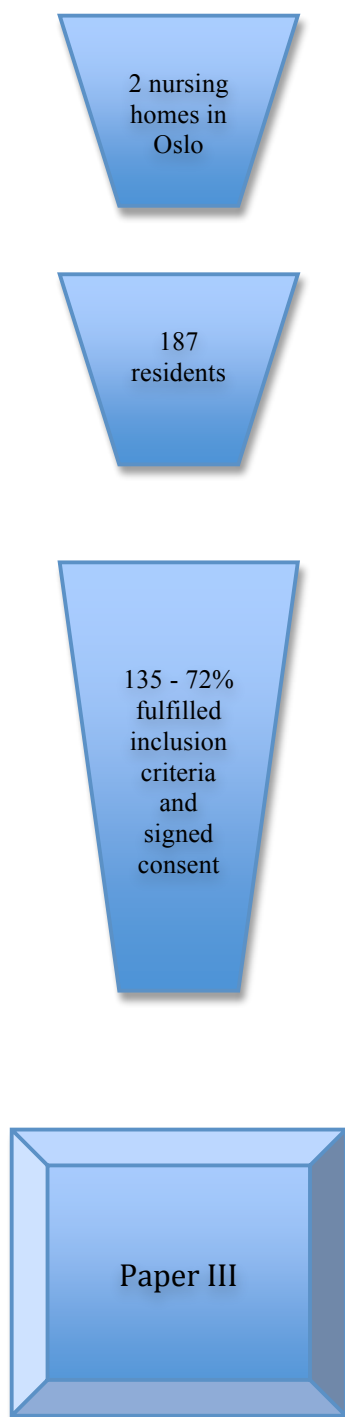


Figure 2. Population in papers I, II and IV: The Granada's sample.

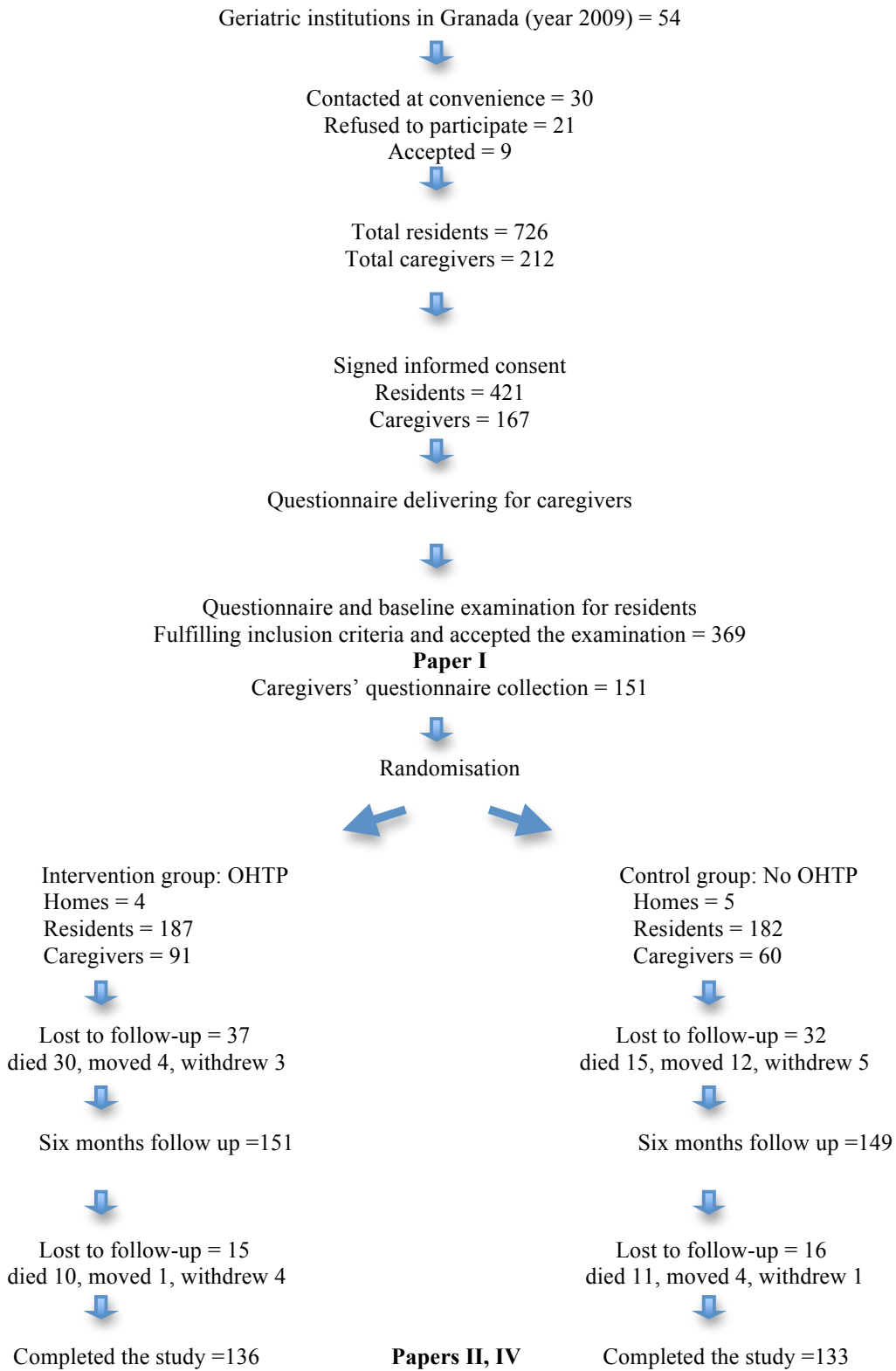




Table 1. Comparison of the variables in the samples.

<b>Variable</b>	<b>Granada's sample</b>		<b>Oslo's sample</b>	
No. of participants				
• Nursing homes		9		3
• Caregivers		167		-
• Residents		369		135
	<b>n</b>	<b>(%)</b>	<b>n</b>	<b>(%)</b>
Sex – women	280	(75.9)	109	(80.7)
Cognitive state n (%)				
• Normal	174	(47)	13	(9.6)
• MCI*	70	(19)	15	(11.1)
• Moderate – severe CI	125	(34)	107	(79.3)
Independence on dressing or washing: n (%)				
• Independent	154	(41.7)	22	(16)
• Some help needed	120	(32.5)	37	(27)
• Dependent	95	(25.7)	77	(57)
Independence on oral health: n (%)				
• Independent	247	(66.9)	70	(51.9)
• Some help needed - Dependent	122	(33.1)	65	(48.1)
Edentulous	114	(30.9)	13	(9.6)
DHI***				
• Good	54	(24.7)	25	(71.4)
• Acceptable	48	(21.9)	3	(8.6)
• Unacceptable	117	(53.4)	7	(20)
Sub-denture stomatitis	94	(42.9)	5	(14.2)
	<b>Range</b>	<b>-mean- (SD)</b>	<b>Range</b>	<b>-mean- (SD)</b>
Residents' age	52 to 102	-83.2- (7,57)	57 to 100	-85.7- (8.81)
No. of teeth	0 to 30	-8.56- (8.89)	0 to 28	-15.56- (8.59)
Retained roots	0 to 16	-0.94- (2.18)	0 to 10	-1.03- (2.18)
Caries:	0 to 10	-1.00- (1.55)	1 to 2	-1.69- (0.46)
OHI-S**	0.3 to 3	-2.11- (0.88)	0 to 3	-1.87- (0.84)
% of plaque	5 to 100	-90.76- (19.0)	36.3 to 100	-90.2- (15.0)

\* MCI: Mild cognitive Impairment; \*\*OHI-S: Oral Hygiene simplified Index;

\*\*\*Denture Hygiene Index

## Chapter I

### INTRODUCTION

The world's elderly population is growing rapidly and Spain is conforming to this trend. According to the National Institute of Statistics, 16.6% of the Spanish population, by the year 2009, was aged 65+; this percentage was 16.1% in the Province of Granada (1). As well as more elderly people living longer, more elderly people still have their natural teeth. The number of elderly people having natural teeth and the amount of natural teeth preserved in each elderly person is rising rapidly (2). The last national oral health (OH) study of Spanish people showed that, between years 2000 and 2005, in 65 – 74 year-old people, edentulism fell from 23.4% to 16.9 % (3). These dentate elderly require more regular and complex OH care. And because a lot of these elderly will not be able to receive complex dental treatments and trying to maintain healthy and functional mouths for as long as possible is a priority, prevention becomes vital.

Elderly people, and especially those in the oldest-age segment, are more susceptible to disease and disability (4) due to physical or mental deterioration. The prevalence of dementia in Spain is about 6% in people aged 65 and more; this percentage rises to 22% in men and 30% in women 85+ (5). A multicentre study of residents from public, private and state-assisted nursing homes throughout Spain determined that the overall prevalence of dementia in Spanish nursing homes was 61.7%, a lot of them not having been diagnosed (6). Cognitively impaired people have more OH problems that progress more rapidly. These OH problems include lingual ulcers, mucosal hyperplasia, sub-denture stomatitis, bad oral hygiene, xerostomya, poorer periodontal condition and more

coronal and root caries (7-9).

There is a multidimensional relationship between OH and Quality of life (QoL) (10). QoL is defined by The World Health Organization as “an individual's perception of their position in life in the context of culture and the value systems in which they live and in relation to their goals, expectations, standards and concerns” (11). Locker and Allen have defined Oral Health related Quality of Life (OH-QoL) as “the impact of oral disorders on aspects of everyday life that are important to patients and persons, with those impacts being of sufficient magnitude, whether in terms of severity, frequency or duration, to affect an individual’s perception of their life overall” (12). In elderly people, OH reflects lifelong experiences of caries and periodontal disease as well as socioeconomic status, life style and attitudes towards dental care. An impaired OH may affect the QoL in many ways (13-16), for instance it may alter the ability to chew (17), and speak, the selection of food and nutritional status (18), the corporal weight, the severity of behavioural problems, facial appearance, social interactions (10, 19, 20); and even the person’s survival rate (21-23).

With more people living longer, and a lot of them having impaired physical and/or mental performance, it can thus be expected that more elderly will depend on the health care provided by carers in community health services and nursing homes in the years ahead. Figures show that 2.3% of Spanish disabled people live in residential homes (24). There is a gap between the high needs for oral care and the limited dental services offered to the institutionalised elderly (25, 26). In comparison with elderly living at home, those living in institutions have been shown to have more oral disease and worst oral hygiene (27, 28). Among other aspects, it could be related to the fact that OH is commonly neglected in geriatric institutions, especially for those physically or

cognitively impaired residents. This situation has multiple causes: geriatric residents' low priority in dental services, poor support for carers (29), residents' behavioural resistance to oral care assistance (30), that institutions do not normally have protocols on oral/denture care, either a dentist or dental service, that dental attendance normally happens because of emergencies, misunderstanding or lack of appreciation of the relationship among OH, general health and well-being, lack of staff, time, knowledge, protocols and regulations (31, 32), and overload of the nurses are some of them (25, 26, 33, 34).

Oral care in nursing homes thus becomes dependent upon suitable daily oral hygiene procedures and may be highly influenced by the approach taken by staff (carers and directors included) (31). Residents living in residential services should receive a high standard of support and be attended by appropriately trained carers. Nevertheless, quality of oral care education imparted by carers is heterogeneous (35-38). A lack of expertise has been reported, especially regarding the oral care of residents having poor mobility or cognitive impairment (39).

Few studies have been carried out comparing oral hygiene between independent elderly who clean their teeth by themselves and those who depend upon oral care assistance and have their teeth cleaned by others. Pearson (16) in a systematic review says that oral care for dependent elderly is a challenging task. Merelie and Heyman (40) found that dentures cleaned by staff were not cleaner than those cleaned by residents. Montal et al (41) in an institutionalised French-sample, found that the oral hygiene quality was better in those self-dependent patients, and that these patients had less calculus, compared

with those needing assistance. So, being independent to perform their own mouth care may be a protective factor for the OH of the elderly living in nursing homes.

Health education, understood as "the process of assisting individuals, acting separately or collectively, to make informed decisions about matters affecting their personal health and treatment of others" (42), influences knowledge and behaviour (43). In this context oral health training programmes (OHTP), that include not only theoretical knowledge but also practical training for the carers, have been proposed as part of the measures to improve the OH of functionally dependent elderly (44-47). However, among the training programmes evaluated by reference to levels of OH in residents, results have varied from having no impact (48), little impact (49, 50) to achieving progressive improvement (45, 51). It seems to suggest that knowledge about OH care is not always translated into practice (52, 53). Clearly this is a complex issue that involves not only the carers but also, the residents' family, the directors of the institutions, the stockholders, and the policy makers.

The ultimate objective of the dental profession is to improve and maintain the OH of people in a comprehensive context of QoL. A lot of papers report studies of OHTP to caregivers and their results are contradictory. Designing and evaluating any kind of intervention without taking into account the context and the different players in this context would be incomplete.

**The aims of this dissertation are:**

*GENERAL OBJECTIVE*

To explore some factors influencing the oral health of institutionalised elderly.

*SPECIFIC OBJECTIVES*

1. To research relationships between OH, cognitive status and OH-QoL.
2. To analyse the relationship between dependence and behaviour during OH care routines and the OH of institutionalised elderly.
3. To ascertain the knowledge of caregivers of geriatric institutions with regard to the OH care of residents.
4. To improve the knowledge and skills for OH care in the caregivers of geriatric institutions.
5. To measure the impact of an OHTP to caregivers on the OH of residents.

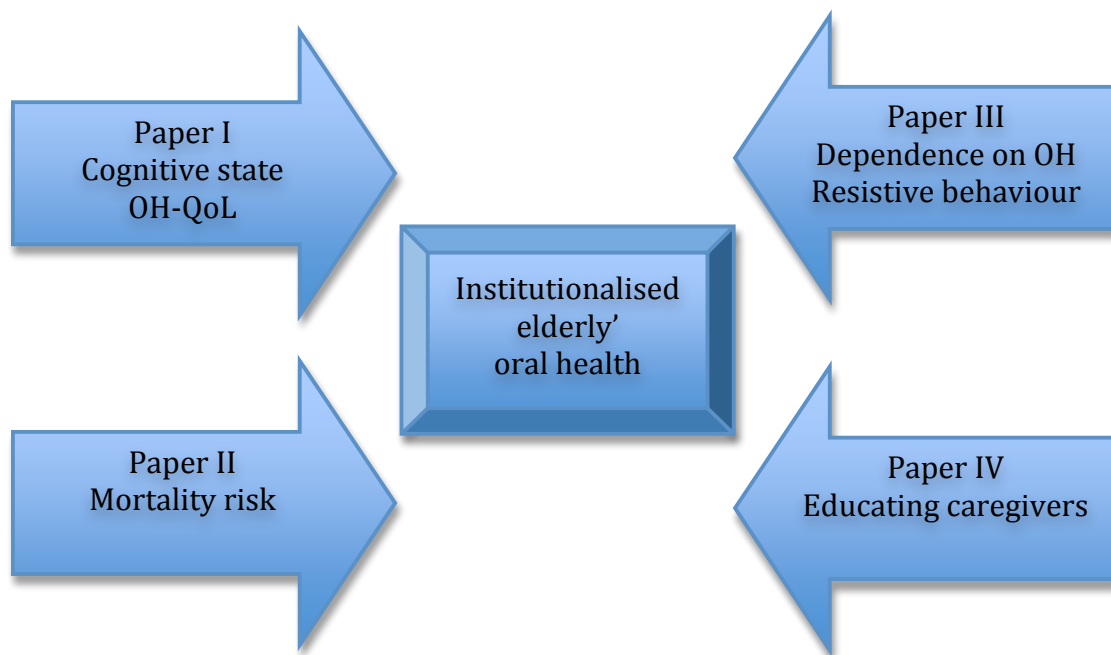
**We had several hypotheses:**

1. MCI does not affect the self-perception of OH in institutionalised elderly.
2. Residents with a better OH status have a better OH-QoL.
3. Caregivers do not have the required knowledge to care properly about the OH of institutionalised elderly.
4. Training caregivers receive on OH care positively affects the OH of the residents.

### The framework of the studies (fig. 3)

*Papers I-III* (chapters II-IV) address the first and second specific objectives; and focus on some of the OH factors dependent on the subject, the resident. Such factors are the interaction between OH, cognitive state and OH-QoL, and the resident's behaviour during OH assistance. *Paper IV* addresses the specific objectives 3-5. It reports the results of the OHTP.

Figure 3. The framework among papers I through IV.



*Paper I.* The sample of this paper was strategically selected on the basis of cognitive performance. This paper analyses the influence of the cognitive state on the OH and OH-QoL, and brings to attention the fact that even mild cognitive impairment (MCI) affects the resident's perception of their own OH status.

*Paper II.* The sample of this paper was strategically selected according to the age of the participants; consequently residents younger than 75 years were not included. It contributes to better understanding of the relationship between OH and mortality risk.

*Paper III.* This paper reports the study carried out in Oslo. It analyses the residents' dependence on caregivers for the oral hygiene activities, and the impact of the resistive behaviour during the oral hygiene assistance on their OH.

*Paper IV, (chapter V).* The sample of this paper includes institutions, caregivers who answered the questionnaire and attended the OHTP, and residents who completed the 12-months follow-up period. The paper analyses the results of the OHTP in terms of OH gains, and includes some of the other players (e.g. nursing homes, caregivers) and makes some comments about the role that policy makers, dental schools and nursing schools should play to ensure adequate oral care for residents in geriatric institutions.



## Chapter II

### **The Association Between Cognitive Impairment and Oral Health-related Quality of Life**

**Authors:** Dairo Javier Marín Zuluaga, DD, MsC\*, José Antonio Gil Montoya, DD, PhD\*\*, Clementina Infante Contreras DD, MsC\*\*\*, Ramona Rubio Herrera PhD\*\*\*\*

\*The Gedorontology Group, Oral Health Department, Faculty of Dentistry, National University of Colombia

\*\*Department of Special Care in Dentistry and Gerodontology, Faculty of Dentistry, University of Granada, Spain

\*\*\*Oral Health Department, Faculty of Dentistry, National University of Colombia

\*\*\*\*Faculty of Psychology, University of Granada, Spain.

*This paper has been delivered to Gerodontology.*

## **Abstract**

**Objective:** Investigating oral health-related quality of life's (OH-QoL) relationship with cognitive state. **Background:** oral health affects OH-QoL and is poor in institutionalised and cognitively impaired people. **Material and Methods:** This was a cross-sectional study involving 215 institutionalised elderly (82.9 mean age) who were interviewed, examined, and cognitively screened using the Pfeiffer test. **Results:** Mean GOHAI score was 53.1; only 43.7% of the participants reported having a good OH-QoL. Needing help with dressing or washing (OR 2.14;  $p=0.004$ ), having one to nine teeth (OR 4.65;  $p=>0.001$ ), eight or less occluding pairs (OR 2.74;  $p=0.002$ ), one to three caries (OR 1.85;  $p=0.005$ ) and being cognitive impaired (OR 0.54;  $p=0.034$ ) were significantly associated with altered OH-QoL in bi-variate analysis. Being edentulous (OR 3.18;  $p=0.0046$ ), having 1–9 teeth (OR 2.62;  $p=0.056$ ) and presenting mild cognitive impairment (OR 0.32;  $p=0.016$ ) appeared as predictive variables in logistic regression for having an altered OH-QoL. **Conclusions:** Participants having mild cognitive impairment had significantly better GOHAI score than cognitively normal residents. Performing cognitive screening parallel to applying any OH-QoL instrument would make the results more reliable and would benefit cognitively impaired people.

**Key words:** Oral health related quality of life, cognitive impairment, institutionalised elderly.

## **Introduction**

Dementia is a very important health and social problem in the elderly population. Its prevalence in Spain is about 6% in people aged over 65; this rises to 22% in men and 30% in women older than 85 (5). A multicenter study of 852 residents from public, private and state-assisted nursing homes throughout Spain determined that the overall prevalence of dementia in Spanish nursing homes was 61.7%, a lot of them not having been diagnosed (6).

Although dementia is the main cause of cognitive impairment amongst the elderly, not all cognitive impaired people are demented. Petersen *et al.*, (54) found that about 16% of elderly dementia-free subjects were affected by mild cognitive impairment (MCI), amnesic MCI being the most common type. Cognitively impaired people experience changes in memory, learning ability, attention, orientation and comprehension (55). Cognitively impaired people also have more rapidly progressive oral health (OH) problems, including lingual ulcers, mucosal hyperplasia, sub-denture stomatitis, bad oral hygiene, xerostomya, poorer periodontal condition and more coronal and root caries (7-9, 56).

Studies have been made into how the elderly perceive their oral health and its impact on their quality of life (QoL) (10, 20). Locker and Allen have defined oral health-related quality of life (OH-QoL) as being, “the impact of oral disorders on aspects of everyday life that are important to patients and persons, with those impacts being of sufficient magnitude, whether in terms of severity, frequency or duration, to affect an individual’s perception of their life overall” (12). There is a multidimensional relationship between oral health and QoL (10); impaired OH may affect QoL in many ways. For instance, the

ability to chew and speak, nutritional status, body weight, severity of behavioural problems, facial appearance and social interactions may be affected when OH becomes altered (10, 20). More than ten instruments are available for measuring OH-QoL; all of them consist of multi-items having high internal consistency and all are valid for measuring oral-specific health-related QoL (57). The Geriatric Oral Health Assessment Index (GOHAI) (58) and the Oral Health Impact Profile (59) are two of the most commonly used instruments in geriatric samples. The GOHAI was initially tested on two independent samples of people older than 65 having no terminal or dementing illness (58); it has since been translated and validated in several countries, Spain included (60, 61). As recommended by the authors, the GOHAI has been used in studies involving samples of people having no diagnosis of dementia but, apart from such requirement, participants in the studies are not normally tested for cognitive impairment and, as it is prevalent in the non-demented elderly (54, 62), we do not know how this could affect the reliability of information provided for cognitively impaired participants.

This study was aimed at investigating the relationship between OH-QoL and cognitive function in a non-demented sample of institutionalized elderly in the Spanish province of Granada.

### **Materials and methods**

This cross-sectional study formed part of a longitudinal study aimed determining how caregivers' improved oral health care knowledge and skills affects institutionalised elderly people's OH and OH-QoL. The study population consisted of elderly subjects living in nine geriatric institutions in the Spanish province of Granada (one public, two state-assisted and six private); these centres constituted the purposive study sample.

Participants were interviewed and examined in the geriatric institutions.

A dentist having experience in geriatric dentistry applied the questionnaire (reading out the questions and all possible answers) and made all the oral examinations and cognitive evaluations between January and August 2009. The examiner did not have any previous relationship with the geriatric institutions that took part in the study. A pilot study consisting of interviewing and examining 10 residents was performed for calibration of the examiner. Information regarding residents who were unable to respond was obtained from the corresponding medical files. 369 residents fit the inclusion criteria of having at least three natural teeth and/or wearing a removable prosthesis and were included in the main study. After interviews and cognitive evaluation, only 295 were included into this sub-sample because the other 74 residents were demented or severely cognitively impaired.

### **Dependent variables**

The GOHAI is a self-reported 12-item questionnaire, which assesses OH-related problems affecting people in three dimensions: physical function (eating, speech, and swallowing), psychosocial function (worry or concern about OH, dissatisfaction with appearance, self-consciousness about OH and avoidance of social contact because of oral problems) and pain or discomfort (use of medication to relieve pain or discomfort in the mouth). Each item is scored on a closed-option 5-point Likert scale (1=always, 2=often, 3=sometimes, 4=seldom and 5=never). Potential simple count scores ranged from 12 to 60, a score lower than 57 indicating negative OH influence on QoL. The range of scores for the dimensions are 4–20=physical, 5–25=psychosocial and 3–15=pain or discomfort (58). A validated Spanish version of the GOHAI was used in this

study (60, 61).

### **Independent variables**

Medical files were checked for obtaining data regarding entry to institutions and the medicines being used by their residents. The questionnaire also included personal data regarding education (low=no studies or primary school, medium=high school and high=technical or university studies), functional ability including dressing/undressing, washing and oral hygiene (independent, some help needed, dependent), regular check-up frequency (each 6-12 months, only if needed), time since last dental visit (6-12 months, 1-2 year, >2 years), dental appointments during the last year (yes, no), brushing teeth (yes, no) and tooth-brushing frequency (weekly, each two days, daily).

The Pfeiffer test was used for establishing cognitive state; it is a brief screening instrument with questions covering orientation, recent memory, retrospective memory, attention and calculus. After being adjusted by educational level (as indicated by the instrument), final scores for this ten-item test were: 4=normal, 3=mild cognitive impairment (MCI), 2=moderate cognitive impairment (MCI) and 1=severe cognitive impairment (SCI) (63).

Oral assessment involved using a headlamp, oral mirror and dental disclosing tablets (Sunstar Americas Inc. Chicago, USA). Assessment included visual detection of coronal and root caries, recording the number of remaining roots and visible teeth, the number of occluding pairs (a natural tooth occluded with another natural or prosthetic tooth), and oral hygiene (determined by applying the simplified oral hygiene index

(OHI-S) (64), the O'Leary index (overall percentage of dental plaque) (65) and the denture hygiene index (1=good, 2=acceptable, 3=unacceptable) (66).

The statistical package for the social sciences (version 15.0, SPSS Inc., Chicago, IL, USA) was used for all data analysis. Total GOHAI scores were added, as recommended by its authors, using the simple count method. The scores were dichotomously divided for the odds ratio (OR) and regression analysis (score 57–60=no influence at all, 12-57 some influence). GOHAI is descriptively presented using means and standard deviations. The Chi-square test and ANOVA were used for bivariate analysis of association between GOHAI dichotomized score and all other variables. Multiple logistic regression facilitated estimation of the association between cognitive impairment and GOHAI (adjusted for age, gender and educational level). Statistical significance level was set at  $p=0.05$ .

The University of Granada's Committee for Human Research Ethics approved the study.

## **Results**

Two hundred and ninety-five elderly subjects from nine geriatric institutions in the Spanish province of Granada were interviewed and examined (73% being women, mean age 82.93 years). 32.2% of the participants were edentulous; the mean number of teeth in the sample was 8.5 and 48% had less than 8 occluding pairs. Table 1 gives the descriptive statistics for the variables being studied.

Table 1. Studied variables frequency distribution (n=295)

Variable	n (%)	Mean (SD)	Range
Age (years)		82.9 (7.6)	52 -97
Gender			
Male	80 (27.1)		
Female	215 (72.9)		
Educational level			
Low	213 (72.2)		
Medium	47 (15.9)		
High	35 (11.9)		
Independence regarding dressing or washing			
Independent	145 (49.2)		
Some help needed	109 (36.9)		
Dependent	41 (13.9)		
Independence regarding oral hygiene			
Independent	233 (79.0)		
Some help needed	28 (9.5)		
Dependent	34 (11.5)		
Frequency of oral/denture hygiene			
Daily	209 (70.8)		
Less than daily	49 (16.6)		
Missing	37 (12.5)		
% of dental plaque (n=196)		88.5 (20.6)	5 - 100%
Dentate			
Edentulous	95 (32.2)		
Natural teeth remaining	200 (67.8)		
No. of teeth		8.5 (8.7)	0 - 30
No. of occluding teeth (n=200)		6.0 (4.1)	0 - 16
≤ 8	142 (48.1)		
> 8	58 (19.7)		
No. of caries (n=200)			0 - 10
None	21 (10.5)		
1-3	74 (37)		
>3	105 (52.5)		
Cognitive state			
Normal	173 (58.6)		
Mild cognitive impairment	70 (23.7)		
Moderate cognitive impairment	52 (17.6)		

OH-QoL was affected in many participants: 58.3% reported altered OH-QoL levels and 41.7% reported good OH-QoL (GOHAI score 57–60). Of the last group, only 61 participants had normal cognitive functioning (20,7% of the complete sample), 35 had MCI and 21 had MCI (table 3). GOHAI score ranged from 20 to 60 with 53.1 mean score (SD 7.4). Table 2 arranges GOHAI items and dimensions according to negative impact (always and often). The most negatively affected OH-QoL aspects in the sample were “Trouble biting or chewing”, “Pleased with look of teeth”, and “Able to eat



without discomfort". Each aspect was related to one of the three dimensions evaluated by the GOHAI (physical function, psychosocial function, and pain or discomfort). The least affected dimension was "psychosocial function" (Table 2).

Table 2. GOHAI items and dimensions arranged by negative impact (n=295)

Item	Always/often		All answers
	N (%)	Mean (SD)	Mean (SD)
Trouble biting or chewing	110 (37.3)	1.14 (0.35)	3.36 (1.81)
Pleased with look of teeth	69 (23.4)	1.05 (0.23)	3.94 (1.68)
Able to eat without discomfort	47 (16.0)	1.25 (0.44)	4.20 (1.40)
Sensitive to hot, cold or sweet food	46 (15.6)	1.19 (0.40)	4.16 (1.42)
Worried about teeth, gums or dentures	42 (14.2)	1.14 (0.35)	4.30 (1.38)
Using medication for relieving pain	28 (9.5)	1.14 (0.35)	4.58 (1.16)
Limiting the kinds of food	19 (6.5)	1.36 (0.49)	4.60 (1.00)
Able to swallow comfortably	17 (5.8)	1.11(0.33)	4.60 (1.02)
Self-conscious regarding teeth, gums or denture problems	17 (5.8)	1.17 (0.39)	4.67 (0.96)
Unable to speak clearly	10 (3.4)	1.40 (0.41)	4.83 (0.70)
Limiting contact with people	5 (1.7)	1.00 (0.00)	4.94 (0.43)
Uncomfortable eating in front of others	5 (1.7)	1.20 (0.44)	4.88 (0.56)
Dimensions			
Pain or discomfort	295 (100)	1.22 (0.42)	12.95 (2.83)
Physical function	295 (100)	1.15 (0.36)	17.40 (3.05)
Psychosocial function	295 (100)	1.13 (0.34)	22.76 (3.32)

Bivariate analysis showed that age, gender, educational level and frequency of oral hygiene were not associated with the GOHAI. The residents who needed some help with dressing or washing, those who had 1-9 teeth, eight or less occluding pairs, or 1-3 caries had a lower GOHAI score than those who were in a better condition for such variables. When analysing the crude association between cognitive status and GOHAI, the OR showed that residents having cognitive impairment had a lower risk of having low GOHAI scores than participants having normal cognitive functioning (i.e. residents suffering MCI had a perception of significantly better oral OH-QoL - Table 3). After adjusting for age, gender and educational level in the logistic regression, the only OH variables that remained in the model as predictive ones were being

edentulous and having 1–9 teeth. Performing oral hygiene less than daily had an OR = 2.31 ( $p = 0.07$ ) of having altered their OH-QoL. Participants with MCI showed 68% lower risk of having altered their OH-QoL (Table 3).

Table 3. Oral health variables and cognitive state association with OH-QoL (n=295)

Variable	Altered OH-QOL (GOHAI $\leq$ 56)	Good OH-QOL (GOHAI 57- 60)	Bivariate analysis		Multivariate analysis*	
			OR	p	OR	p
Age						
< 74	23	19	1		1	
$\geq 74$	149	104	1.18	0.61	1.22	0.65
Gender						
Male	45	35	0.89	0.66	0.74	0.52
Female	127	88	1		1	
Educational level						
Low	128	85	1		1	
Medium	24	23	0.69	0.25	0.54	0.21
High	20	15	0.88	0.74	1.01	0.98
Independence regarding dressing and washing						
Independent	72	73	1		1	
Some help needed	74	35	2.14	0.004	2.72	0.20
Dependent	26	15	1.75	0.12	1.001	0.99
Frequency of oral/denture hygiene						
Daily	113	96	1		1	
Less than daily	32	17	1.59	0.15	2.31	0.07
No. of remaining teeth						
> 9	58	51	1		1	
1 – 9	66	25	4.65	< 0.001	2.62	0.056
Edentulous	48	47	1.80	0.10	3.18	0.046
No. of occlusal pairs						
> 8	26	32	1		1	
$\leq 8$	98	44	2.74	0.002	1.11	0.82
No. of caries						
None	65	51	1		1	
1 – 3	52	22	1.85	0.05	0.90	0.80
>3	55	50	0.86	0.58	1.91	0.50
Cognitive state						
Normal	112	61	1		1	
Mild cognitive impairment	35	35	0.54	0.034	0.32	0.016
Moderate cognitive impairment	25	27	0.50	0.032	0.51	0.22

\* Adjusted for age, gender and educational level.

## Discussion

Mean GOHAI score was 53.1 in our 295-institutionalised elderly sample and only 43.7% of the participants reported having good OH-QoL. Needing help with dressing or washing, having one-trough nine teeth, eight or less occluding pairs, one-trough three

caries and being cognitive impaired were significantly associated with an altered OH-QoL. On the other hand, being cognitively impaired resulted in a significantly better GOHAI score.

There was a statistically significant relationship between cognitive impairment and OH-QoL measured with GOHAI in both bivariate and multivariate analysis. As we were not aware of other studies on this issue, then well-designed studies had to be carried out in this field. Instruments for measuring OH-QoL are not for cognitively impaired people due to changes in their memory, learning ability, attention, orientation and comprehension (55). People presenting MCI may have normal lives and even be independent. A lot of them may not have been diagnosed because they can develop compensatory measures thereby disguising the problem from family members, or the elderly may even naturally attribute such changes in memory, attention or orientation to ageing, as well as it being the case that some of the elderly (especially in third-world countries) do not have access to medical or social services. Thereby, researchers may not be aware about the fact that they are including in their samples cognitively impaired people.

The fact that participants suffering from MCI reported a significantly better GOHAI score than cognitively normal ones shows that there could be an early effect on the perception of oral health because of cognitive impairment; this may have several implications. Firstly, it means that there should be periodic cognitive screening in geriatric institutions to meet residents' care requirements. Secondly, the GOHAI or any other instrument used for obtaining information about OH-QoL or the elderly dental treatment needs should be applied accompanied by cognitive screening to ensure the

reliability of the information reported by the elderly because many people who are not demented may be cognitively-impaired (54). If cognitive impairment is detected, then oral examination should be performed to corroborate GOHAI findings; this is supported by the fact that 48% of the residents who had a normal GOHAI score were cognitively impaired. Thirdly, not doing the above could severely affect the OH and OH-QoL of cognitively impaired residents by reporting better OH status than their real ones. Dental treatment should be provided as early as possible for such people to maintain functional and healthy mouths as long as possible expressly because of limitations in treatments that will arise as a result of the future decline in their cognitive performance and because cognitive impairment is clearly associated with poor OH (7-9, 56).

QoL mainly became altered due to OH in three areas: trouble while biting or eating, being displeased with the look of teeth and suffering discomfort while eating (i.e., the three dimensions evaluated by GOHAI, physical function, psychosocial function, and pain or discomfort were altered). It meant that psychosocial function was perhaps the most preserved dimension (Table 2) as neither of the other two would be neglected when thinking about the relationship between OH and QoL. Therefore, these three mainly altered aspects constitute targets for staff in the institutions and for dentists when treating their elder patients.

Other studies have reported that the ability to chew, problems in communication and appearance may affect vital satisfaction (19, 20). As in the present study, Zini and Sgan-Cohen (67) found that suffering discomfort while eating was one of the most altered aspects of the OH-QoL in their sample of community-living elderly people, especially amongst those who were housebound. They also found a significant association

between physical functioning (needing assistance with dressing or washing) and OH-QoL, as in this study. Independent people are able to take care of their OH by themselves and maybe because of that they report having better OH-QoL than disabled or dependent people. Tsakos *et al.*, (68) reported high prevalence regarding concern about appearance (as found here) but we did not find any statistically significant association between GOHAI score and educational level (as they did).

Having caries, up to eight occluding pairs and up to nine teeth correlated significantly with a lower GOHAI in bivariate analysis when analysing OH variables and being edentulous and having up to nine teeth appeared in the logistic regression model. It has been reported that being edentulous and wearing poorly-fitting dentures are causes of poor QoL (69) and that overall GOHAI score rises after new dentures have been fitted (70, 71). Swoboda *et al.*, (72) reported that mean GOHAI and subscale scores were skewed toward a more favourable OH-QoL in a 4-year follow-up study on a sample of 733 non-institutionalised dentate elderly (mean 21.5 teeth). This correlates with our finding that participants having a low number of remaining teeth had lower GOHAI score. Akifusa *et al.*, (73) in a study concerning general health-related QoL also found that participants having 20 or more teeth had better subjective physical health than those with 19 teeth, or less. Nowadays we know that not having teeth is not determinant for nutritional status but is so for food consistency choice (74). Geriatric institutions are normally concerned about their residents' nutritional status and adapt food type and consistency to fit their residents' nutritional requirements, no matter what their oral health status is (this aspect merits the development of studies to provide empirical data). This is good but could hide a widely reported problem of neglected OH care in geriatric institutions (75) and, when talking about QoL, one has to remember that eating is not

only about nutrition but is also about enjoying food and the social relationships developed around meal times.

Some the present study's limitations need to be discussed. The sample was not selected from all the geriatric institutions in the province of Granada; only 30 out of the 54 nursing homes in the province were contacted and only nine of them agreed to participate and thus constitute part of the sample. These institutions were considered to be representative of such population but the sampling framework was not random. Potential selection bias, due to this, cannot be ignored, even though it was not clearly apparent. Although checking 10 residents two times was conducted for calibration, and it were not differences between both measures, intra-examiner reliability was not measured by performing any formal test, and could represent a source of potential bias.

### **Conclusions**

Participants suffering mild cognitive impairment had significantly better GOHAI scores than cognitively normal residents. Cognitive screening combined with applying any OH-QoL instrument would make the results more reliable and would benefit such cognitively impaired people.

### **Chapter III**

#### **Oral Health and Mortality in the Institutionalized Elderly**

**Authors:** Dairo Javier Marín Zuluaga\*, Leiv Sandvik\*\*, Tiril Willumsen\*\*

\*The Gerodontology Group, Oral Health Department, Faculty of Dentistry, National University of Colombia, Bogotá – Colombia

\*\*\* Cariology and Gerodontology Department, Faculty of Dentistry, University of Oslo, Oslo - Norway

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**Abstract. Background.** Oral health has been found to be related to general health, cognitive status and quality of life and such aspects to be predictors of late life survival.

**Materials and methods.** It was hypothesized that oral health would be related to mortality in an institutionalised geriatric population. A 12-month prospective study of 292 elderly residing in nine geriatric institutions in Granada, Spain, was thus carried out to evaluate the association between oral health and mortality. Independent samples, T-test, chi-square test and Cox regression analysis were used to analyse the data. Sixty-three participants died during the 12-month follow-up.

**Results.** Mortality was increased in denture users (RR = 2.18, p= 0.007) and in people suffering severe cognitive impairment (RR = 2.24, p= 0.003). One-year mortality was 50% in participants having both these characteristics.

**Conclusions.** Oral hygiene was not significantly associated with mortality. Cognitive impairment and wearing dentures increased the risk of death. One-year mortality was 50% in cognitively impaired residents wearing dentures as opposed to 10% in patients without dentures and cognitive impairment.



## **Introduction**

Average life span has been increasing all around the world and also in the elderly population. Oral health is related to general health, cognitive status and quality of life (72, 76); these aspects have been found to be predictors of late-life survival (21). The elderly are expected to preserve most of their teeth in the future, particularly in developed countries, but current cohorts of elderly have lost a lot of teeth throughout their lives. Dental status results from accumulated oral infections (among other factors); in the elderly it reflects lifelong experiences of caries and periodontal disease as well as socioeconomic status, life-style and attitudes towards dental care (77). Loss of teeth has been found to affect masticatory ability (17), to influence the selection of food and nutritional status (18) and to have a negative impact on oral-related quality of life (QoL) (13-14).

Several studies have addressed whether dental status is associated with mortality. Heitmann *et al.*, (78) concluded that tooth loss indicates a high risk for cardiovascular disease and stroke. Poor dentition, especially edentulousness, has been associated with deterioration in the systemic health and higher mortality of the aged (21-23). However, the age-range has been broad in many studies, but relatively few have been limited to an 80+ population. Hamalainen *et al.*, (79) found the hazard ratio for death associated with a decrease of one missing tooth was 1.026 ( $p < 0.05$ ) in a 10-year cohort study. Ansai *et al.*, (80) found tooth-loss to be a significant predictor of mortality, even when controlling for socio-economic status.

Poor oral hygiene may be considered a measure of current oral infection level. Proper oral hygiene has been found to be important in preventing death from aspiration

pneumonia in nursing homes (81). Sjøgren *et al.*, (82) concluded that around one in 10 cases of death from pneumonia in elderly nursing-home residents might have been prevented by improving oral hygiene.

It was thus hypothesized that oral health would affect mortality in an institutionalised geriatric population. The present study was aimed at examining oral health and oral hygiene as predictors of subsequent one-year survival in the institutionalised elderly.

### **Material and Methods**

This study forms part of a longitudinal study (the main study) on a population consisting of institutionalized people aged 52–102 living in the Province of Granada, Spain. Data was collected from April 2009 to September 2010. The main study's inclusion criteria were to have at least three natural teeth and/or to wear dentures. 369 residents were examined at baseline. During the 12-month follow-up period 102 participants were retired from the study, 66 because they died and 36 because of other causes.

The participants were interviewed and given a dental examination at their institutions in a room guaranteeing acceptable privacy. Head nurses, physicians and residents' relatives were asked to provide information where necessary because of cognitive impairment. A headlamp and a mouth mirror were used during oral examination. A dentist having an MSc in Gerontology and experience in Gerodontology (first author) collected all data.

The present paper includes all participants older than 75 from the main study. This left 292 participants; 63 died within the first year and 229 survived. The participants who died were categorised into: (A) died within the first three months after examination, (B) died within the first six months after examination, (C) died within the first nine months after examination and (D) died within the first twelve months after examination.

## **Measurement**

### Background variables

*Age and gender* was recorded, as was *educational level* (low = no studies or primary school, medium = high school and high = technical or university studies).

### Nursing and general medical variables

*Independence for dressing and washing* and *independence for oral hygiene* were categorised into three levels (independent, some help needed and dependent). Their medical histories were checked for obtaining data on *entry to institutions* and the *medicines being used*. A doctor estimated the *number of pathologies* from the medicines each participant was using.

*Cognitive state* was established by using the Pfeiffer test (63) (a 10-question screening instrument covering orientation, recent memory, retrospective memory, attention and calculus). Final scores range from 4 (normal), 3 (mild cognitive impairment), 2 (moderate cognitive impairment) to 1 (severe cognitive impairment). Participants unable to answer because they obviously had severe cognitive impairment or dementia directly scored 1.

### Oral health variables

*Use of dental services* was evaluated by asking about regular oral check-up frequency (each 6-12 months, only if needed) and time since the last dental visit (6-12 months, 1-2 year, >2 years).

*Dental status* was recorded as being the number of visible natural teeth, occluding pairs (natural teeth having a natural or prosthetic antagonist), retained roots, and dental caries (visually examined and recorded by tooth as being crown caries or root caries; this was recorded as root caries when a lesion affected both crown and root).

*Oral hygiene* was measured using Sunstar dental disclosing tablets (G-U-M/MD Americas Inc. Chicago, IL 60630 USA) for disclosing dental and denture plaque. Residents having remaining natural teeth were asked to chew one tablet for around 30 seconds. Mouths were then rinsed with water. The simplified oral hygiene index (OHI-S) (64) was recorded for all residents who had at least two of the teeth required by this index. The O'Leary Index (overall percentage of plaque) (65) was used for all who had at least one natural remaining tooth. The denture hygiene index (DHI) (66) was recorded by dissolving five dental disclosing tablets in 50cc of water into which the dentures (previously rinsed with water) were placed for 30 seconds and then rinsed with running water. Denture cleanness was evaluated as being excellent (none or only a few spots of plaque), fair (more extended plaque, less than half the denture base covered by plaque) and poor (more than half the denture base covered by plaque).

Dental status and the presence of dentures made it impossible to use the same oral hygiene index for all participants. A new global oral hygiene variable was calculated

from the following criteria to include all participants in the same analysis: first priority included the OHI-S category, the second priority (if not enough teeth present for OHI-S) the DHI value and third priority (if neither OHI-S nor DHI were available) the percentage of plaque. The global oral hygiene score was categorised into the following criteria: 1= excellent (OHI-S score below 0.6 or DHI score = 1 or less than 50% overall plaque score), 2 = acceptable (acceptable OHI-S score (0.7-1.6) or DHI score = 2 or 50%-80% overall plaque score) and 3 = unacceptable (unacceptable OHI-S score (above 1.6) or DHI score = 3 or >80% overall plaque score).

*Survival:* participants who died were recorded at 3, 6, 9 and 12 months.

### **Statistical analysis**

The Statistical Package for Social Sciences (Version 15.0) (SPSS Inc., Chicago, IL, USA) was used for data analysis. All variables regarding group differences were tested using independent T-tests for numerical data and the Mann-Whitney test for skewed numerical or categorical data. Kaplan Meier plots with log-rank test were used for identifying factors significantly associated with survival (bi-variate analysis). Cox regression analysis was used for multivariate analysis. Inclusion criteria for Cox regression analysis were (A)  $p < 0.20$  Kaplan Meier, (B) VIF  $< 2.5$  collinearity. A 5% significance level was used throughout.

### **Results**

Most of the 292 participants were women (228, 78.2%). Their ages ranged from 75 to 102 (mean = 85.3 years). 74.5% of the participants had a low educational level. About a

quarter of the residents (81, 27.7%) were dependent on help for dressing and washing, and 76 (26%) depended on assistance for tooth cleaning.

The number of medicines varied from 0 (3.4%) to 20 (0.3%) with a mean of 7.3 (SD 3.8). Number of pathologies varied between 0 (3.4%) and 7 (1.4%) (mean 3.4, SD 1.4). The most usual pathological diagnoses were hypertension (61.6%), gastritis (50.3 %), depression (26.0%), psychosomatic pain (16.1%), cardiac pathology (15.4 %), insomnia (13.7%), constipation (13.4%), hypercholesterolemia (11.6%), psychosis (9.2%), eye-related diseases (7.2%) and respiratory system diseases (6.8%).

According to the Pfeiffer test, 130 (44.5%) participants had normal cognitive function, 58 (19.9%) had mild cognitive impairment, 49 (16.8%) had moderate cognitive impairment and 55 (18.8%) had severe cognitive impairment. There was no statistical significant difference between men / women as regards cognitive impairment ( $p=0.08$ ) or being dentate / edentulous ( $p=0.6$ ).

Most participants made use of dental services only when needed (81.5%) and 59.2% had not been to the dentist for more than two years. Significantly more dentate participants regularly went to a dentist than edentulous ones.

### Oral status

Most residents had remaining teeth. The mean number of teeth was 8.2 (range 0-30), 95 (32.5%) were edentulous, 44 (15.1%) had more than 20 teeth and 175 (59.9%) wore dentures. Among participants having remaining teeth, the mean number of decayed teeth was 1.1 (range 0-10). There was a significant difference between people who died

and survived as regards having less than seven remaining teeth ( $p=0.04$ ). Table 1 shows background and oral health variables among survivors and participants who died.

Table 1. Background variables for those who survived and those who died within the first 12 months after examination.

Characteristics	Alive N = 229	Died N= 63	Independent T test p-value
	Mean ( SD)	mean SD)	
Age	85.0 (5.1)	86.3 (6.4)	0.1
No. of medicines	2.21(3.7)	4.95 (3.7)	0.05
No. of pathologies	3.37 (1.5)	3.68 (1.2)	0.12
No. of teeth	8.6 (8.7)	6.7 (8.5)	0.14
Occluding pairs	5.3 (4.4)	5.7 (3.9)	0.71
Retained roots	1.0 (2.1)	1.0 (2.6)	0.9
Dental caries	1.1 (1.6)	1.2 (1.6)	0.54

### Oral hygiene

Only 37 participants (12.7%) had excellent oral hygiene, 78 (26.7%) were rated acceptable but most (177, 60.6%) had unacceptable oral hygiene. There were no significant differences between men/women regarding the use of medications or having more than 10 teeth. Significantly more residents suffering severe cognitive impairment had unacceptable oral hygiene ( $p=0.001$ ).

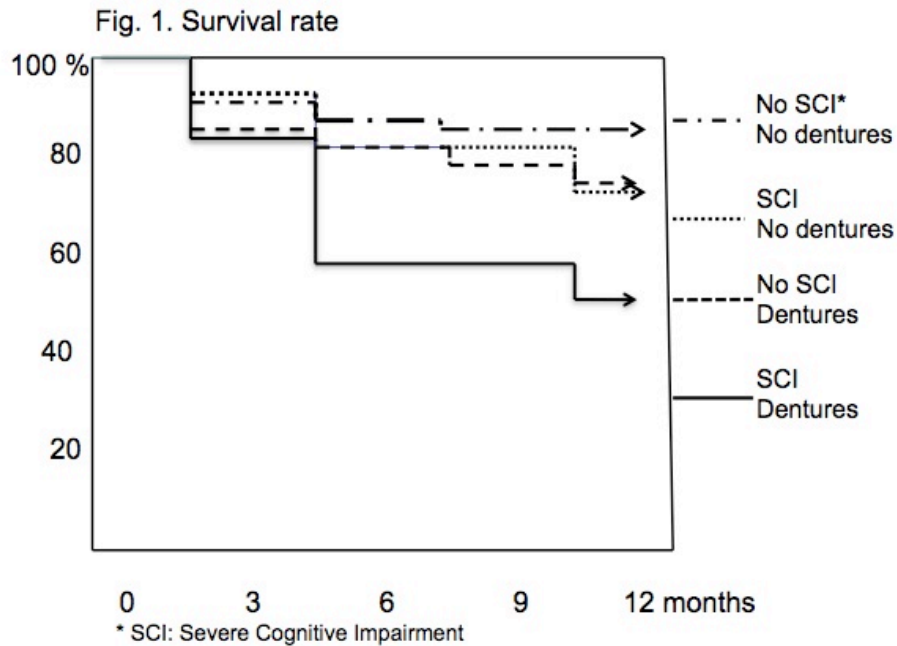
All 12 factors fulfilled collinearity inclusion criteria ( $p<0.2$ ) (table 2). All these factors were thus simultaneously included in the Cox regression analysis. The following two factors remained after stepwise backward variable selection until all remaining factors became statistically significant ( $p<0.05$ ): severe cognitive impairment and denture use. Severe cognitive impairment increased mortality by 120% ( $HR=2.24$ ,  $p=0.003$ ) and denture use increased mortality by 120% ( $HR=2.18$ ,  $p=0.007$ ).

Table 2. Variables that met inclusion criteria ( $p < 0.2$ ) for Cox regression analyses

Characteristics	Alive N = 229	Died N= 63	Mann Whitney test	Colinearity Statistics	Survival Kaplan Meier
	n (%)	n (%)	p value	VIF	p value
Low educational level	164 (76,6)	38 (66,7)	0.1	1.47	0.15
High educational level	18 (8,4)	8 (14.0)	0.2	1.48	0.21
Dependent on dressing or washing	56 (24.5)	25 (39.7)	0.02	2.03	0.017
Dependent on tooth cleaning	54 (23.6)	22(34.9)	0.07	2.02	0.02
Number of medications more than 3	189 (82.9)	54 (88.5)	0.05	1.21	0.07
Number of pathologies more than 3	104 (45.6)	31 (50.8)	0.05	1.202	0.02
Normal cognitive state	108 (47.2)	22 (34.9)	0.08	1.226	0.09
Severe cognitive impairment	36 (15.7)	19 (30.2)	0.01	1.21	0.01
Edentulous	69 (30.1)	26 (41.3)	0.09	1.37	0.08
Less than 7 remaining teeth	126 (55%)	44 (69.8)	0.04	1.68	0.08
Presence of movable dentures	129 (56.3)	46 (73.9)	0.02	1.61	0.02
Good oral hygiene	26 (11.4)	11(17.5)	0.2	1.38	0.09

The participants were categorised into 4 groups to further illustrate how these two factors were associated with mortality: (1) no denture and no severe cognitive impairment (n=86), (2) no denture and severe cognitive impairment (n=151), (3) denture and no severe cognitive impairment (n=31) and (4) denture and severe cognitive impairment (n=24). These four groups' Kaplan Meier regression curves are shown in Figure 1. 10% of participants having no denture and no severe cognitive impairment died during one year as opposed to 50% of participants wearing dentures and suffering severe cognitive impairment.





### Discussion

This study's main findings were that wearing dentures increased mortality even when controlled for age, severe cognitive impairment, educational level, needing help for dressing or washing and needing help for tooth cleaning. Thus, having only natural teeth and no dentures appears to increase one-year survival. Being cognitively impaired also increased the risk of death. One-year mortality was 50% when wearing dentures and also being cognitively impaired. Oral hygiene had no impact on survival rate.

Some of the present study's limitations need to be discussed. The sampling method was not random and only nine of the 54 geriatric institutions in Granada participated in the study (even though they were considered to be representative of this population). A potential selection bias, although not clearly apparent, cannot thus be ignored.

Aging has been considered the most important risk factor for physical and mental disorders and death (83). However, it was not significantly difference at baseline between the age of those who died or survived in our study on a population aged 75+ and the mortality risk of denture users was significantly higher, even after being controlled for age. Our results support earlier studies that have reported denture use as a mortality risk. Fukai *et al.*, (84) found that wearing dentures was one of the factors associated with mortality in a 15-year follow-up study on a sample of people aged 40+. Furthermore, Shimazaki *et al.*, have found that people having the worst dentition status (edentulous subjects without dentures) suffered significantly increased mortality, independent of physical-mental health status at baseline and concluded that maintaining more functional occlusion (with natural teeth or dentures) may lead to longer life expectancy (23).

Being severely cognitive impaired in our study increased the risk of death by 120%. Thorstensson *et al.*, reported similar findings in a 10-year study on Swedish octogenarian twins. They found cognitive status to be the overall survival predictor, independently of age or gender (21). The present study found that the risk of dying within a year was substantial when joining the two main explanatory variables (wearing dentures and having severe cognitive impairment).

It could be speculated that high mortality rate among denture wearers suffering severe cognitive impairment could represent an increased masticatory, or functional disability (23). Chewing ability, when using dentures, depends on both muscular strength and neuro-muscular control. Severe cognitive impairment could alter neuro-muscular control, thereby affecting chewing performance. It is a common clinical observation that dentures (especially lower full dentures) are often left unused in demented people and

their chewing ability consequently becomes worse.

Tooth loss also affects masticatory functioning (86) and altered chewing ability is associated with a diet low in ingredients like plant food (87); low plant food intake is associated with worse cognitive function (88). Patients' health may thus be lead into a vicious circle involving decreased general health, lower cognitive function and increased risk of death. Chewing ability has also been found to be associated with a greater risk of mortality in community-residing elderly people by Nakanishi *et al.*, who evaluated self-assessed masticatory ability in dentate and denture users amongst community-residing elderly in a 9-year mortality cohort study (89).

Denture use results from loss of teeth, reflecting a cumulative experience of oral infection. Although the number of teeth, pathologies or medications was not found to be strong predictors of death in the regression analysis, there were significant differences in uni-variate analysis regarding these variables between survivors and participants who died. Significantly more people who survived had more than 7 teeth in our study, indicating that the number of teeth is an important factor for survival rate. This agreed with Hamalainen *et al.*, who concluded that, the more teeth or filled teeth a subject had, the smaller their risk of death (79). Osterberg *et al.*, also found that each remaining tooth at age 70 decreased 7-year mortality risk by 4% (85). Loss of teeth may be associated with other health risks such as smoking, diet and lifestyle (77), thereby reflecting a persons' general health and mortality risk. It has also been associated with an increased risk of death, independently of health factors, socio-economic status and lifestyle (80, 90).

Sjogren, in a systematic review of randomized controlled trials, concluded that mechanical oral hygiene has a preventative effect on mortality from pneumonia and that about one in 10 cases of death from pneumonia in elderly nursing home residents may be prevented by improving oral hygiene (82). Even if significantly more residents suffering from severe cognitive impairment had unacceptable oral hygiene in our sample, oral hygiene had no impact on survival rate. One explanation may be that no deaths were reported as being due to pneumonia. Even if not associated with survival rate, dental plaque is important as the main cause of dental caries and periodontal disease (i.e. the most prevalent oral diseases) as both cause loss of teeth (associated with decreased oral-related QoL (91) and increased risk of death) and periodontal disease has been reported as being associated with the risk of death among elderly people (88).

## **Conclusion**

Our findings let us accept our working hypothesis and state that poor oral health increased mortality risk in our sample of the institutionalised elderly.

Conclusion: Oral hygiene had no impact on survival rate. Cognitive impairment and use of dentures increased the risk of death. The risk of death within a year was 50% in cognitively impaired residents wearing dentures.

## **Acknowledgments**

We would like to thank the staff and residents of the geriatric institutions who participated in the study.

## Chapter IV

### **Oral health in institutionalised elderly people in Oslo – Norway and its relationship with dependence and cognitive impairment**

**Authors:** Dairo Javier Marín Zuluaga, DD, MsC\*, Jenny Ferreira, DD\*\*, José Antonio Gil Montoya, DD, PhD\*\*\*, Tiril Willumsen, DD, PhD\*\*

\*The Gedorontology Group, Oral Health Department, Faculty of Dentistry, National University of Colombia

\*\* Cariology and Gerodontology Department, Faculty of Dentistry, University of Oslo, Norway

\*\*\* Department of Special Care in Dentistry and Gerodontology, Faculty of Dentistry, University of Granada, Spain

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## **Abstract**

**Objective:** Investigating oral health's relationship with dependency and cognitive state.

**Background:** Oral hygiene is poor in the institutionalised elderly. There are problems regarding the oral care of residents having poor mobility or cognitive impairment.

**Material and Methods:** Cross-sectional study involving 135 participants (85.7, SD 8.8 years) in two categories: nurses doing tooth cleaning and residents doing tooth cleaning. Those cleaned by nurses were categorised as cooperative or non-cooperative. The oral hygiene status, presence of caries, retained roots and denture-related stomatitis, were recorded.

**Results:** 70% of the participants only had natural teeth. The prevalence of caries was 28%. A significant correlation showed that having more teeth gave a poorer Simplified Oral Hygiene Index (OHI-S) ( $p=0.018$ ). The number of retained roots increased with the severity of cognitive impairment ( $p<0.05$ ). Significant differences were found between nurses or residents doing the tooth cleaning on the OHI-S ( $p=0.05$ ) and percentage of dental plaque ( $p=0.003$ ).

Uncooperative residents had poorer oral hygiene ( $p=0.028$ ), more caries ( $p=0.008$ ) and were more often moderate–severe cognitive impaired ( $p=0.016$ ).

**Conclusions:** A high percentage of participants had unacceptable oral hygiene. Residents whose teeth were cleaned by the nurses had poorer oral hygiene. Uncooperative residents had the worst oral hygiene and more caries.

**Key words:** dependence and cooperation regarding oral health, cognitive status, institutionalised elderly.

## **Introduction**

The elderly population is growing rapidly worldwide and in Norway. According to a January 2010 report, 20.6% of the Norwegian population is aged 60+; and is 16.9% in Oslo (92). It can thus be expected that more people will depend on the health care provided by carers in community health services and nursing homes in the years ahead. As well as more elderly people living longer, more elderly people still have their natural teeth. The numbers of elderly having natural teeth and the number of natural teeth in each elderly person are rising rapidly (2). In a recent study from Oslo, 83% of the subjects had at least one natural tooth (13) and 60% had only natural teeth.

The most serious oral problem amongst residents in nursing homes is infection in teeth and gums; good oral hygiene is essential for avoiding such infection. Oral hygiene has too often been found to be poor amongst people suffering from disabilities (30). Poor oral hygiene may be further worsened by systemic diseases and medication and may produce a rapid decline in oral health. Declining oral health affects both general health (13) and quality of life in nursing home residents (16).

There is a gap between the high needs for oral care and the limited dental services offered to the institutionalised elderly (25, 26). Oral care in nursing homes thus becomes dependent upon suitable daily oral hygiene procedures and may be highly influenced by the approach taken by staff (carers and directors included) (31). Residents living in residential services should receive a high standard of support and be attended by appropriately trained carers. Nevertheless, inadequate oral care is a recognised problem in nursing homes and the quality of oral care education imparted by carers is

heterogeneous (35-38). A lack of expertise has been reported, especially regarding the oral care of residents having poor mobility or cognitive impairment (39).

The oral health of residents is frequently poor and a low priority in nursing homes. Some of the reported causes are geriatric residents' low priority in dental services, poor support for carers (29), residents' behavioural resistance to oral care assistance (30), and lack of staff, time, knowledge, protocols and regulations (31, 32). So, being independent to perform their own mouth care may be a protective factor for the oral health of the elderly living in nursing homes. The relationship between handgrip strength and oral health has been studied in older people (93), but the relationship between the handgrip and the oral hygiene is not studied enough. Few studies have been carried out comparing oral hygiene between independent elderly who cleans their teeth by themselves and those who depend upon oral care assistance and have their teeth cleaned by others. Pearson (16) in a systematic review says that oral care for dependent older adults is a challenging task. Merelie and Heyman (40) found that dentures cleaned by staff were not cleaner than those cleaned by residents. Montal et al (41) in an institutionalised French-sample, found that the oral hygiene quality was better in those self-dependent patients, and that these patients had less calculus, compared with those needing assistance.

The purpose of this study was to obtain information about institutionalised elderly people's oral health and its relationship with dependency and cognitive state.



## **Materials and methods**

### **Design**

This was a cross-sectional study consisting of a clinical interview and a dental examination carried out in nursing-home residents' rooms. Two qualified dentists having experience in gerodontology examined each resident at the same time; headlamp (SILVA headlamp, SILVA Sweden AB, Sollentuna, Sweden), intraoral mirror and periodontal probe were used during the examinations.

### **Sample**

One hundred and eighty-seven residents from two nursing homes in Oslo were invited to participate in the study. The nursing homes' chief physicians evaluated each patient's ability to give their written consent. All the residents, or their relatives (when a resident was unable to give their own consent) were invited to participate. The informed consent forms were collected and residents who had at least three teeth and/or used dentures were included in the study. One hundred and thirty-five elderly people fulfilled the inclusion criteria: 109 (81%) women and 26 (19%) men (mean age 85.7, SD 8.8 years).

### **Data collected and measurements taken**

Background data (gender, age, educational level, help with dressing and washing) was collected and recorded through interviews (non-demented participants) and dental files (demented participants). The head nurses reported on residents' dependence on dressing and washing and residents' dependence on oral hygiene care (i.e. for those who were dependent upon oral hygiene care assistance (nurses did their tooth cleaning) and those who were independent (resident did their tooth cleaning by themselves). They also

reported on residents who were cooperative or uncooperative with the nurses when they were dependent upon assistance for their oral hygiene care.

Residents' cognitive state was measured by using the PFEIFFER 10-item test (63). The final score is adjusted by educational level in this test, ranging from 4 (normal), 3 (mild cognitive impairment), 2 (moderate cognitive impairment) to 1 (severe cognitive impairment). The test was administered during the interview at the nursing homes; if a patient was severely demented and unable to answer any questions, then the Pfeiffer test was recorded as being 1. The group having cognitive impairment was divided into two subgroups to investigate the impact of the severity of cognitive impairment on oral health: subgroup 1 had mild cognitive impairment (they had scored 3) and subgroup 2 had moderate to severe cognitive impairment (scores 2 and 1).

Handgrip strength was tested; a Baseline hydraulic handgrip dynamometer (model 12-0240, Fabrication Enterprises, Inc., White Plains, New York) was used. Grip strength was measured in a seated position with the elbow flexed at 90<sup>0</sup>. Grip strength was measured three times for the hand used for tooth cleaning. Participants were encouraged to exhibit their greatest possible force and the highest output was registered. For the analysis the handgrip strength was re-grouped as being >18kg or >18kg 220 (94).

The number of teeth; the number of retained roots (teeth having no coronal surfaces remaining); the presence of coronal and root caries (as being either yes or no); the presence of denture-related stomatitis (if a resident used dentures) were recorded.

Dental and denture plaque was disclosed to measure oral hygiene (Rondell röd, Infärgning av dentalt plack, DAB Dental, UpplandsVäsby, Sweden). The Debris Index (DI-S) from the Simplified Oral Hygiene Index (OHI-S) (64), (scores 0–3) was used for measuring dentate residents' oral hygiene. The cut-off points of the DI-S for evaluating oral hygiene quality were: 0–0.6 good, 0.7–1.8 acceptable and >1.8 unacceptable. The global percentage of dental plaque (65) was used for recording the total number of dental surfaces having plaque. The Denture Hygiene Index (DHI) (66) was recorded (after disclosing the plaque on the fitting surface of the dentures) when a resident used a removable prosthesis. Denture cleanness was evaluated as being excellent (no or only a few spots of plaque), fair (more extended plaque, less than half of the denture base covered by plaque) and poor (more than half of the denture base covered by plaque).

### **Statistical analysis**

Social Sciences (SPSS, 16.0) Statistical Package (SPSS Inc., Chicago, USA) was used for analysing the data. Descriptive statistics were performed. T-tests were used for comparing numerical data having normal distribution. Categorical data and skewed numerical data were compared by Chi-square test. Numerical data were approximated to the first decimal.

The Regional Committee for Medical and Health Research Ethics approved the study.

### **Results**

In total, 72.2% of the residents gave their written consent to participate in the study. The main reasons for non-attendance at the examination were that residents or their relatives did not want to participate and that the residents refused the oral examination (even

though the informed consents were signed by the relatives). One hundred and thirty-five residents fulfilled the inclusion criteria and were included in the study. Eighty-six (63.7%) of the participants were living in nursing home 1 and 49 (36%) were living in nursing home 2. Mean age was 85.7 (SD=8.81 years). One hundred and nine (80.1%) of the participants were women. The women were significantly older (86.9, SD 8.5) than the men (81.1, SD 8.8); men and women did not differ significantly regarding all other study variables. Regarding cognitive state, 26 (19.3%) participants were normal, 16 (11.9%) had mild cognitive impairment and 93 (68.9%) had moderate to severe cognitive impairment.

The head nurses reported that 70 (51.9%) participants received oral care assistance and that the nurses did the tooth cleaning whilst 65 (47.8%) participants cleaned their teeth by themselves. Furthermore, they reported that 31 of the residents (44%) whose teeth were cleaned by the nurses were uncooperative. The sample was divided into two groups to explore the differences between residents who cleaned their teeth by themselves and those whose teeth were cleaned by the nurses. (Table 1)

Table 2. Dental hygiene variables for residents who had their teeth cleaned by the nurses, separated into two groups: Uncooperative and cooperative.

	Uncooperative during oral care assistance n = 31		Cooperative during oral care assistance n = 39		p*
	Median	Percentiles 25 - 75	Median	Percentiles 25 - 75	
Dental hygiene					
% Plaque (n= 62)**	100	100-100	100	86.5-100	ns
OHI-S*** (n= 52)	2.8	2.0-3,0	1.7	1.7-2.6	p= 0.028
	n	%	n	%	
Moderate - severe cognitive impairment (n= 70)	29	93.5 %	25	64%	p= 0.008
Caries (n=62)	16/26	61.5%	11/36	30.6%	p= 0.016

\* Mann Whitney test

\*\* n, describes the total number of people having a certain characteristic

\*\*\* Simplified Oral Hygiene Index

Sixty-two (88.6%) of the residents who received help with cleaning their teeth had moderate to severe cognitive impairment and only 5 (7.1%) enjoyed a normal cognitive state; such percentages were 47.7% and 32.3%, respectively, for residents who cleaned their teeth themselves.

Twenty-two (16.3%) participants were independent in dressing and washing, 37 (27.4%) needed some help and 76 (56.3) were completely dependent on the nurses for dressing and washing. There was a significant relationship ( $p=0.001$ ) between cognitive impairment, dependence on dressing and washing and dependence on others for teeth cleaning (Table 1).

### **Dental status**

One hundred (74%) residents had just natural teeth; 60 (45%) had at least 20 teeth. The mean number of teeth for the entire sample was 15.6, 16.9 for dentate residents, 15.5 for the residents dependent on others for their teeth cleaning and 16.7 for the residents who clean their own teeth. 35 participants (25.7%) had dentures, but only 11 (8.1%) of them had full dentures. Eighty-six (69.4%) of the 124 participants having remaining natural teeth were caries-free; among the 38 with caries, 11 (28.9%) had coronal caries and 32 (23.7%) had root or coronal-root caries. There was a statistically significant relationship between dependence on others for tooth cleaning and having caries ( $p=0.002$ ) (Table 1).

The mean number of retained roots for the entire sample was 1.0 and 3.0 (range 1-10) among the 47 (35%) participants who had them. Seventeen (89%) of the 19 residents who had more than 2 retained roots had moderate to severe cognitive impairment. Residents who were dependent on others for their teeth cleaning had a mean of 1.4

retained roots, while the independent residents had a mean of 0.7 retained roots. There was a significant relationship between the number of retained roots and dependence on others for teeth cleaning (T value 1.9,  $p < 0.05$ ). This also correlated with the severity of cognitive impairment (Pearson's correlation,  $p < 0.05$ ).

### **Oral hygiene**

The OHI-S was calculated for the 106 participants (78%) who fulfilled the OHI-S criteria (having at least two teeth from those examined for the Index); the median was 2.0 (1.35-2.8 percentile). There was a significant correlation (Pearson test) between the number of teeth and the OHI-S ( $p = 0.018$ ). Only 5 (4.7%) of the participants had good oral hygiene (OHI-S  $< 0.7$ ); 4 of them cleaned their teeth by themselves. Forty-seven participants (44.3%) had acceptable oral hygiene and 54 (50.9%) had unacceptable oral hygiene (Table 1). The OHI-S for the 31 (47%) residents who cleaned their own teeth and who had moderate to severe cognitive impairment did not differ from those who did their teeth cleaning by themselves and had normal cognitive function. The median percentage of plaque ( $n = 124$ ) was 100% (83.0-100 percentile) (Table 1).

The Denture Hygiene Index was recorded for the 35 participants having dentures. It showed that 12 (70.6%) of the participants who cleaned their teeth by themselves had excellent denture hygiene and 5 (29.4%) had fair or poor denture hygiene. Thirteen (72.2%) of the participants whose teeth were cleaned by nurses had excellent denture hygiene and 5 (27.8%) had fair or poor denture hygiene. No significant difference was found. Five of the 35 (14.3%) participants who were wearing dentures had denture-related stomatitis.

The median handgrip strength was 15.2 kg for the 39 dentate female residents who cleaned their teeth by themselves; 9 (37.8%) had handgrip strength of more than 18 kg and their median OHI-S was 1.0 (percentile 1.0-2.0); while the 30 residents having handgrip strength of less than 18 Kg had 1.7 (percentile 1.0-2.0) median OHI-S. No significant difference was found. Because this subgroup had few men in it (n=8), they were excluded from this analysis.

### **Participants who had their teeth cleaned by nurses**

The nurses rated 39 (55.7%) of the 70 residents whose teeth were cleaned by a nurse as being cooperative and 31 (44.3%) as being non-cooperative. Mean age was 86.0 (SD 8.6, range 57-99) for the cooperative residents and 83.3 (SD 9.6, range 64-99) for the un-cooperative ones; No statistical differences were found. The cooperative participants had 14.3 teeth (SD 9.7) and the non-cooperative ones had 14.7 teeth (SD 8.3).

Fifty-two of the 70 residents whose teeth were cleaned by the nurses fulfilled the OHI-S criteria. There were statistically significant relationships between the OHI-S ( $p=0.028$ ), having caries ( $p=0.016$ ) and presenting moderate to severe cognitive impairment ( $p=0.008$ ) with being un-cooperative during tooth cleaning (Table 2). 44.8% of the cooperative and 78.3% of the non-cooperative participants had unacceptable oral hygiene according to the cut-off points for acceptable oral hygiene in the OHI-S (Chi square test,  $p=0.002$ ). The Denture Hygiene Index showed that 9 (69.2%) cooperative participants had excellent hygiene and 4 fair or poor among the denture wearers (n=18) whose teeth were cleaned by the nurses; 4 (80.0%) of the non-cooperative participants had excellent hygiene and one poor. No significant differences were found.

Table 1. Comparisons between residents who had their teeth cleaned by the nurses or by themselves.

Variable	Nurse do the tooth cleaning n = 70		Resident do the tooth cleaning n = 65		p
	n	%	n	%	
Cognitive state. (n = 135) *					
Normal	5	7.1	21	32.3	ns
Mild cognitive impairment	3	4.3	13	20.0	ns
Moderate - severe cognitive impairment	62	88.6	31	47.7	p<0.001**
Help with dressing and washing. (n = 135)					
Independent – some help	16	22.9	43	66.2	ns
Dependent	54	77.1	22	33.8	p<0.001**
Presence of teeth and dental caries. (n = 124)					
10 or more natural teeth	47	67.1	52	80.0	ns
15 or more natural teeth	40	57.1	41	63.1	ns
20 or more teeth	28	40.0	32	49.2	ns
Dental caries	27	38.6	11	16.9	p=0.002***
Coronal caries	1	8.6	4	7.7	ns
Root caries	23	32.9	9	13.8	ns
Quality of oral hygiene - OHI-S****. (n= 106)					
Good - Acceptable (Score ≤1.8)	20	38.5	30	55.6	ns
Unacceptable (Score >1.8)	32	61.5	24	44.5	p=0.02****
Oral hygiene (n = 135)					
	Median	Percentile 25 -75	Median	Percentile 25 -75	
OHI-S (n = 106)	2.2	1.4 – 3.0	1.8	1.0 -2.3	p=0.031***
Percent plaque (n = 124)	100.0	91 -100	92.2	76 – 100	p=0.003***
Denture hygiene index. (n = 35)	1.0	1.0 - 2.0	1.0	1.0 -2.5	ns

\* n, describes the total number of people having a certain characteristic

\*\* df = 2, Chi square, \*\*\* Mann Whitney test, \*\*\*\* Pearson chi square test

\*\*\*\*\* Simplified Oral Hygiene Index

## Discussion

A high percentage (51%) of the participants had unacceptable oral hygiene and that the residents whose teeth were cleaned by the nurses had a poorer oral hygiene; among those, non-cooperative residents had the worst oral hygiene and had more caries. Being dependent on dressing and washing and presenting cognitive impairment correlated significantly with being dependent on teeth cleaning. Because of the relative low sample-size and because different conditions might exist in other nursing homes, the results of this work cannot be generalized to the entire institutionalized people.



The participants in the study had many teeth (mean 16); 45% had 20 or more natural teeth. Willumsen (13) had similar findings in a housebound sample in Oslo. Taking into account that the sample in the current study is old-old, it means that the WHO goal of at least 50% of people aged 65 and older having at least 20 functional teeth by the year 2000 has been reached (95). As in other studies (30, 96), this work revealed a significant problem regarding unacceptable (poor) oral hygiene in the population being studied; it correlated significantly with the number of teeth and with cognitive impairment. These findings represent a challenge for the dental profession and carers because the number of remaining natural teeth in the elderly continues to grow while life expectancy increases, the incidence and prevalence of cognitive impairment rises.

Functional dependence and the need for assistance with oral hygiene care are risk factors for the onset and progression of oral diseases and conditions (16). The significant differences found regarding oral hygiene, the presence of caries and the number of retained roots among the residents who cleaned their teeth by themselves and those whose teeth were cleaned by the nurses showed that dependence on oral care is a major problem in the old-old population, especially when a resident has a lot of natural teeth and does not cooperate during tooth cleaning.

Going deeper into this issue and comparing the quality of oral hygiene, it was found that when the nurses performed the tooth cleaning only 38.5% of the residents had acceptable oral hygiene and that there was a significant difference between cooperative and non-cooperative residents regarding OHI-S, presence of caries and having moderate to severe cognitive impairment. The percentage of acceptable oral hygiene rose to 55% among cooperative residents when comparing cooperative and non-cooperative

residents. Such data suggest that uncooperative residents should be a target group for oral care. Tramini et al., (97) found that cooperative behaviour is a protective factor for tooth-loss in long-term institutionalised elderly people. An interdisciplinary team approach is needed involving a team including psychologists, dentists, dental hygienists, physicians and nursing home staff (nurses, social workers and directors). This team would work on the ways to approach demented and un-cooperative residents in order to perform oral care. This is not a minor problem. Nowadays, we know more about the close relationship between oral health, overall health and the quality of life; oral health is thus important for the quality of life and dignity during the last stage of life. Everybody should receive guaranteed assistance regarding daily hygiene if required and be free of oral infections and pain (98). There is a need for well-designed studies in this field; expert opinion suggests that follow-up, communication and behaviour management, using chemical control for dental plaque (chlorhexidine gluconate), fluoride products and electric toothbrushes are effective in these particular residents (16).

The handgrip strength has been studied in relation to oral health but not specifically with oral hygiene (93). In our study no significant association was found between the OHI-S and handgrip strength. It could thus be speculated that the quality of tooth cleaning may be more dependent on the technique and neuromuscular control than on the force used in performing it. As for all small samples, these results should be assessed with care as type II error may occur. A remarkable finding was that 47.7% of the residents having moderate to severe cognitive impairment were still cleaning their own teeth and their oral hygiene was about as good as the other independent tooth cleaners. This result is in accordance with Merelie and Heyman (40) who found that the

condition of teeth and dentures were similar in confused and non-confused residents. As tooth cleaning is a task learned in early childhood, it is perhaps part of the crystallised memory. This may act as a protective factor when people become weak or in some stages of cognitive impairment and dementia. This issue merits further research.

### **Conclusion**

A high percentage of the participants had unacceptable oral hygiene. Residents whose teeth were cleaned by the nurses had poorer oral hygiene. Un-cooperative residents had the worst oral hygiene and had more caries. This represents a challenge for doctors and people working in health-care.

## Chapter V

### **Change in oral health of institutionalised elderly after caregiver training in oral health**

**Authors:** Dairo Javier Marín Zuluaga\*, José Antonio Gil Montoya\*\*, Tiril Willumsen\*\*\*

\*The Gedorontology Group, Oral Health Department, Dentistry Faculty, Universidad Nacional de Colombia. Bogotá, Colombia.

\*\* Special Care in Dentistry and Gerodontology Department, Dentistry Faculty, University of Granada, Spain

\*\*\* Cariology and Gerodontology Department, Faculty of Dentistry, University of Oslo, Norway

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**Abstract. Background.** Educating caregivers have been suggested to improve the oral health of institutionalised elderly. **Objectives.** We aimed to measure the effectiveness of a 3-hours oral health training-programme (OHTP) provided for caregivers, by assessing carers' change in knowledge and residents' OH gains. **Materials and methods.** It was a longitudinal-controlled-interventional study evaluated with a carers' questionnaire and residents' oral examinations. In 2009, managers of 30 nursing homes in Granada-Spain were contacted and offered three oral examinations for the residents, and an OHTP for the carers. Nine accepted to participate for all consenting people. 269 residents were examined at baseline and 12 months. After the baseline examination and a carers' questionnaire application (71% answered), the nursing homes were randomised into a work or control group; then the OHTP was carried out in the work group (83% participation). At the end of the study the OHTP was carried out in the control group. **Results.** After the OHTP, the caregivers' knowledge on OH ( $p < 0.0001$ ), and the residents' global oral hygiene ( $P = 0.03$ ), improved significantly in control group; wearing dentures at night decreased significantly in both groups. **Conclusions.** The OHTP was effective on improving the caregivers' knowledge and OH care routines, as showed by the improvement on the residents' overall OH.

**Keywords:** Caregivers education in Oral health, Institutionalised elderly.

## **Introduction**

The elderly population has been rapidly increasing; these people, especially the oldest-old segment, are more susceptible to disease and disability (4); 2.3% of these disabled people live in residential homes in Spain (24). Compared to the elderly living at home, those living in institutions have been shown to have worse oral health (OH) (27, 28).

Providing oral care for the institutionalised elderly is a basic nursing task (44); residents should be helped in maintaining their OH, preventing and treating oral pathologies and promoting healthy living and ageing (99). Unfortunately, this is frequently omitted or neglected in nursing homes (29, 40), some reasons for such neglect being the cost of treatment, mobility and cognitive problems making it difficult to get to the dental office, resistive behaviour, low perceived needs by residents and staff, low OH priority and lack of time, knowledge and training (100-103).

Health education, understood as being, “the process of assisting individuals, acting separately or collectively, to make informed decisions about matters affecting their personal health and treatment of others,” (42) influences knowledge and behaviour (43). OH education programmes including not only theoretical knowledge but also practical training for the caregivers have thus been proposed as part of the measures aimed at improving the OH of the functionally-dependent elderly (44-47). However, results from training programmes evaluated by reference to residents’ OH levels have varied from having any impact (48), little impact (49, 50) to achieving progressive improvement (45). It seems to reflect the fact that knowledge about OH care is not always put into practice (52, 53). This is clearly a complex issue, which must include caregivers and also residents’ families, directors of institutions and stakeholders.

The study was aimed at measuring the effectiveness of a theoretical and practical oral health training-programme (OHTP) being provided for caregivers of the institutionalised elderly living in nine geriatric institutions in the Province of Granada in Spain by assessing caregivers' change in knowledge and residents' OH gain after 12 months.

## **Materials and Methods**

*Design:* This was a longitudinal-controlled-interventional study.

*Subjects and sample:* The study population consisted of caregivers and institutionalised elderly living in the Province of Granada, Spain. Thirty out of 54 nursing homes were chosen at convenience in January 2009 (inclusion criterion was not to be more than one-hour away from the city of Granada); their directors were contacted and offered three oral examinations for their residents for one year and an OHTP for their caregivers. Nine directors agreed to participate for all consenting residents and caregivers. A questionnaire about OH care-policies was sent to these directors. 421 (58%) residents or guardians and 167 (79%) caregivers agreed to participate in the study and signed an informed written consent form. 369 residents matched the inclusion criteria of having at less three natural teeth and/or wearing dentures and were included in the study. 369, 300 and 269 residents were interviewed and examined at baseline and after 6 and 12 months respectively.

The baseline examination of the residents and the caregivers' questionnaire was applied between April and September 2009. The nursing homes were then assigned to a work (4 institutions) or control group (five Institutions) by cluster randomisation. The names of

the nursing homes were first written down on pieces of paper and put into a bag to randomise them; they were then taken out one by one and alternatively assigned to a group. When the groups had been arranged, a coin was tossed to name them as either control or work group. After randomisation, the OHTP was carried out on the work group (82 caregivers attended, 83%). At the end of the study the OHTP was also carried out on the control group.

### **Intervention**

A dentist experienced in gerodontology performed all the clinical examinations and ran the interviews; re-examining 10 participants determined intra-examining calibration. Examinations using a mouth mirror and a headlamp (SILVA headlamp, SILVA Sweden AB, Sollentuna, Sweden) took place in an area of the institution ensuring the residents' privacy.

*Institutions' questionnaire.* Directors of the institutions taking part in the study received a 15-item questionnaire. Four questions asked about the number of residents, nurses and nursing aids and whether the institution was public or private. 11 yes/no questions asked about OH policies and practices being implemented in the institutions.

*Caregivers' questionnaire.* A structured questionnaire was sent to all nurses and auxiliary nurses participating in the study (167 people) prior to the OHTP. The questionnaire included demographical data, covered aspects regarding educational level, personal OH care, whether they were used to helping residents with their oral hygiene and, if so, whether they had problems while doing it, what kind of problems and which aspects they would like to learn more about regarding OH care involving



institutionalised people. Most of the OH care issues they wanted to learn more about, as well as the problems they reported facing during oral hygiene assistance, were then included in the OHTP.

*OH training-programme.* The OHTP was carried out by a professor in gerodontology (first author) and consisted of a single three-hour workshop session conducted at the residential homes, scheduled at two different times to preserve the institutions' normal functioning. The OHTP was arranged in chapters covering aspects such as OH-related quality of life, social and biological functions of the mouth, frequent diseases and entities in the mouth, misconceptions about OH for the elderly, different kinds of residents and their oral care needs and management, demonstrations of cleaning techniques for dentures and natural teeth, and practising these techniques by caregivers using models and dentures, routines and aids for oral care and the caregivers' crucial role in maintaining residents' OH. 6-12 caregivers participated in each workshop; the meetings closed with a discussion and oral evaluation of the programme. The caregivers completed a test including 18 true/false questions about the different issues covered by the OHTP to evaluate changes in OH knowledge before and immediately after the OHTP, each correct answer scoring one (Table 1). After the OHTP, attendees received a certificate from the University of Granada's Stomatology Department.

*Residents' interview.* A questionnaire in the form of a structured interview was conducted with all residents who were able to respond. Head nurses, physicians and residents' relatives were asked to provide supplementary information on residents who were unable to respond and the medical files were checked for data regarding the time the residents had spent living in the institutions and the medicines they used. The data

included gender, age, educational level, independence re dressing and washing and independence re oral hygiene, regular oral check-up frequency, time since the last dental visit (6-12 months, 1-2 year, >2 years), dental appointments during the last year, cause of the last dental attendance, tooth brushing, and tooth brushing frequency (daily, less than daily).

*Residents' OH variables.* OH was measured by the number of retained roots, remaining natural teeth and decayed teeth (visually examined and recorded by tooth as being crown or root caries, being recorded as root caries when a lesion affected both crown and root). It was also recorded whether denture wearers wore their dentures at night (yes/no) and the presence and severity of denture-related stomatitis (according to Newton's criteria (104)).

Dental and denture plaque were disclosed using dental disclosing tablets (G-U-M/MD. Sunstar Americas Inc. Chicago, IL 60630 USA) to measure oral hygiene. Residents having remaining natural teeth were asked to chew one tablet for 30 seconds; mouths were then rinsed with water. When dentures were present, they were put under running water for 15 seconds to eliminate any debris and then placed into a bowl for 30 seconds with 50cc of water with 10 dissolved disclosing tablets. They were then rinsed with running water for 10 seconds. Overall oral hygiene was measured by a combination of three assessment tools: the Simplified Oral Hygiene Index (64) (OHI-S) (scores 0-3), the O'Leary Index (65) (percentage of tooth surfaces having visible dental plaque, scored 0-100%) and the Denture Hygiene Index (66) (excellent: none or only a few spots of plaque; fair: more extended plaque, less than half the denture base covered by plaque; and poor: more than half the denture base covered by plaque).

Overall oral hygiene was calculated from the following criteria: first priority being the OHI-S category, second priority (if not enough teeth present for OHI-S) being the DHI value and third priority (if neither OHI-S or DHI were available) being the percentage of plaque. This left us with an oral hygiene measurement for all participants independent of dental status, categorised into the following criteria: 1=good (OHI-S score lower than 0.6 or DHI score=1, or overall plaque score below 50%), 2=acceptable (0.7 - 1.6 OHI-S score or DHI score=2, or 50%-80% overall plaque score ) and 3=unacceptable (OHI-S score above 1.6, or DHI score=3, or >80% overall plaque score).

The University of Granada's Committee for Human Research Ethics approved the study.

### **Statistical analysis**

All the data were analysed using Statistical Package for Social Sciences (Version 15.0) (SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean and standard deviation, binary variables as number and percentage. An independent sample t-test was used when comparing means in two groups; the chi square test was used when comparing binary variables in two groups. A linear regression was performed when evaluating change in a continuous variable from baseline to 12 months afterwards between two groups (value 12 months after as dependent variable and value at baseline and group (work/ control) as independent variable) (26). The McNemar test was used when evaluating change in a binary variable from baseline to 12 months afterwards.

## **Results**

### *Institutions*

The work group had three private and one state-assisted institution and the control group had three private, one state-assisted and one public institution. There were no clearly apparent differences between them. Directors of three institutions reported that they had an OH care-policy for their residents, two had guidelines or protocols about OH care and three included OH during health check on residents' entrance to the institution. Not all the residents had a toothbrush in three institutions; in six of them, residents had neither toothbrush nor toothpaste. Four had systems for identifying the residents' dentures; one ran a dental service through an agreement with a school of dentistry. None had routines for cooperation with dental services; dentists were only consulted when nurses/relatives found that residents had treatment needs, but none of them had a dentist or dental hygienist as part of their staff. Any of them performed residents' periodic OH checking and dental treatment was only provided on request. Three out of four directors of the work group institutions attended the OHTP; the fourth one delegated the doctor. One out of five directors of the control group attended the OHTP.

### *Caregivers' questionnaires and OH training-programme*

One hundred and seventy seven (79%) caregivers agreed to participate in the study, but only 151 (71%) returned the questionnaire; 91 (60%) belonged to the work group. Control group caregivers were significantly older ( $p=0.006$ ) (39.6 years, SD 10.6) and had been working more time at their current institution ( $p=0.055$ ) (7.7 years, SD 7.2), than work group caregivers (34.7 years, SD 10.1, and 5.5 years, SD 6.5, respectively).

The groups did not significantly differ regarding any other of the collected data (Table 1). 17% were nurses and 83% aid nurses. Mean provider experience was 8.9 years (SD 6.67). 62% reported having received information or training on OH care (71% during their caregivers' studies, 17% through academic meetings and 12% while working with a dentist). When asked about their oral hygiene practice, 100% reported using a toothbrush, 94% toothpaste, 54% dental floss and 70% mouth-rinse. 78% had gone to a dentist during the last year. The last dental attendance had been due to a regular control or professional cleaning (34%), or any kind of urgent treatment (66%, pain, caries, dental abscesses, or making or repairing a prosthesis).

Table 1 Caregivers background variables, comparison between work and control groups.

Parameter	Work n=91	Control n=60
Number of respondents	Number of answers (%)	
Female	84	57
Mean age (SD)	34.7(10.1)	39.6(10.6)
Educational level		
Primary	10(11)	10(17)
High school	8(9)	4(7)
Technical	61(67)	35(58)
University	12(13)	11(18)
Profession		
Nurse	13(14)	12(20)
Nurse aid	78(86)	48(80)
Oral health formation	59(61)	35(58)
Frequency of dental meetings		
Once a year or more	65(71)	49(80)
Only if needed	25(27)	11(18)
Time since the last dental visit		
6-12 months	71(78)	46(77)
1-2 years	15(16)	6(10)
>2 years	5(5)	8(13)
Think to have required knowledge for oral health support	61(67)	39(65)
Think that is able to detect pain or infection to any resident	46(51)	32(53)
Perform, assist, or verify the residents' oral hygiene	76(84)	53(88)
Frequency: daily	69(91)	48(91)
Kind of residents assisted		
Everybody	15(20)	20(38)
Only those who ask	16(21)	4(8)
Only those dependents	45(59)	29(54)

64% of the nurses and 6% of the nursing aids said that they did not help residents with their oral hygiene. When asked about barriers to providing oral care, 5% answered that they had not experienced any barrier, 17% reported not having the required knowledge, 82% said that they did not have enough time and were overloaded at work, 4% reported residents' resistive behaviour and 1% considered OH as not being important at all.

When asked about the issues which they would like to learn in the OHTP, the answers were all related themes (25%), oral care for dependents (16%), identifying oral problems and pathological signs (18%), preventative measures and oral hygiene techniques (41%). Caregivers gave some suggestions for improving the residents' OH. These were education programmes for residents (8%) and caregivers (32%), having more time for oral care (29%), providing residents and caregivers with all the required items for oral care (17%), having protocols about oral care for each kind of resident they had to manage (8%) and periodic oral checking of the residents performed by a dentist (6%).

Eighty-two caregivers (90%) from the work group attended the OHTP. Their baseline knowledge about OH was acceptable, as shown by 73% correct answers in the test applied before the OHTP. There was no difference from the control group (72% correct answers at baseline). On average, caregivers answered 13.24 out of 18 (73%) items correctly on the pre-test and answered 17.12 out of 18 (90%) correctly in the post-test, indicating a significant improvement ( $p < 0.01$ ), as shown in Table 2.

Table 2. Comparison of work group carer's pre and post training knowledge on oral health, right answers, n = 82

Question	pre n (%)	post n (%)	P*
The mouth performs biological as well as social functions	79 (96)	82 (100)	0.083
Not-controlled diabetes may affect oral health	74 (90)	82 (100)	0.004
If a person have had recently a stroke, the risk of bronchoaspiration is higher	58 (71)	81 (99)	<0.001
Periodontal disease enhances the risk of having cardiovascular diseases	47 (57)	76 (93)	<0.001
Poor oral hygiene increases the risk of developing respiratory problems and pneumonia in institutionalised elderly	55 (67)	82 (100)	<0.001
Unfitted dentures and/or poor dentition may affect nutritional status	72 (88)	79 (96)	0.034
Caries and periodontal disease are infections	76 (93)	82 (100)	0.013
Being physically or cognitively impaired may increase the risk of caries	51 (62)	77 (94)	<0.001
It is normal to have xerostomya if you are elderly	18 (22)	61 (74)	<0.001
If a denture wearer does not have pain in the mouth it means that every thing is all right	56 (68)	78 (95)	<0.001
Edentulous people do not need to attend to the dental office any more	75 (92)	79 (96)	0.159
Elderly in nursing homes use to have more caries than community bounds elderly	26 (32)	71 (87)	<0.001
Nurses and nurse aids should check and/or help with the oral hygiene of the residents independently of their functional or cognitive status	78 (95)	81 (99)	0.052
The mouth should be included in the first checking of the residents when they arrive to the institution	67 (82)	79 (96)	0.001
All, teeth, dentures, palate, gums, and tongue must be cleaned during oral hygiene	82 (100)	81 (99)	0.320
Use of Fluor is only indicated and effective during childhood	68 (71)	76 (93)	<0.001
A lesion in the mouth that does not heal, even if it is painless, may be cancer	29 (35)	77 (94)	<0.001
Denture wearers should sleep with the dentures to prevent gums and bone atrophy	75 (92)	80 (98)	0.058
Percent of correct answers of all questions	1,086(73)	1,405(95)	<0.001

\* T test for related samples

### *Residents*

269 of the original 369 residents remained at the end of the 12-month follow-up period, 66 having died and 34 withdrew. The retention rates at 6 and 12 months for the work group were 81% and 90%, respectively (n=187 at baseline). The corresponding figures for the control group were 82% and 89% (n=182 at baseline). The 269 residents who completed the study comprised 136 people living in the 4 institutions that received caregiver training and 133 people from the 5 institutions without it. The residents' personal and background variables are presented in Table 3.

Table 3. Residents' background variables at baseline.

Variable	Work group	Control group	Between group p value**
	(n=136) n/total (%)*	(n=133) n/total (%)	
Dead/drop out	51 (27.3)	49 (26.9)	ns
Sex - Women	105 (77.2)	99 (74.4)	ns
Mean age $\pm$ sd	82.8 $\pm$ 7.6	82.7 $\pm$ 7.4	ns
Mean number of medicines $\pm$ sd	6.9 $\pm$ 3.5	7.4 $\pm$ 4.1	ns
Mean number of pathologies $\pm$ sd	3.4 $\pm$ 1.3	3.3 $\pm$ 1.6	ns
Educational level			
Low	87 (71.9)	101 (75.9)	ns
Medium	20 (16.5)	18 (13.5)	ns
High	14 (11.6)	14 (10.5)	ns
Independence on dressing and washing			
Independent	56 (41.2)	67 (50.4)	ns
Some help needed	42 (30.9)	41 (30.8)	ns
Dependent	38 (27.9)	25 (18.8)	ns
Independence on oral health			
Independent	89 (64.4)	103 (77.45)	0.03
Some help needed	11 (8.1)	7 (5.3)	ns
Dependent	36 (26.5)	23 (17.3)	ns
Frequency of dental meetings			
About yearly	10 (8.8)	12 (9.3)	ns
Only if needed	103 (91.25)	117 (90.7)	ns

\* n corresponds to the number of answers gotten to the variable

\*\* Chi square test categorical data, independent T test numerical data

Residents were irregular dental attendees; two or more years had passed since the last dental visit for 75% of them. Only 23% of the latter had attended regular control, the others (77%) attended due to the need for urgent treatment (pain, caries, making or repairing prosthesis and other causes). When asked about their oral hygiene routines, 17% of the participants reported not performing oral hygiene. Among those who performed it, 81% did it daily and 19% less than daily. 12% of residents said that they did not use toothbrush, 24% did not use toothpaste, 105 (94%) of those who could use dental floss because of their number and arrangement of teeth did not do so. 56% (150 residents) wore complete or partial dentures, 14% of them said that they used pills for soaking them at night, 39% used dentures at night and 42% had denture-related stomatitis (37% type I, 38% type II and 25% type III). Pearson correlation was significant between “sleeping with dentures” and “sub-denture stomatitis” both at



baseline ( $p=0.001$ ) and after 12 months ( $p=0.001$ ). Comparing baseline and after 12 months, significantly less residents in the control group wore dentures at night ( $p=0.003$ ), (control group  $p=0.132$ ) and sub-denture stomatitis decreased (approaching significance, ( $p=0.090$ ), while it increased in the control group (ns,  $p=0.637$ ), (Table 4).

Table 4. Oral health variables at baseline and 12-months follow-up period

Variable	Work group n = 136		Control group n= 133	
	Baseline n (%)	After one year n (%)	Baseline n (%)	After one year n (%)
Dental meetings in the last year	10 (8.8%)	28 (20.7%)	12 (9.3%)	25 (19.1%)
Night use of dentures	32/72* (44.4%)	21/72 (29.1%)	26/77 (33.8)	19/73 (26.0%)
Sub-denture stomatitis	33/73*(45.2) mean (sd)	26/72 (36.1%) mean (sd)	30/77 (39.0) mean (sd)	31/73 (42.5%) mean (sd)
No. of teeth	8.4 ± 8.9	7.6 ± 8.3	8.7 ± 8.9	8.3 ± 8.8
No. of decayed teeth	1.0 ± 1.4	1.3 ± 1.5	1.0 ± 1.7	1.6 ± 1.7
No. of retained roots	1.2 ± 2.6	1.7 ± 3.1	1.2 ± 2.3	1.9 ± 2.8

\* Total amount of cases for this variable.

Edentulousness prevalence was 28%. The residents had lost from 0 to 18 teeth (mean  $0.7 \pm 1.6$ ) during one year in an institution and they had from 6 less to 5 more retained roots less (mean  $0.4 \pm 1.1$ ). Paired t-tests showed significant changes from baseline to 12 months for the number of remaining teeth ( $p < 0.001$ ) decayed teeth ( $p > 0.001$ ) and number of retained roots ( $p = 0.011$ ). The work group had lost more teeth ( $0.91 \pm 2.1$ ) than control ( $0.47 \pm 0.9$ ) and had more retained roots (work  $0.4 \pm 1.1$ , control  $0.35 \pm 1.0$ ). ANCOVA analysis with number of teeth after 12 months as dependent variable and number of teeth at baseline and work/control as predictors was used to control for baseline ( $p = 0.018$ ) between group differences. Equal analysis for controlling for baseline showed no effect in the number of caries when controlling for baseline between groups ( $p = 0.089$ ) and that retained roots diminished ( $p = 0.366$ ).

58% of residents had unacceptable global oral hygiene at baseline; after the 12-month follow-up period it improved for 27.5%, remained unchanged for 59.9% and worsened for 12.6% ( $p < 0.001$ ). More residents in the work group statistically improved their global oral hygiene ( $p = 0.003$ ), Table 5.

Table 5. Global Oral Hygiene at baseline and follow up period, work group (n=136) and control group (n=133)

Time/group	Good %	Acceptable %	Unacceptable %	Chi square
T0 Work	13.2	30.9	55.9	p= 0.46
T0 Control	11.3	28.6	60.2	
T1 Work	22.1	25.0	52.2	p= 0.048
T1 Control	12.0	21.8	66.2	
T2 Work	26.5	30.9	42.6	p= 0.035
T2 Control	18.0	27.1	54.9	
Change in oral hygiene T0-T2	Improved	The same	Worse	
Work	34.6	53.7	11.8	p= 0.03
Control	20.3	66.2	13.5	

\*T0: Baseline; T1: Six months; T3: 12 months.

## Discussion

Caregiver participation in the OHTP was 83% and their knowledge about OH care improved significantly after the programme. 269 out of 369 residents completed the 12-month follow-up period. This paper describes OH baseline status and changes in the outcome variables of those residents who completed the study.

The OHTP was found to be effective as overall oral hygiene improved significantly in the work group when compared to the control group; night use of dentures also decreased significantly and sub-denture stomatitis almost significantly in the work group. The work group also showed a lower increase in the number of decayed teeth after one year than the control group did. Nevertheless oral hygiene was still unacceptable and reflected the difficulty of the task re improving oral hygiene in nursing homes.

The low priority given to OH in geriatric institutions has been frequently reported (28, 40); the invited institutions participation rate (nine out of 30, 30%) gave a realistic view of this situation. Even in the institutions that took part in the study this was not very different, as shown by the questionnaire answered by directors. Lack of OH policies as evidenced in residents' oral care protocols and guidelines affected not only their OH but also the caregivers' work. The fact that not all caregivers verified, helped or performed residents' OH and the type of residents helped by them confirmed this issue. The finding that 82% of nurses claimed being overworked as the most frequent barrier to providing adequate OH highlighted the need for institutions to include oral care in daily general care routine protocols and guidelines. Time must be made available for nurses to work on oral care. Directors' participation in OH education programmes is thus very important; however, only 44% of them participated in our study.

Substantial groups of both nurses and residents (66% and 79%, respectively) attended dental services only when they had urgent treatment needs. This fact, that 46% of caregivers did not use dental floss and 32% had not attended the dentist during the previous year, showed that their OH routines were not optimum. It may be that caregivers who do not care adequately about their own OH would not do it for their patients. This correlates with Nordenram *et al.*, who stated that, in cases of dependence, provision of care and treatment depends on what perspective and treatment priorities the advocate has (105) and with Frenkel *et al.*, who stated that the main predictors for knowledge and attitude towards OH care were caregivers' age and dental attendance pattern (46). Furthermore, studies show (2, 106, 107) that nursing aid schools often deliver inadequate training on oral care. This was supported in our study, as 56% of participants had not received any oral care training during their studies.

Although only 44% of the caregivers had received OH care formation during their studies, their baseline knowledge was acceptable, the same as in other studies (46). This could have been related to the years of provider experience (8.9 years in the current work), as reported by others (108). This high provider experience in the caregiver sample may have compensated for the significantly higher age and time spent in their current work in the control group. There was significant improvement in the knowledge exhibited by the attendees after the OHTP; this agreed with other works (48, 50, 108, 109). A post-test was carried out immediately after the OHTP; this could have influenced the high recall, although there is enough evidence in the literature about the maintenance of the effect of these programs in terms of knowledge and attitudes, even after three years, (46, 50, 109), and in terms of residents' OH gain after six years (51).

The picture described above is incomplete without three more players, stakeholders, policy-makers and dental and nursing schools. Only 14% of the places in residential homes in Andalucía, Spain, are public, 56% are private and 30% are state-assisted (24). With most nursing homes in private ownership, then need-for-profit may potentially conflict with high-quality care delivery (46). Policy-makers are thus responsible for legislating to guarantee adequate care in nursing homes, OH care included. Dental schools should contact and work together with nursing schools to include OH care in their curricula and should assist policy-makers in including oral care as a compulsory daily task in nursing homes.

After each residents' oral screening, the main OH problems found and the measures needed to manage such problems were reported to the head nurses and directors of all institutions. This may have explained the improvement in overall oral hygiene and the

decrease in night-time use of dentures in the control group. Sub-denture stomatitis decreased almost significantly in the work group; this condition is associated with night-time use of dentures and unacceptable denture hygiene (104, 110, 111), so this change could also have been attributed to the OHTP results and this was highly significant from a clinical point of view. Other studies have reported similar findings in denture-wearing habits and sub-denture stomatitis prevalence after caregivers have participated in educational programmes (45, 112).

As in other works (48), overall oral hygiene improvement was not enough to significantly affect caries' prevalence. Obtaining improvements in denture hygiene is much easier than getting improvements re dental plaque at such magnitude to reduce caries' incidence (50, 103). Caregivers' education regarding OH and preparing them to face adverse situation at work (113) is a partial solution to this problem. This is a complex issue that the dental profession must focus on in the foreseeable future and needs an integral approach. Caregivers and residents' potential psychological barriers to performing intraoral care, ethical discussion about autonomy, legislation about integral care in nursing homes that includes oral care and work with stakeholders and institutional staff about building oral care policies, are some of the issues that need to be addressed.

The study had some limitations in. Only 56% of Granada's nursing homes were contacted and only nine became involved. They were considered to be representative of such population but the sampling framework was not random. The potential selection bias resulting from this cannot be ignored, even though it did not become clearly apparent. Although calibration was conducted on 10 residents, intra-examiner reliability

was not measured and could have represented a source of potential bias. Given the relatively low sample-size and different conditions probably existing in other nursing homes, one should be cautious when generalising the results. Furthermore, the use of clustering instead of individual randomisation created more uncertainty and the p values should be interpreted with caution.

### **Conclusion**

The OHTP was effective in improving caregivers' knowledge and OH care routines, as shown by the improvement in residents' overall OH.

### **Acknowledgments**

We would like to thank residents and staff who formed part of this work.

## Chapter VI

### GENERAL DISCUSSION

The aims of this dissertation were to explore some risk factors of poor OH and the OH effects on mortality risk for institutionalised elderly; and to evaluate carer training on OH by examining carers' change in knowledge and assessing the training in terms of OH gain of the residents after 12 months. In order to achieve it, we designed a main longitudinal controlled trial and a cross-sectional study; from the main trial three different studies were conducted, one cross-sectional and two prospective. As a body, the four studies analyse different aspects and contribute to the understanding of the main issue, which is the OH of institutionalised elderly.

The rationale for our research studies was that OH of institutionalised elderly is the result of multiple factors, and that health is associated with different levels: individual, communitarian and organizational (114). Implementation of well-designed oral health training-programmes directed to caregivers is important but not enough to guarantee an adequate OH of those institutionalised elderly. Our studies aimed at exploring some of the personal factors affecting OH, such as cognitive status, perception of the OH-QoL, dependence on OH care, and behaviour during OH assistance; as well as some organizational factors like the institutional OH care policies, and the caregivers' knowledge and practices of OH.

Two samples were used in this study. While there was a dental service in both institutions of the Oslo sample, and the residents used to have frequent dental

appointments, none of the institutions in Granada had dental services and more than two years had passed since the last dental appointment of most of the residents had been carried out. As a result, residents of the Oslo sample had lower caries prevalence and less retained roots than the residents of the Granada sample, as described in the papers I and IV (chapters II-V). However, more than 50% of the residents in the two samples had unacceptable oral hygiene (Granada, 58%; Oslo, 53%) therefore it is possible to say that there was the same problem of oral hygiene care routines in both samples.

Ageing is considered to be the most important risk factor for physical and mental disorders and death (83). In addition, physical and mental disorders lead to dependence, which is a risk factor for the onset and progression of dental diseases and conditions (16). For these reasons we decided to analyse cognitive state, OH-QoL, and dependence in our samples (papers I-III). The findings of the first paper supported the hypothesis that residents with a better OH state have a better OH-QoL, but they refuted the hypothesis that MCI does not affect the perception of the OH status. The results showed that poor OH and cognitive impairment were associated with a poor OH-QoL; and that residents suffering MCI had a perception of a significantly better OH-QoL than cognitively normal people. This could show that indifference towards their OH could be an early effect of their perception of OH because of cognitive impairment. This result is very important because cognitive impairment has been associated with poor OH (7-9, 16, 115-116), and as stated, mild cognitively impaired people may have not been diagnosed.

QoL mainly became altered due to OH in three areas: trouble while biting or eating, being displeased with the look of teeth, and suffering discomfort while eating. These



were in concordance with other studies, which have reported that, the ability to chew, problems in communication, and appearance may affect life satisfaction (10, 19, 68). As in other Spanish studies (3, 117-118), the prevalence of edentulism in the sample was high, and being edentulous or having a low number of remaining teeth correlated significantly with a lower GOHAI score. It has been reported that being edentulous and wearing poorly fitting dentures are causes of a poor QoL (69). Nowadays we know that not having teeth is no determinant for the nutritional status, but rather it is due to food consistency choice (74). Geriatric institutions are normally concerned about their residents' nutritional status and adapt food type and consistency to fit the residents' nutritional requirements, no matter what their OH status is. This could hide a widely reported problem of neglected OH care in geriatric institutions (75).

In the second study (chapter III) we found that mortality risk of denture users was significantly higher even after controlling for age; this finding is in concordance with other studies (84). It seems that the number of teeth is not only important for the OH-QoL, as found in paper I, but it also seems to be of importance to survival rates (23, 79, 85). The first study showed a relationship between edentulousness and impaired OH-QoL, it found too, that the most negatively affected OH-QoL aspect in the sample was "Trouble biting or chewing". So it seems reasonable to think that most dentures worn by residents were unfitted, which produces chewing problems, and chewing ability has been found to be associated with a greater risk of mortality (89). We also found that when suffering from severe cognitive impairment and wearing dentures, the risk of dying within a year was 50%. Other studies have found cognitive status to be the overall predictor of survival, independent of age and gender (21). Note that the findings of this work also confirm hypothesis number 2.

The third study found, as other studies have done (30, 96), a significant problem regarding unacceptable oral hygiene in the sample studied; it correlated significantly with the number of teeth and cognitive impairment. We also found that 47.7% of the residents with moderate to severe cognitive impairment were still cleaning their own teeth and their oral hygiene was about as good as the other independent teeth cleaners. This result is in accordance with Merelie and Heyman (40) who found that the condition of teeth and dentures were similar in confused and non-confused residents. Significant differences regarding oral hygiene, and the number of caries and the remaining roots among the residents whose teeth were cleaned by themselves and those cleaned by the caregivers, were also found. Cooperative behaviour seems to be a protective factor for tooth-loss in long-term institutionalised elderly people (97), this is concordant with the significant difference found between cooperative and non-cooperative residents regarding OHI-S, presence of caries, and having moderate to severe cognitive impairment.

The fourth study (chapter V) found that the caregivers' knowledge about OH care improved significantly after the programme, this is in concordance with the results of other studies (48, 50, 108-109). The OHTP was also effective in improving the residents' OH, as the global oral hygiene improved significantly; and night use of dentures and sub-denture stomatitis (SS) decreased in the work group; other studies have reported similar findings related to denture wearing habits, and prevalence of SS after carers educational programmes (45, 112). Although the improvement in the global oral hygiene was not enough to reduce caries prevalence this is in agreement with other studies (48, 50, 103). These results suggest that an appropriate OH care in nursing

homes requires not only caregivers' education, but also all the nursing homes staffs' participation.

As has been shown in other studies (28, 40) OH had a low priority in the institutions that participated in this work. Consequently, participation of directors in education programmes would be very important to overcome these problems. Caregivers' personal OH care routines were not optimum, and this could affect the oral care provided to the residents, as stated in other works (46, 105). As reported in other studies (106-107), most carers (56%) did not receive any oral care training during their studies. Apart from this, the carers' baseline knowledge on OH was acceptable, again in concurrence with other studies (46). Therefore the results of this study confirm our forth hypothesis and refute the third one.

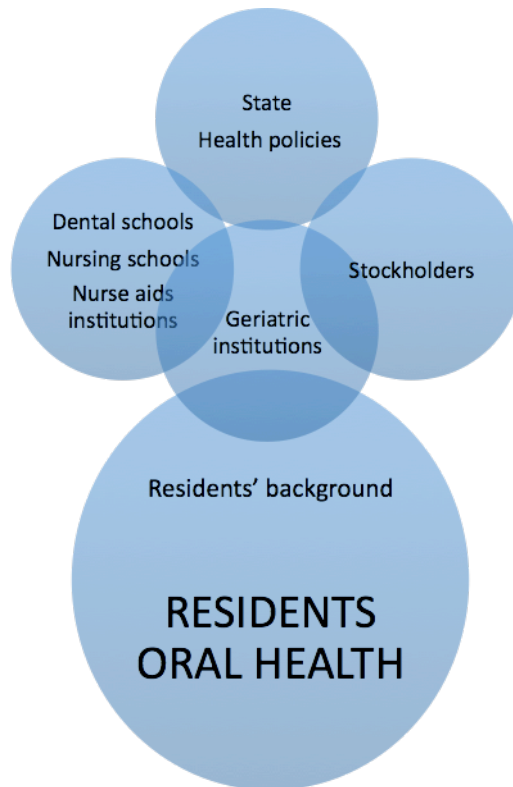
### **General conclusions**

- Mild cognitively impaired residents had a perception of a better OH-QoL than cognitively normal ones, in our sample of institutionalised elderly.
- Being cognitively impaired and wearing dentures significantly increased the risk of death.
- Residents whose teeth were cleaned by the nurses had poorer oral hygiene than those self-dependent residents.
- In the Oslo's sample, 48% of the residents with moderate to severe cognitive impairment were still cleaning their own teeth and their oral hygiene was about as good as the other independent tooth cleaners.
- Uncooperative residents with regard to oral care had the worst oral hygiene and had more caries than the cooperative ones.

- The effectiveness of OHTP to caregivers in terms of knowledge improvement is reported in many studies, but their effectiveness in terms of OH gain of the residents is controversial. Our OHTP was effective at both levels, improving the knowledge and practices of the caregivers about the OH care of the residents and improving the overall OH status of the residents.

The main questions are the clinical significance of these results, and how much it is possible to expect from this kind of intervention. The answer to the first question is easy: from the clinical point of view these results are relevant but insufficient; nevertheless the importance of the oral health training programmes to caregivers cannot be questioned. The second question is more complex and we do not have enough information to address it adequately here. As discussed in the forth paper, there are many players and determinants of the OH of institutionalised elderly. Resident's personal background (education, socio-economic status, OH history, functional and cognitive status, etc.), geriatric institutions' health care policies, caregivers knowledge and attitudes to oral care, stockholders, dental and nursing schools, and policy makers are some of them and each one plays a role. In this context OH training to caregivers is an important but insufficient measure to guarantee an adequate OH state and care of the residents. The carrying out of comprehensive studies investigating the best way to work with all the players on this issue (figure 2) will tell us how much each one of those players has to do, and *what are the measures needed to guarantee the OH of institutionalised elderly.*

*Figure 4. Comprehensive players in providing adequate oral health for institutionalised elderly*



### **Future directions**

It is important to highlight the break that apparently exists (as showed by the Oslo sample) among the dental services and the daily care routines in nursing homes. Dental care for institutionalised elderly, particularly for the dependent ones, must be an integral task involving the dentist, the dental hygienist, and the caregivers. There should be coordination between the periodical work at the dental office and the daily work at the nursing home. If this is not the case, the work at the dental office would be more curative than preventive, and this is expensive from the psychological, biological and economical points of view. Research on this issue would be important to calculate the different costs of this lack of coordination and the appropriate measures to prevent it occurring.

Papers that report the use of instruments that measure OH-QoL do not normally inform about having performed a cognitive screening, they only exclude those demented people from their samples, which can lead to including people with MCI. Our findings illustrated a possible early effect of MCI on the perception of OH; this suggests the importance of carrying out more studies concerning this issue.

Do the institutions adapt the kind and consistency of food to the particular oral health conditions of the residents? Or as a rule, do they adapt food type and consistency to fit their residents' nutritional requirements, no matter what their oral health status is, and if so, could this hide a widely reported problem of neglected OH care in geriatric institutions? This is a very interesting topic to search about.

The finding that 47.7% (in the third study) of the residents having moderate to severe cognitive impairment were still cleaning their own teeth, and that their oral hygiene was about as good as the other independent tooth cleaners, merits further research. It could be that because tooth cleaning is a task learned in early childhood it may act as a protective factor when people become weak or in some stages of cognitive impairment and dementia.

An interdisciplinary team approach to work on the ways to manage demented and uncooperative elderly residents in order to perform oral care is needed. Expert opinion suggests that follow-up, communication and behaviour management, using chemical control for dental plaque, and fluoride products and electric toothbrushes are effective in these particular residents, but our knowledge about this problem is clearly limited.

It seems that improving denture hygiene is much easier than making progress on dental plaque so as to reduce the incidence of caries. Education of caregivers on OH is a partial solution to this problem. This is a complex issue requiring an integrated approach that should be a point of focus for the dental profession in the foreseeable future. Carers and residents potential psychological barriers to perform intraoral care, ethical discussion about autonomy, strategies to overcome barriers to provision of oral care in nursing homes, legislation about integral care in nursing homes that includes oral care, and work with stockholders and institutional staff about building oral care policies, are some of the issues that need to be addressed.

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**SPANISH ABSTRACT**



**Salud Oral en Adultos Mayores Institucionalizados:  
Relaciones entre Deterioro Cognoscitivo, Mortalidad,  
Calidad de Vida Relacionada con la Salud Oral y la Salud Oral.  
Efecto de un Programa de Educación en Salud Oral a Cuidadores**

Tesis doctoral

Dairo Javier Marín Zuluaga

Directores

Dr. José Antonio Gil Montoya, Universidad de Granada  
Dr. Ramona Rubio Herrera, Universidad de Granada  
Dr. Tiril Wilumsen, Universidad de Oslo

Departamento de Estomatología, Facultad de Odontología  
Universidad de Granada, España  
2011

El objetivo final de la profesión odontológica es mejorar y mantener la salud de las personas en un contexto comprensivo de calidad de vida. Muchos artículos reportan estudios de formación en salud oral a cuidadores, y sus resultados son contradictorios. Diseñar cualquier clase de intervención sin tener en cuenta el contexto y los diferentes sujetos que intervienen en el, es por lo menos, incompleto.

Esta tesis doctoral aspira a la mención de Doctorado Europeo, por la Universidad de Granada. Por esta razón, se trabajó con dos muestras, en las que se diseñaron cuatro estudios así:

- Muestra de Granada: dos estudios prospectivos a 12 meses (artículos II y IV) y un estudio de corte (artículo I).
- Muestra de Oslo: Un estudio de corte (artículo III)

**Los objetivos de esta tesis fueron:**

OBJETIVOS GENERALES

Explorar algunos de los factores de riesgo para una mala salud oral y los efectos de la salud oral sobre el riesgo de muerte, en adultos mayores institucionalizados.

Evaluar los efectos de un programa de educación en salud oral a cuidadores, sobre sus conocimientos y rutinas de cuidado a adultos mayores institucionalizados.

OBJETIVOS ESPECÍFICOS

1. Investigar a cerca de las relaciones entre salud oral, estado cognoscitivo y calidad de vida relacionada con la salud oral (CV-SO).

2. Investigar sobre las relaciones entre salud oral, dependencia para la higiene oral y el comportamiento durante las rutinas de cuidado oral.
3. Verificar si los cuidadores en instituciones geriátricas, tienen los conocimientos necesarios para ayudar a los residentes en sus rutinas de cuidado oral.
4. Mejorar el conocimiento y las habilidades de cuidados orales, en cuidadores de instituciones geriátricas.
5. Medir el impacto de un programa de educación en salud oral dirigido a cuidadores de instituciones geriátricas, sobre la salud oral de los residentes.

### **Las hipótesis de trabajo:**

1. El deterioro cognoscitivo leve no afecta la percepción de la salud oral en adultos mayores institucionalizados.
2. Los residentes con mejor salud oral presentan una mejor CV-SO.
3. Los cuidadores no tienen los conocimientos requeridos para cuidar adecuadamente de la salud oral de los residentes.
4. La educación en salud oral a los cuidadores, afecta positivamente la salud oral de los residentes.

### **El eje estructural de los estudios y sus resultados**

Los artículos I-III, presentados en los capítulos II-IV, buscaron conseguir los dos primeros objetivos específicos. Se enfocaron en algunos de los factores dependientes del propio sujeto (en nuestro caso, el adulto mayor institucionalizado), como las interacciones entre la salud oral, el estado cognoscitivo y la CV-SO, al igual que el



comportamiento del residente mientras le asisten en sus cuidados orales. El artículo IV, presentado en el capítulo V, desarrolla los objetivos tres a cinco y reporta los resultados del programa de educación en salud oral a los cuidadores.

La muestra del *artículo I* se seleccionó estratégicamente, tomando como base el estado cognoscitivo. Este estudio analiza la influencia del estado cognoscitivo sobre la salud oral y la CV-SO. Sus resultados confirmaron la segunda hipótesis de trabajo y rechazaron la primera. En este trabajo se encontró:

- La mala salud oral y el deterioro cognoscitivo se asociaron con una pobre CV-SO.
- Los residentes con deterioro cognoscitivo leve presentaron mejor CV-SO, que quienes tenían un estado cognoscitivo normal.
- La CV-SO estaba alterada principalmente en tres aspectos: Problemas al comer o morder, insatisfecho con la apariencia de los dientes o prótesis y dis-confort durante las comidas.

La muestra para el *artículo II* fue seleccionada de acuerdo con la edad de los residentes, incluyendo solo a quienes tenían 75 o más años de edad. Este estudio longitudinal a 12 meses, hace un análisis sobre la relación de la salud oral y el riesgo de muerte. Sus resultados contribuyen con el logro del primer objetivo y confirman igualmente la segunda hipótesis:

- El riesgo de muerte a 12 meses fue significativamente mayor (25%) en usuarios de prótesis removibles y alcanzaba el 50% si el residente además presentaba deterioro cognoscitivo.

El *artículo III* reporta los resultados del estudio desarrollado en Oslo. Analiza la dependencia y comportamiento durante la higiene oral y su impacto sobre la salud oral de los residentes. Sus resultados aportan al logro de los objetivos uno y dos.

- La mala higiene oral se asoció significativamente con el deterioro cognoscitivo y el número de dientes.
- Un 47.7% de residentes con deterioro cognoscitivo moderado o severo, continuaban realizando su propia higiene oral y ésta era tan buena como la de un residente sin deterioro cognoscitivo e independiente para la higiene oral.
- Los residentes que realizaban su propia higiene oral presentaron significativamente mejor higiene oral y menos caries y restos radiculares, que quienes eran asistidos por las cuidadoras.
- Los residentes dependientes para la higiene oral y que eran cooperadores presentaron significativamente mejor higiene oral y menos caries.

El *artículo IV* (presentado en el capítulo V), incluye en su muestra a las instituciones, cuidadores y residentes, con los cuales se desarrolló el programa de educación en higiene oral. En este estudio se analizan los resultados de este programa. Este estudio aporta a los tres primeros objetivos; sus resultados confirman la cuarta hipótesis y rechaza la tercera hipótesis de esta tesis:

- Los cuidadores presentaron un aceptable nivel de conocimientos sobre salud oral, antes del desarrollo del programa educativo.
- Los cuidadores mejoraron significativamente sus conocimientos de salud oral, después del programa educativo.
- La salud oral de los residentes del grupo de trabajo mejoró significativamente.

### **Líneas de futuros trabajos investigativos**

- En la muestra de Oslo se evidenció una aparente ruptura entre el trabajo desarrollado en los servicios odontológicos y las rutinas de cuidado oral diario de las cuidadoras. El cuidado de la salud oral de los mayores institucionalizados debe ser un continuum entre el odontólogo e higienista dental, quienes desempeñan un papel periódico y el trabajo diario de la pareja cuidador-residente. De lo contrario, el trabajo en oficina dental será más curativo que preventivo, y esto resulta costoso desde el punto de vista psicosocial, biológico y emocional. El desarrollo de investigaciones en este campo será importante para calcular esos costos y las mejores estrategias para resolver el problema.
- Los estudios que reportan el uso de instrumentos para medir la CV-SO, no reportan que realicen normalmente un tamizaje cognoscitivo. Regularmente se limitan a eliminar de sus muestras a personas con demencias o incapaces de responder a sus preguntas. Nuestros resultados sugieren que personas con deterioro cognoscitivo leve (las cuales pueden tener una vida normal e inclusive no estar diagnosticadas) pueden presentar una alteración temprana de la percepción de su propia salud oral, lo cual alteraría los resultados de estos estudios. El desarrollo de más investigaciones sobre este aspecto es de gran importancia.
- Los resultados que mostraron que en un 47.7% de los residentes con deterioro cognoscitivo moderado o severo y que seguían a cargo de su higiene oral, ésta era tan buena como la de otros residentes no dependientes, amerita mayor investigación. Podría relacionarse con el hecho de que la higiene oral es una tarea que se aprende a

muy temprana edad, lo cual podría actuar como un factor de protección en pacientes débiles y en algunos estadios del deterioro cognoscitivo y las demencias.

- Es necesario realizar más trabajos sobre el abordaje interdisciplinario para el manejo de la salud oral de personas con demencia y/o no cooperadoras. Algunos expertos sugieren que las estrategias de manejo comportamental, el control químico de la placa dento-bacteriana, los productos fluorados y los cepillos eléctricos, son medidas a emplear en estos casos. Sin embargo nuestro conocimiento al respecto sigue siendo escaso.
- Al parecer, conseguir mejoras en la higiene dental con la magnitud necesaria para reducir la incidencia de caries, resulta más difícil que conseguir mejoras en la higiene protésica. La educación a los cuidadores es solo una parte, aunque muy importante, de la solución de este problema; que es complejo, requiere un abordaje interdisciplinario y debe focalizar la atención de la profesión odontológica en el futuro inmediato. Las barreras psicológicas de cuidadores y personas mayores, para el abordaje de la cavidad oral, una discusión ética sobre la autonomía del mayor, la legislación sobre cuidado integral de la salud en las instituciones geriátricas, el trabajo con los dueños de estas instituciones y todo su personal, son algunos de los problemas que requieren investigación.

**APPENDIXES**

*Appendix 1. Questionnaire delivered to directors of the institutions in the Granda's sample.*

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**INSTITUTIONS' QUESTIONNAIRE**

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Institution kind	Public	State assisted	Private
	_____	_____	_____
Number of residents living at the institution			no. _____
How many nurses are employed by the institution			no. _____
How many nurse aids are working at the institution			no. _____
Does the institution have a dental service?		Yes _____	No _____
Is there a dentist on the staff?		Yes _____	No _____
Is there a dental hygienist on the staff?		Yes _____	No _____
Is the knowledge about oral health care checked when the institution hires a nurse or a nurse aid?		Yes _____	No _____
Does the institution have an oral health care policy for the residents?		Yes _____	No _____
Does the institution have oral hygiene protocols or guides?		Yes _____	No _____
Is the oral health checked when a resident is admitted?		Yes _____	No _____
Is the resident's oral health periodically checked?		Yes _____	No _____
Are dental appointments arranged only by the residents' request?		Yes _____	No _____
Does the institution have any kind of identification system for the resident's dentures?		Yes _____	No _____
Do all the residents have:			
Toothbrush		Yes _____	No _____
Toothpaste		Yes _____	No _____

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*Appendix 2. Questionnaire delivered to caregivers of the Granda's sample.*

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**CAREGIVERS' QUESTIONNAIRE**

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Sex	Female ___	Male ___
Age		_____
How many years have you been working at the current institution?		_____
Profession	Nurse ___	Nurse aid ___
How many years of provider experience do you have?		_____
Educational level		
Primary studies	Yes ___	No ___
High school	Yes ___	No ___
Technical studies	Yes ___	No ___
University	Yes ___	No ___
Do have training on oral health care?	Yes ___	No ___
In case of having training on oral health care, when did you have it?		
While studying nursing or aid nursing	Yes ___	No ___
Attending academic meetings	Yes ___	No ___
While working with a dentist	Yes ___	No ___
Others		
How many years have passed since your last oral health training?		_____
How frequent do you attend to the dentist?		
About two times yearly	Yes ___	No ___
About yearly	Yes ___	No ___
Only in needed	Yes ___	No ___
What do you use for your personal oral hygiene?		
Toothbrush	Yes ___	No ___
Toothpaste	Yes ___	No ___
Dental floss	Yes ___	No ___
Mouth rinses	Yes ___	No ___
Others		
How much time has passed since your last dental appointment?		
Less than six months		
About 6 – 12 months	Yes ___	No ___
About 1 – 2 years	Yes ___	No ___
More than two years	Yes ___	No ___
What was the cause of your last dental appointment?		
Pain	Yes ___	No ___
Caries	Yes ___	No ___
Dental abscesses	Yes ___	No ___
Make or repair prosthesis	Yes ___	No ___
Professional control	Yes ___	No ___
Others		
Do you have the knowledge and expertise required to	Yes ___	No ___

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assist the residents in their oral health care?

Are you able to detect any pain or infection in the residents' mouth? Yes\_\_\_ No\_\_\_

Do you verify, assist or perform the residents' oral hygiene? Yes\_\_\_ No\_\_\_

If you answered "NO" to the previous question, please go to the question about the barriers.

Do you do it daily? Yes\_\_\_ No\_\_\_

Do you do it less than daily?

To which kind of residents do you use to verify, assist or perform the oral hygiene?

To everybody Yes\_\_\_ No\_\_\_

Only to those who request it Yes\_\_\_ No\_\_\_

Only to those dependents Yes\_\_\_ No\_\_\_

Only to those partially dependents Yes\_\_\_ No\_\_\_

Only to those self-dependents Yes\_\_\_ No\_\_\_

Which kind of residents represent a problem when you verify, assist or perform the oral hygiene? (You can choose more than one option if needed)

Everybody Yes\_\_\_ No\_\_\_

Only those who request it Yes\_\_\_ No\_\_\_

Only those dependents Yes\_\_\_ No\_\_\_

Only those partially dependents Yes\_\_\_ No\_\_\_

Only those self-dependents Yes\_\_\_ No\_\_\_

Nobody Yes\_\_\_ No\_\_\_

Which barriers prevent or make it difficult for you to verify, assist or perform the residents' oral hygiene?

Lack of knowledge Yes\_\_\_ No\_\_\_

Lack of time or work overload Yes\_\_\_ No\_\_\_

You think that Oral hygiene is not important in the elderly Yes\_\_\_ No\_\_\_

You do not have any problem Yes\_\_\_ No\_\_\_

Others

Which particular aspect or theme would you like to learn about oral health care of the institutionalised elderly?

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How do you think the oral health care of the institutionalised elderly could be improved?

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*Appendix 3. Questionnaire delivered to residents of the Granda's sample.*

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**RESIDENTS' QUESTIONNAIRE**

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Sex	Female ___	Male ___
Age		_____
How many years have you been living at the current institution?		_____
Educational level		
Primary studies	Yes ___	No ___
High school	Yes ___	No ___
Technical studies	Yes ___	No ___
University	Yes ___	No ___
Medicines being taken		
General pathologies		
Independence on dressing or washing		
Independent	Yes ___	No ___
Some help needed	Yes ___	No ___
Dependent	Yes ___	No ___
How frequent do you attend to the dentist?		
About two times yearly	Yes ___	No ___
About yearly	Yes ___	No ___
Only in needed	Yes ___	No ___
How much time has passed since your last dental appointment?		
Less than six months		
About 6 – 12 months	Yes ___	No ___
About 1 – 2 years	Yes ___	No ___
More than two years	Yes ___	No ___
What was the cause of your last dental appointment?		
Pain	Yes ___	No ___
Caries	Yes ___	No ___
Dental abscesses	Yes ___	No ___
Make or repair prosthesis	Yes ___	No ___
Professional control	Yes ___	No ___
Others		
Do you use to clean your teeth/dentures?	Yes ___	No ___
How often do you clean your teeth/dentures?		
Daily	Yes ___	No ___
Less than daily		
What do you use for your personal oral hygiene?		
Toothbrush	Yes ___	No ___
Toothpaste	Yes ___	No ___
Dental floss	Yes ___	No ___
Mouth rinses	Yes ___	No ___
Pills for soaking dentures at night	Yes ___	No ___
Others	Yes ___	No ___
In case of wearing dentures, do you use to wear it at night?	Yes ___	No ___

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Oral Health related Quality of Life: total GOHAI score			_____
Cognitive state: PFEIFFER test score			_____
Oral health status			_____
OHI-S score			_____
% of dental plaque			_____
No. of natural remaining teeth			_____
No. of occluding pairs			_____
Presence of decayed teeth	Yes	_____	No _____
No. of decayed teeth			_____
No. of coronal caries			_____
No. of root caries			_____
No. of retained roots			_____
Denture hygiene index score			_____
Sub-denture stomatitis	Yes	_____	No _____
Sub-denture stomatitis severity	Type I	_____	Type II _____ Type III _____

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