ORAL HEALTHCARE IN NURSING HOMES:
FIGHTING AGAINST THE BACKLOG

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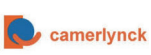

"I may not have gone where I intended to go, but I think I have ended up where I needed to be."

- Douglas Adams, *The Long Dark Tea-Time of the Soul* (1988) -

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List of abbreviations

ABRIM	Actief Begeleide Richtlijn Implementatie Mondzorg / Actively Supervised Implementation of an oral healthcare guideline
ADL	Activities of Daily Living
ATC	Anatomical Therapeutic Chemical
BENECOMO	Belgisch-Nederlands Consortium voor Onderzoek over Mondzorg van Ouderen / Flemish-Netherlands Geriatric Oral Research Group
CI	Confidence Interval
CPITN	Community Periodontal Index of Treatment Needs
DDD	Defined Daily Dose
DMFt	Sum of Decayed Missed and Filled teeth
h	hour
n	number
OGOLI	Oral health care in (residential) care homes for elderly people http://www.academia.edu/12695718/An_oral_health_care_guideline_for_institutionalised_older_people
OHCT	Oral Health Care Team
OR	Odds Ratio
PDD	Prescribed Daily Dose
PHEBE	Prescribing in Homes for the Elderly in Belgium
RCT	Randomized controlled trial
SD	Standard Deviation
SE	Standard Error
SFR	Salivary Flow Rate
SGH	Salivary Gland Hypofunction
Sig	Significance
US	United States
UWS	Unstimulated Whole Salivary Flow
WHO	World Health Organisation
WOO	Ward Oral healthcare Organizer
WZC	Woonzorgcentrum

List of frequently used terms

D_3MFt Sum of teeth with visually obvious dental decay in the dentine of the tooth (D_3), missing teeth (M) and filled teeth (F). Since D_3MFT is an index usually used for the assessment of dental caries, the M component is an indication for the proportion of teeth that has been extracted because of dental caries. In older adults the index is less valid for caries assessment because teeth can become lost for reasons other than caries. Nevertheless, it gives an overall insight in the dental status of the individual patient.

Dentist experienced in geriatric dentistry Dentists with at least one year of clinical experience and working at least half-time in a geriatric setting.

Frailty In this thesis, frailty is meant to be a dynamic state affecting an individual, who experiences losses in one or more domains of human functioning (physical, psychological, social, environmental), which is caused by a range of determinants and which increases the risk of adverse outcomes (1,2). In such a way frailty is considered from a holistic vision.

Restorative Index The restorative index is derived from the DMFt index and expresses the percentage of decayed teeth that received restorative treatment. It is calculated by the following formula: [F/(D+F)] x 100. The more untreated caries, the lower the restorative index.

Treatment Index The treatment index is derived from the DMFt index and expresses the percentage of decayed teeth that received restorative treatment or were extracted. It is calculated by the following formula: [(F+M)/(D+F+M)] x 100. The more untreated caries, the lower the restorative index. The treatment index is especially relevant compared to the restorative index when the number of missing teeth is high.

Study population In this thesis, the study population of Chapter 1, 2 and 3 are nursing home residents with limited access to regular dental care due to frailty, physical or cognitive impairment and where dental treatment is requested by the resident, his/her family or the caring staff.

SGH Salivary gland hypofunction (SGH) is considered when the salivary flow rate (SFR) is reduced by 50% with an unstimulated whole salivary flow (UWS) between 0.12 and 0.16ml/min. (3,4)

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Introduction

Introduction

Globally, the population over the age of 60 is the fastest growing one and is expected to more than double by 2050 and more than triple by 2100. Likewise, the proportion of the population of 60 years and older will rise in Belgium from 24.1% in 2015 to 32,6% in 2050 and the proportion of the population of 80 years and above will double from 5.5% to 10.6% (1). The current challenge for the ageing population will be to add health and well-being to life years rather than adding years lived with disability (2). As a consequence, health policymakers are shifting from the concept of simply prolonging the life span in calendar years towards adding years of life in good health (healthy ageing; 3).

The "World Report on Ageing and Health" by the World Health Organisation (WHO) stated that *"Oral health is a crucial and often neglected area of healthy ageing"* (3). Poor oral health is associated with lower quality of life, higher morbidity and earlier mortality in elders (4–6). Due to the use of fluoride toothpaste, policies based on prevention and the overall improvement in oral healthcare, more people are growing old with a considerable number of natural teeth. The challenge is to extend these health gains into older age and to the vulnerable segments of the ageing population. Nowadays, multiple restorations, prosthetic appliances and exposed root surfaces can be seen in the mouth as an indication of old age, creating an ideal environment for plaque retention. As a consequence, good daily oral hygiene is essential to maintain oral health. At the same time, if physical and cognitive skills are declining with age, achieving optimal oral hygiene can become a challenging task. Moreover, ageing goes hand in hand with a higher risk of comorbidities, poly-pharmacy, frailty and care dependency, which make elderly even more vulnerable to oral health problems. Dental professionals must prepare to encounter the challenges of providing oral health services to the increasing number of this vulnerable part of the population (7). Moreover, they must have sufficient knowledge on the risk factors for poor oral health in this population group. If not, poor oral health will become a potential new geriatric syndrome and a major public health problem during the 21st century (8).

In Flanders (i.e. the northern part of Belgium), nursing homes are one of the forms of residential housing for disabled and care-dependent older people. Between 2010 and 2013, 1% of the Flemish population aged between 65 and 74 years old was living in a nursing home. This proportion increased with age to 63% considering the population aged 95 and above. As a result of the ageing population, the

number of nursing home beds in Flanders has increased to 79.749 situated in 807 nursing homes in 2017. Not only the number of beds, but also the proportion of nursing home residents with a high care dependency has increased (9,10).

Until the beginning of this century, oral health data of nursing home residents were lacking in Flanders (Belgium) and the interest in oral healthcare delivery for this specific population was very low. The healthcare system as such was not adapted to guarantee the oral health of frail elderly. Neither dentists, nor care staff had adequate education on oral healthcare for frail elderly. Moreover, dental practices were often not adapted to meet the needs of frail elderly. As a consequence, many nursing home residents lacked customized oral healthcare. Alternative ways of oral healthcare had to be developed to pursue "patient-centered care" and to achieve "compression of morbidity", resulting in good oral health until the end of life, or at least for as long as possible. The dental team as well as care staff have an impotant role to play in this. In light of this, a comprehensive and innovative research project was set up to develop and apply an oral healthcare model for nursing home residents emphasizing the integration of oral healthcare into daily nursing home care.

The development of this model consisted of different stages:

- First, a literature review was performed to explore the field of oral health (care) of nursing home residents on a European level (11). This literature review concluded that, despite the low perceived oral health needs, nursing home residents in general had poor oral health and poor oral hygiene.
- Second, institutional elderly care was explored by four cross-sectional studies at different levels: the factors contributing to the variation in oral hygiene practices and facilities in nursing homes (12), the oral hygiene of nursing home residents (13), the actual state and opinions of dentists towards a well-organized community approach for oral healthcare for frail elderly people (14) and the attitudes of recently graduated dentists towards nursing home residents (15). These four studies showed that: (1) the oral hygiene of nursing home residents in Flanders (Belgium) was very poor; (2) in order to improve oral hygiene of nursing home residents, the management team needs to understand and acknowledge the importance of good oral health at old age and the caring staff needs to increase their knowledge and skills on oral health; (3) depending on age and gender, dentists were more or less interested to offer domiciliary oral healthcare services within a structured community approach and; (4) the attitude of recently graduated dentists in Belgium towards the institutionalised elderly was rather negative and their knowledge of ageing was poor.

- Third, an oral healthcare protocol was developed to facilitate the integration of oral healthcare into daily nursing home care. This protocol was implemented and evaluated during a longitudinal cluster randomized controlled trial (RCT). After 5 years, the oral hygiene protocol in nursing homes resulted in lower levels of dental and denture plaque, however the differences between the two groups (intervention and control) were neither statistically significant nor clinically relevant (16). Taking into account the results of this longitudinal study, an adapted oral healthcare protocol including supervision was derived from the guideline *"Oral health care in (residential) care homes for elderly people"* (OGOLI; 17,18). This adapted protocol was implemented during a 6-month study period in a second cluster randomized controlled trial, resulting in limited improvement of denture hygiene but no significant reduction of dental and tongue plaque (19,20).
- Since it became clear by these 2 previous RCT's that the implementation of a protocol did not result in better oral hygiene outcomes, a qualitative study was performed to explore the impact of enabling and disabling factors on the integration of oral healthcare into the daily care of nursing home residents (21).

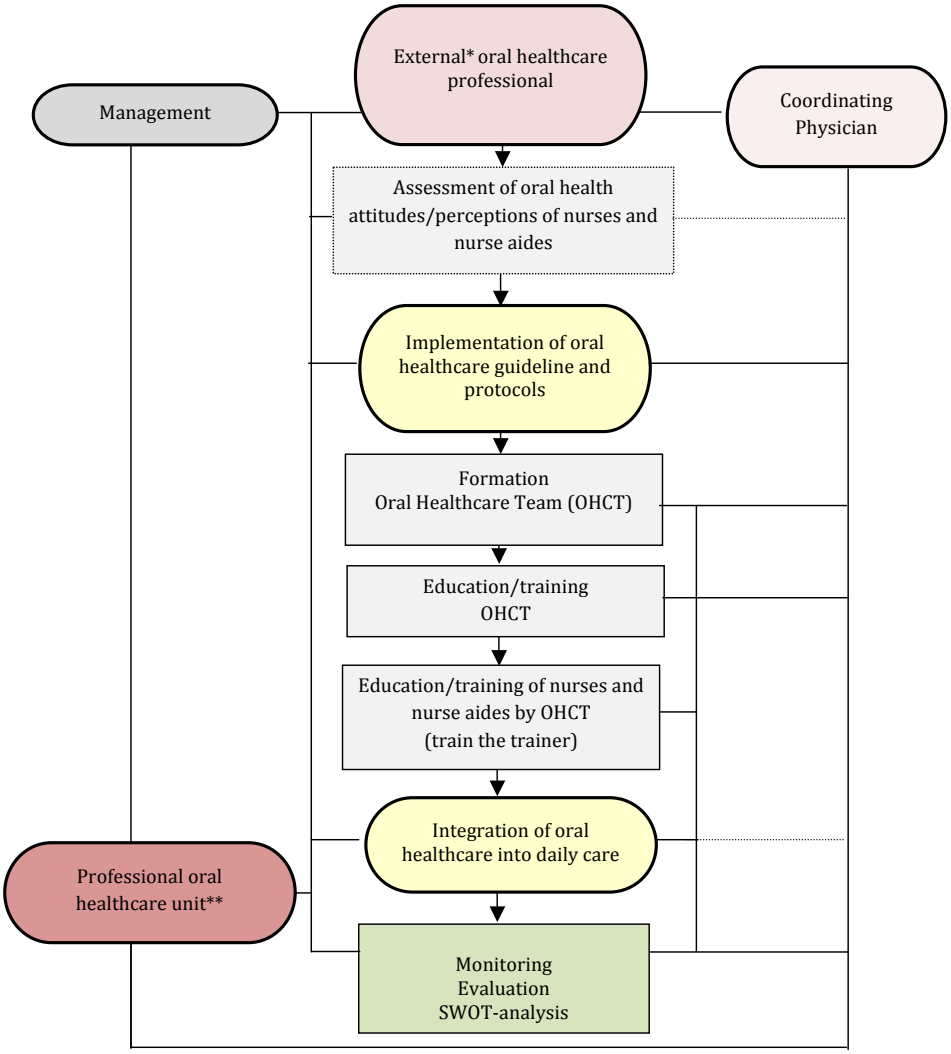
Taking into account the results of all previous studies, an oral healthcare model, which could be applied in different care settings, was developed including a mobile professional oral healthcare unit to assist in providing more structural preventive and curative oral healthcare on-site (**Figure 1**).

This model starts with the assessment of the oral health attitudes and perceptions of the care staff of the care setting. This assessment further guides the content and frequency of a theoretical and practical customized education. To supervise the implementation of the guidelines and protocols on oral health, the involvement of dental professionals is highly necessary. To follow the progress of the implementation, periodical internal and external monitoring and feedback are fundamental. Finally, to meet the oral healthcare needs of the setting, oral health professionals should provide the necessary support and treatments.

To meet the existing oral healthcare needs encountered in the nursing homes during the previously mentioned studies (12,13,16,19,20), "Gerodent" came into existence.

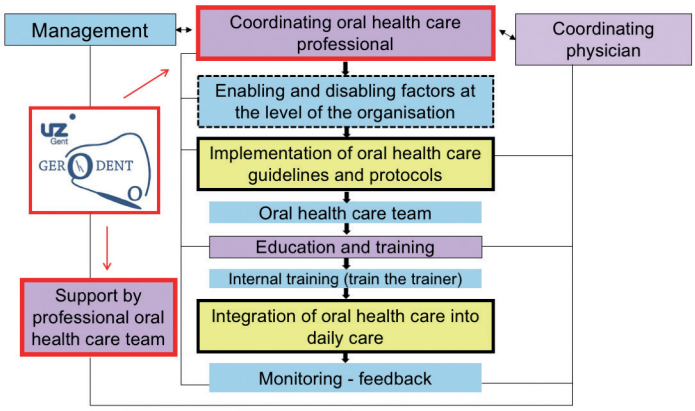
Gerodent is a mobile dental team acting within the previously designed oral healthcare model and supporting the nursing homes on both a preventive and a curative level. Within the care model, Gerodent takes the role of the coordinating oral healthcare professional and the supportive professional oral healthcare team (**Figure 2**).

Figure 1. Oral healthcare model



*the external oral healthcare professional can be replaced in time by an internal oral healthcare professional (dental hygienist or dentist)
**assistance in providing preventive and curative oral healthcare

Figure 2. Oral healthcare model of Gerodent



The preventive level includes (1) the formation of an oral healthcare team in the nursing home with one nursing home project supervisor, at least two oral health-care organisers (nurse or nurse aides) per ward, a physician, and optionally an occupational or speech therapist; (2) the education of the members of the oral healthcare team on oral health and oral hygiene including hands on training. Members of this oral healthcare team have to educate the nurses and nurses' aides on each ward using the train-the-trainer principle; (3) the implementation of the above-mentioned guideline OGOLI and concomitant protocols and (4) the integration of oral healthcare into daily nursing care based on the individual risk profile of the resident.

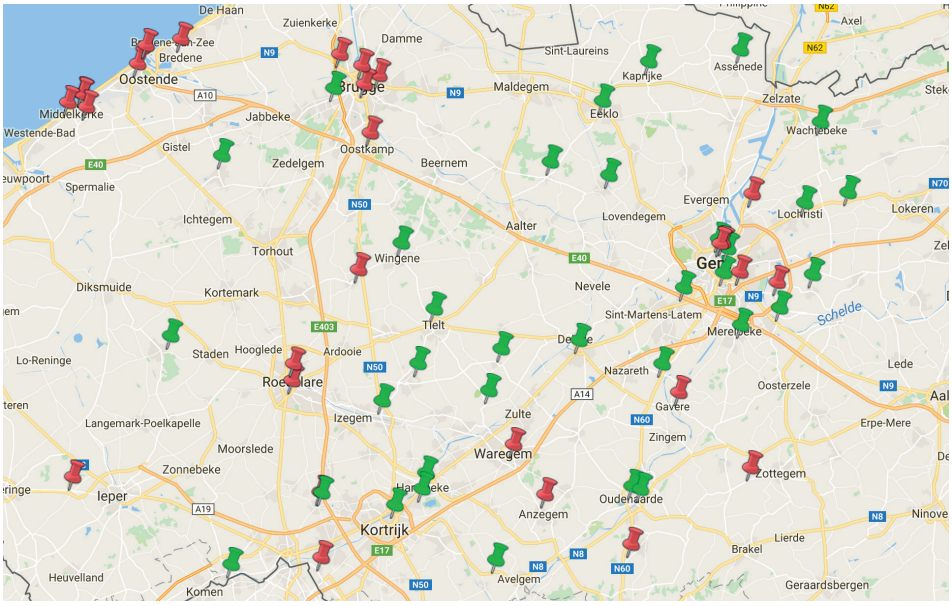
Subsequently, some months after implementing these preventive steps, Gerodent also offers curative care. It operates with two mobile dental clinics, each equipped with two complete dental units, which can be easily set up in the nursing home. The aim of the curative part is to offer oral healthcare to residents with limited access to regular dental care due to frailty, physical or cognitive impairment and where treatment is requested by the resident, his/her family or the caring staff. The dentists in Gerodent are able to carry out all dental treatments as provided in a regular practice. During dental treatment, the caring staff is involved and individual preventive measures are delivered to the residents if needed. Other activities of Gerodent are the continuous education of nursing home care staff and dental professionals in gerodontology and to enable research in this field.

Picture 1. Dental unit (NSK©), suction (Catani©) and digital X-ray (Rextar©)

Picture 2. Mobile dental clinic set up in a nursing home room before attending the residents

Picture 3 and 4. Carts with materials and products, led-light and person lifter (iron nurse)

Picture 5. Geographic spread of the nursing homes (Green= Gerodent 1, Red = Gerodent 2)



Picture 6. The team of dental professionals of Gerodent

Currently, the mobile dental team operates in an oral healthcare network of 56 nursing homes out of the 404 nursing homes in East and West Flanders (i.e. 14%) and out of the 807 nursing homes in Flanders (i.e. 7%). The Gerodent dental team comprises 8 dentists, 4 dental assistants and one coordinator.

A major strength of Gerodent is that dental treatment is time saving for the residents, the nursing home and the accompanying care staff or family members. Specifically for the nursing home residents, it is an accessible (physically and economically) and feasible option for dental treatment with considerable stress reduction as dentists with experience in gerodontology treat them in their living environment. In particular, this is very important for older people suffering from dementia. The nursing home has no maintenance costs for dental equipment, they can offer innovative oral healthcare to their residents and improve their multidisciplinary approach. For the care staff, the communication with the dental team improves and they receive continuous on-site training and education. Finally, the University Hospital of Ghent and Ghent University can play an exemplary role in innovative elderly care, expanding their network for clinical care, education and translational research, bridging science with daily practice.

Mobile and portable on-site treatment settings to provide oral healthcare to elderly with limited access to regular care have been suggested as a save, cost-effective alternative for regular dental clinics (22–25). Nevertheless, there is little information on the implementation of these on-site services. One short regional Austrian report concluded that mobile dentists were active in 51.5% of the nursing homes, but these mobile services were not embedded in a structured programme (26). In contrast, in other countries such as Sweden, a structured programme is already in place at a national level (27).

Although a comprehensive system is often still lacking, general guidelines for mobile and on-site dental care have already been formulated by Helgeson *et al.* (23):
"These delivery systems are not simply traditional dental practices located in nursing homes. They are interdisciplinary team efforts designed to address the oral health needs of nursing home residents systematically. The provision of dental care involves not only dental staff, but also nursing staff, primary care physicians, resident representatives, and third-party payers, each of whom has an important role to play. In addition, on-site delivery systems must assist in establishing preventive programmes, provide education for nursing staff, and participate actively in the medical-dental management of medically compromised patients."

These guidelines have already been applied in some mobile dental clinics (28,29) and have been shown to achieve oral health stability, requiring only diagnostic or preventive services at periodic examination, in up to 44% of the residents (30). The success of the approach has also been illustrated in a study by Sjögren *et al*., which demonstrated that professional domiciliary care, limited to professional cleaning, reduced dental plaque and gingivitis in nursing home residents (31). Nevertheless, there remains an overall paucity of information on how the implementation of an oral healthcare strategy, including a mobile dental team for preventive and curative treatment, impacts on the oral health of nursing home residents and on the knowledge and attitudes of the care staff. Moreover, information on the determinants for oral health such as age, gender, medication use, income level and care dependency in this population group is limited.

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General hypothesis and objectives

General hypothesis:

Nursing home residents with limited access to oral healthcare have inadequate oral health, which is influenced by a multitude of factors of which comorbidity is a very important one together with the nursing care staff's knowledge and attitude towards oral care.

An integral preventive and curative oral healthcare programme with on-site oral healthcare delivery (Gerodent) can provide oral health stability and improve both the residents' oral health status and the nurses' and nurses' aides' knowledge and attitude.

Research Questions:

1. What is the oral health status and what are the treatment needs of nursing home residents in Flanders?
2. What are the most commonly prescribed medications in nursing home residents?
3. Do the number and type of medications influence the oral health status and treatment needs?
4. Does an integral preventive and curative oral healthcare programme with on-site oral healthcare delivery (Gerodent) have an impact on the treatment needs of nursing home residents and provide oral health stability?
5. Will the preventive part of the oral healthcare programme in nursing homes have an impact on the knowledge and the attitude of the nurses and nurses' aides?
6. Will there be an additional effect of the on-site preventive and curative oral healthcare delivery to nursing home residents on the knowledge and attitude of the nurses and nurses' aides?

Objectives:

Chapter I:

To assess the oral health status and treatment needs of nursing home residents in Flanders.

Barbara Janssens, Jacques Vanobbergen, Mirko Petrovic, Wolfgang Jacquet, Jos M.G.A. Schols, Luc De Visschere. The oral health condition and treatment needs assessment of nursing home residents in Flanders (Belgium).Community Dental Health. 2017; 34: 143-151.

Chapter II:

To assess the medication intake of nursing home residents in Flanders and its possible impact on oral health.

Barbara Janssens, Mirko Petrovic, Wolfgang Jacquet, Jos M.G.A. Schols, Jacques Vanobbergen, Luc De Visschere. Medication use and its potential impact on the oral health status of nursing home residents in Flanders (Belgium). Journal of the American Medical Directors Association. 2017; 18: 809.e1-809.e8.

Chapter III:

To assess the impact of an oral healthcare programme on the oral health status and treatment needs of nursing home residents in Flanders.

Barbara Janssens, Jacques Vanobbergen, Jos M.G.A. Schols, Mirko Petrovic, Wolfgang Jacquet, Luc De Visschere. The impact of a preventive and curative oral healthcare programme on the prevalence and incidence of oral health problems in nursing home residents. PLoS One. Submitted.

Chapter IV:

To assess the impact of an oral healthcare programme on the knowledge and attitude of nurses and nurses' aides in nursing homes.

Part I:

To assess the impact of the preventive part of the oral healthcare programme.

Barbara Janssens, Luc De Visschere, Gert-Jan van der Putten, Kersti de Lugt–Lustig, Jos M.G.A. Schols , Jacques Vanobbergen. Effect of an oral health care protocol in nursing homes on care staffs' knowledge and attitude towards oral healthcare: a cluster-randomised controlled trial. Gerodontology. 2016; 33: 275-286

Part II:

To assess the impact of the additional on-site preventive and curative oral healthcare delivery of the oral healthcare programme.

Barbara Janssens, Jacques Vanobbergen, Martijn Lambert, Jos M.G.A. Schols, Luc De Visschere. Effect of an oral healthcare programme on care staff knowledge and attitude regarding oral health: a non-randomised intervention trial. Clinical Oral Investigations. 2017. doi:10.1007/s00784-017-2110-6

Chapter 1

The oral health condition and treatment needs assessment of nursing home residents in Flanders (Belgium).

This chapter is an edited version of the manuscript:
Janssens B, Vanobbergen J, Petrovic M, Jacquet W, Schols JMGA, De Visschere L.
The oral health condition and treatment needs assessment of nursing home residents in Flanders (Belgium). Community Dental Health. 2017; 34: 143-151.

Abstract

Objective: A study was conducted of nursing home residents with limited access to regular oral healthcare services to evaluate their oral health status, to perform an assessment of the need for oral treatment and to determine the possible predicting[1] value of age, gender, care dependency and income level on their oral health status and treatment needs.

Materials and methods: Three experienced dentists collected clinical oral health data with a mobile dental unit in 23 nursing homes. Socio-demographic data were extracted from the residents' records in the nursing home. Besides the descriptive and bivariate analysis, a general linear mixed model analysis was also performed with the nursing home as random effect.

Results: The study sample consisted of 1,226 residents with a mean age of 83.9 years, of which 41.9% was edentulous. The mean D_3MFt in the dentate group was 24.5 and 77% needed extractions or fillings. In the group of residents wearing removable dentures, 36.9% needed repair, rebasing or renewal of the denture. The mixed model analysis demonstrated that with each year a resident gets older, the oral health outcomes get worse and that men have worse oral health and higher treatment needs than women. In addition, the level of income and care dependency had a less extensive role in predicting the oral health outcomes.

Conclusion: The nursing home residents presented a poor overall oral health status and high dental and prosthetic treatment needs. Gender and age were important predicting variables for the oral health outcomes.

Introduction

Globally, the population aged 60 and above is the fastest growing one and is expected to more than double by 2050 and more than triple by 2100. Likewise, the proportion of the population of 60 years and above will rise in Belgium from 24.1% in 2015 to 32,6% in 2050 and the proportion of the population of 80 years and above will double from 5.5% to 10.6% (1).

In general, aging goes hand in hand with a higher risk of comorbidities, frailty and care dependency. In Flanders (i.e. the northern part of Belgium), nursing homes are one of the residential forms of housing for care-dependent older people. Between 2010 and 2013, 1% of the Flemish population between 65 and 74 years old lived in a nursing home. This proportion increases with age up to 63% of the population aged 95 and above. As a result of the aging population, the number of nursing home beds in Flanders increased up to 79,749 dispersed over 807 nursing homes. Not only the number of beds, but also the proportion of nursing home residents with a high care dependency increases (2,3).

Among different aspects of care dependency, several studies have identified poor oral hygiene in nursing home residents across Europe as a result of their physical and cognitive deterioration and a lack of support from the caring staff in performing daily oral hygiene (4–10). Two studies in Belgian nursing homes reported mean dental plaque levels of 2.1 (Silness & Loë – range 0 to 3) and very poor denture hygiene (> 50% of surface covered with plaque) in 13.8 to 46.5% of the residents, depending on the study (11,12). The amount of plaque increased with higher care-dependency levels.

A Belgian national survey on the oral health of people with special needs (13) revealed that nursing home residents had fewer dental visits compared to home-dwelling care-dependent elders. In addition, within the nursing homes, residents with a higher level of care dependency had even fewer dental visits. Whereas 91 to 98% of the nursing home residents had regular contact with their physician, only 2 to 21% had regular contact with their dentist (at least 4 visits in 4 different years throughout the 7-year period of observation). Almost half of the residents (45.8%) did not have a dental visit during the previous five years. If a dental visit took place, it mostly concerned an urgent treatment. For 64% of the nursing home residents, transport to the dental clinic was an important barrier.

[1] The term predictive needs to be interpreted as an association and not as a causal relationship.

The high plaque levels among nursing home residents worldwide, in combination with their comorbidities, care dependency and limited professional oral care are the perfect breeding ground for deteriorating oral health and high treatment needs, which has been confirmed in several studies. In general, high levels of periodontal disease were reported, with 36 to 84% of the residents with a CPITN index (Community Periodontal Index of Treatment Needs) of 3 or more and D_3MFt levels ranging from 23 to 27 (6–8,12,14). The dental and prosthetic treatment needs, assessed by a dental professional, were also very high. Restorative treatment was necessary for 30 up to 47% of the residents, half of the residents (45-54%) needed extractions, and 52 to 81% needed prosthetic treatment (4,5,7,8,15). Although there are some data on the oral health status of nursing home residents in general, little is known about the specific group of residents with limited access to regular dental care or without a family dentist.

In October 2010, a mobile oral healthcare project called "Gerodent" was initiated in reaction to the poor oral health of care-dependent elderly and the lack of oral healthcare provision for nursing home residents in Flanders (Belgium). The goal of this project is to support care staff of nursing homes with the implementation of an oral healthcare guideline and concomitant protocols (16,17) targeting the integration of oral healthcare into daily nursing care. As part of the project, two mobile dental clinics offer preventive and curative care to nursing home residents unable to visit their regular dentist due to cognitive or physical impairment or frailty. At the time of the study period, the mobile dental team operated in an oral healthcare network of 23 nursing homes in Flanders, though this project is still expanding and to date more than 60 nursing homes have already become part of this network.

The present research studied nursing home residents with limited access to regular oral care services with the aim to evaluate their basic oral health status, to perform an oral treatment need assessment and to determine the possible predicting value of age, gender, care dependency and income level on their oral health status and treatment needs assessment.

Materials and methods

Study design, study population and study sample

The present study used a descriptive cross-sectional design and was approved by the Ethical Committee of Ghent University (B670201318461). The study population consisted of nursing home residents of East and West Flanders (two Belgian provinces) with limited access to regular oral healthcare due to physical or cognitive impairment. Residents were considered having limited access to regular oral healthcare based on an assessment of the nursing staff. The study sample was obtained from residents of the 23 nursing homes belonging to the Gerodent oral healthcare network during the study period. The nursing homes themselves requested to be included in the network; this inclusion rate was limited by the maximum working capacity of the dental team to be able to ensure preventive and curative treatment at a regular basis. The nursing home residents attended the consultation on a voluntary basis or as demanded by the family or caring staff in case of cognitive impairment.

Data collection

Data were extracted from the oral health records of nursing home residents visiting the mobile dental clinic for a first consultation between October 2010 (the start of Gerodent) and April 2012. These records include an oral, medical, physical and cognitive assessment. The latter three were performed by the caring staff and physician of the nursing home; the oral assessment was performed by one of the three dentists of the Gerodent team (first, second and last author). All three dentists are experienced in geriatric dentistry and worked as a team. For the registration of the oral health status, the dentists disposed of a fully equipped mobile dental unit with a portable dental operating light (Aseptico). A mobile x-ray device (Rextar EXO1414) was available to ensure a correct diagnosis and to draft the most suitable treatment plan.

The oral health status comprised the number of natural teeth, dental caries, residual roots, filled teeth, implants and ceramic crowns as well as information about the presence of denture-related pressure ulcers and removable dentures. Dental caries was scored on cavitation level and tooth level, related to visually obvious dental decay in the dentine of the tooth and indicated as D_3. When a tooth showed caries and a filling, it was considered to be decayed. The presence of removable dentures was categorized into 'no denture', 'partial denture', 'overdenture' or 'full denture'.

The objective oral treatment need(s) assessment was based on clinically observed conditions not taking into account the self-perceived needs of the residents. For dentate people, the treatment need assessment comprised the need for fillings at tooth level and extractions. A need for a filling was recorded when a tooth presented a carious cavitation which could be technically filled with a good prognosis. There was a need for extraction when one or more of the following conditions were met: the cavity was too extended to be filled with a good prognosis; the pulp was exposed or the tooth presented a peri-apical lesion, fistula or swelling and an endodontic treatment was impossible due to the physical or cognitive condition of the resident; the tooth hampered functionality; the tooth was the cause of traumatic injuries; the tooth presented high mobility (third degree according to the Miller classification) and signs of infection (bleeding, plaque, calculus); or it was impossible to brush the carious teeth due to resistant behaviour of the resident. The total treatment need for natural teeth was defined as the sum of needed fillings and extractions. Finally, the treatment index ((F+M)/(D+M+F)) and the restorative index (F/(D+F)) were also calculated.

The treatment need assessment for participants with removable dentures comprised the need for rebasing, repair or renewal of dentures. A rebasing was needed when the resident presented an unstable denture hampering normal functionality. Denture repair was needed if one or more of the following conditions were presented: the denture was cracked or broken; a new clamp was needed for retention; or one or more teeth needed to be added to the denture. Renewal was needed if repair or rebasing was impossible because too many teeth were missing on the denture or there was not enough stability to make a good impression with the available denture. Wear of the occlusal surfaces of the denture was not a reason to consider renewal if the resident had no complaints.

Apart from the oral health status and treatment need(s) assessment, demographic data such as age, gender and nursing home of residence were collected. The physical and cognitive status of the residents was assessed by a care-dependency scale based on the KATZ index of Independence in Activities of Daily Living (Table 1). In Belgium, this dependency scale is obligatory for each resident at the time of admission to a nursing home to assess the resident's ability to perform activities of daily living (bathing, dressing, toileting, transferring, continence, and feeding) and any cognitive impairment. During the stay, the resident's index is adapted according to changes in the physical and cognitive status. For the analysis, three levels of care dependency were defined: low (KATZ O and A), medium (KATZ B) and high (KATZ C and Cd). To explore the impact of social environment on the oral health

condition and treatment needs, all oral outcome variables have been analysed with a summary measure based on income level: the preferential tariff. This is a governmental measure for persons whose income is below a certain limit. They are entitled to an increased reimbursement for healthcare interventions, an initiative undertaken to improve access to the healthcare system. The age, gender, KATZ index and preferential tariff served as explanatory variables.

Table 1. Description of the KATZ care dependency scale [1]

Category	Clinical criteria
O	Nearly physically and cognitively independent individuals.
A	Physically dependent individuals: dependent for clothing and/or bathing. Cognitively dependent individuals: disorientated in space and time, and physically independent.
B	Physically dependent individuals: dependent for clothing and bathing, and dependent for transferring and/or toileting. Cognitively dependent individuals: disorientated in space and time, and physically dependent for clothing and/or washing.
C	Physically dependent individuals: dependent for clothing and bathing, and dependent for transferring and toileting, and dependent for eating and/or due to incontinence. Cognitively dependent individuals: disorientated in space and time, and physically dependent for clothing and bathing, and dependent for transferring and/or toileting.
Cd[2]	Cognitively dependent individuals: disorientated in space and time or with officially diagnosed dementia by a neurologist, psychiatrist or geriatrist, and physically dependent for clothing and washing, and for transferring and/or toileting and/or eating, and due to incontinence.

[1] Source: National Institute for Health and Disability Insurance (NIHDI)
[2] d = demented

Statistical analysis

Descriptive analyses were performed of all variables included in the oral health status (the number of natural teeth, dental caries, residual roots, filled teeth, implants, ceramic crowns and the presence of denture-related pressure ulcers and removable dentures), variables expressing the treatment need(s) assessment (need for fillings and extractions, the treatment index, the restorative index and the need for rebasing, repair or renewal of dentures) and explanatory variables. To explore the impact of the explanatory variables on the dependent variables defined as oral health status and the treatment need(s) of the dentate elderly, the nonparametric Mann-Withney U and Kruskal Wallis tests were performed as the data did not meet the assumption of normality. If applicable, the outcome variables were corrected for the number of natural teeth. In this case, it has to be considered as part in its relation to the total number of remaining natural teeth. Finally, a general linear logistic mixed model analysis was performed with the nursing home as random effect. Age, gender, care dependency and preferential tariff were introduced as explanatory variables. The outcome variables were cor-

rected for the number of natural teeth and dichotomized by median value. Tests resulting in P-values <0.05 were considered significant. All analyses were carried out using SPSS for windows version 22 (SPSS Inc., Chicago, IL, USA).

Results

During the study period, the mobile dental team was active in 23 nursing homes with a capacity between 64 and 200 beds (mean = 122.22; SD = 35.23). The mean number of residents per nursing home visiting the mobile dental team during the study period was 53.3 (SD 21.36; range 28-116).

The total study sample consisted of 1,226 residents with a mean age of 83.9 years (SD 8.5) of whom 858 (70.0%) were female. The level of care dependency was low for 218 (17.9%), medium for 328 (26.9%) and high for 675 (55.3%) individuals. With regard to the social environment, 835 participants (68.1%) were entitled to an increased allowance for health costs (preferential tariff). In total, 514 participants (41.9%) were edentulous, with a higher proportion of edentulousness in the female group (44%) compared to the male group (37%, $p = 0.023$) and in the group with preferential tariff (47.1%) compared to the group without preferential tariff (30.9%, $p < 0.001$). Four hundred fifteen residents (33.8%) were wearing a full upper and lower denture and 279 residents (22.8%) had a combination of natural teeth and removable dentures. Only 12 residents with implants were observed; in 10 of these cases the implants were supplied with abutments for an overdenture in the upper or lower jaw and in two cases for fixed crowns or bridges (Table 2). The mean number of natural teeth in dentate residents (n = 712) was 12.3 (SD 8.1; range 1-32), of which 1.9 (SD 3.4; range 0-27) were residual roots. Two hundred eighty-five participants (40.4%) had carious lesions (excluding residual roots) with a mean number of 1.1 per person (SD 1.9, range 0-11). Considering all residual roots as decayed, this results in 69.6% of the residents with decay or a mean number of 3.0 (SD 4.0; range 0-27) decayed teeth in the dentate group. Filled teeth (excluding crowned teeth) were found in 225 individuals (31.9%), with a mean number of 1.0 (SD 1.9; range 0-13). Fixed crowns and bridges were found in 135 individuals (19.0%), with a mean number of 4.9 (SD 4.0) replaced teeth, including pillar teeth. This resulted in a mean D_3MFt of 24.50 (SD 7.0; range 0-32).

Table 2. Socio-demographic data and (oral) health profile of the participants (total n = 1226)

Variable	n	Mean (median) or Number	SD or %
Age (years)			
Total sample	1226	83.9 (85.3)	8.5
< 65		41	3.3%
65 - 79		222	18.1%
80 - 89		601	49.0%
> 89		362	29.5%
Gender	1226		
Male		368	30%
Female		858	70%
Increased allowance for health costs (preferential tariff)	1226	835	68.1%
Care dependency	1221		
Low (KATZ O and A)		218	17.9%
Medium (KATZ B)		328	26.9%
High (KATZ C and Cd)		675	55.3%
Natural teeth	1226	712	58.1%
Number of natural teeth			
Total Sample	1226	7.1 (3.0)	8.6
0 teeth		514	41.9%
1 - 9 teeth		310	25.3%
10 - 20 teeth		270	22.0%
> 20 teeth		132	10.8%
Number of residual roots	1223	1.1 (0.0)	2.7
Decayed teeth	1217	1.8 (0.0)	3.4
Missing teeth	1226	24.9 (29.0)	8.6
Filled teeth	1220	1.0 (0.0)	2.3
DMFt	1216	27.7 (32.0)	6.5
Implants	1226	12	1.0%
Full denture upper and lower jaw	1226	415	33.8%
Overdenture in the upper or lower jaw	1226	27	2.2%
Full denture in upper jaw in combination with natural teeth (and partial denture) in lower jaw	1226	173	14.1%
Full denture in lower jaw in combination with natural teeth (and partial denture) in upper jaw	1226	38	3.1%
Natural teeth in combination with partial denture	1226	279	22.8%

The bivariate analysis in the dentate group (**Table 3**) showed that male residents had more natural teeth (p = 0.003), a higher proportion of decayed teeth (p = 0.001) and a higher proportion of residual roots (p = 0.001) than female residents. However, female residents had a significantly higher proportion of fillings (p = 0.007). Residents younger than the mean age had more natural teeth (p < 0.001), a lower proportion of decay (p = 0.002) and lower D_3MFt values (p < 0.001) than residents above the mean age. Residents with the highest care dependency had a higher proportion of residual roots (p = 0.024) than less dependent residents. Participants with a preferential tariff had a significantly lower proportion of fillings (p < 0.001) than those without a preferential tariff.

In the dentate group, 222 residents (31.4%) needed dental fillings, with a mean number of 0.76 (SD 1.5; range 0-8) per person, and 480 residents (67.7%) needed extractions, with a mean number of 3.0 per person (SD 4.3), range 0-32). In total, 548 participants (77%) needed dental treatment for their natural teeth. The total treatment need at tooth level was 3.74 (SD4.5; range 0-32). The mean restorative index and treatment index were 32.90% (SD 38.9) and 84.34% (SD 16.61) respectively.

The bivariate analysis (**Table 4**) could not deliver a predicting value of the explanatory variables for the proportion of needed fillings. Men showed a higher assessed need for extractions (p = 0.001), a higher total treatment need (p < 0.001), and a lower treatment (p < 0.001) and restorative index (p < 0.001) than woman. Residents younger than the mean age needed less extractions (p = 0.019), had a lower proportion of total treatment need (p < 0.001) and a higher restorative index (p = 0.024) than residents above the mean age. Participants with a preferential tariff had a lower restorative index (p = 0.002) than those without a preferential tariff. Participants with the highest care dependency had the lowest treatment index (p = 0.035).The general linear logistic mixed model analysis, as seen in **Table 5**, revealed that the most predicting explanatory variables for the oral health status and treatment need(s) assessment of the dentate group were the residents' age and gender. With each year a resident gets older, the outcomes get worse and men have worse oral health and higher needs than women. For the outcome variable "filled teeth" and "restorative index", the preferential tariff also had a significant predicting value as residents with a preferential tariff have a lower proportion of fillings (p = 0.003) and a lower restorative index (p = 0.005). Care dependency had a significant impact on the proportion of extractions needed and the treatment index: the group with the highest care dependency needing more extractions than the group with medium care dependency (p = 0.013) and

having a lower treatment index than the group with the lowest care dependency ($p = 0.011$). The power on the level of the effects for odds ratios 2 and higher or 0.5 and lower ranged from 88.3% to 100%.

Among the edentulous (n = 514), 390 participants (75.9%) had full upper and lower dentures, 71 (13.8%) were wearing only an upper denture, 2 (0.4%) only a lower denture and 44 (8.6%) were not wearing any denture at all. Of all individuals wearing removable dentures (n = 745), 47 (6.3%) were suffering from pressure ulcers and in 275 (36.9%) cases repair, rebasing or renewal of the denture was strongly recommended. Residents older than the mean age ($p = 0.007$) and those with a preferential tariff ($p < 0.002$) had more full dentures. Significant differences in treatment need were found for the explanatory variables gender and age: men ($p = 0.013$) and residents younger than the mean age ($p < 0.001$) needed more denture renewals.

A general linear logistic mixed model analysis of the total study sample showed that medium care dependency ($p = 0.012$), increasing age ($p < 0.001$) and the possession of a preferential tariff ($p = 0.026$) resulted in a higher risk of wearing a full denture.

Table 3. The distribution of oral health indicators by sociodemographic groups and care dependency in the dentate group (n = 712)

Variables	Number of natural teeth			Decayed [3]			Filled [3]			D_3MFt			Residual roots [3]		
	n	%	Mean(SD)	n	%	Mean (SD)	n	%	Mean (SD)	n	%	Mean (SD)	n	%	Mean (SD)
Gender	**712**			**703**			**706**			**702**			**709**		
Male	232	32.6	13.64 (8.40)	228	32.4	34.24 (33.65)	228	32.3	9.63 (18.46)	228	32.5	23.67 (7.79)	232	32.7	24.30 (32.30)
Female	480	67.4	11.63 (7.81)	475	67.6	26.91 (32.18)	478	67.7	13.95 (22.01)	474	67.5	24.89 (6.53)	477	67.3	16.67 (27.41)
p – value [1]			**0.003**			**0.001**			**0.007**			0.173			**0.001**
Age	**712**			**703**			**706**			**702**			**709**		
< Mean age	355	49.9	14.12 (8.34)	351	49.9	24.76 (30.19)	353	50.0	12.54 (19.89)	351	50.0	22.95 (7.42)	353	49.8	15.91 (25.93)
> Mean age	357	50.1	10.47 (7.32)	352	50.1	33.79 (34.70)	353	50.0	12.58 (22.12)	351	50.0	26.04 (6.14)	356	50.2	22.39 (32.00)
p – value [1]			**< 0.001**			**0.002**			0.231			**< 0.001**			0.067
Care dependency	**710**			**701**			**704**			**700**			**707**		
Low	123	17.3	11.49 (7.96)	121	17.3	26.22 (29.94)	122	17.3	13.01 (20.92)	121	17.3	24.76 (6.74)	122	17.3	15.72 (25.89)
Medium	181	25.5	11.35 (7.82)	180	25.7	26.21 (30.71)	180	25.6	12.88 (21.26)	180	25.7	25.06 (6.25)	181	25.6	15.23 (25.93)
High	406	57.2	12.91 (8.14)	400	57.1	31.68 (34.46)	402	57.1	12.29 (21.02)	399	57.0	24.20 (7.35)	404	57.1	22.02 (31.41)
p – value [2]			0.051			0.222			0.909			0.880			**0.037**
Preferential tariff	**712**			**703**			**706**			**702**			**709**		
No	270	37.9	12.79 (8.06)	266	37.8	29.04 (32.80)	267	37.8	16.90 (25.00)	266	37.9	24.58 (7.19)	269	37.9	18.58 (28.65)
Yes	442	62.1	11.98 (8.04)	437	62.2	29.43 (32.86)	439	62.2	9.92 (17.70)	436	62.1	24.45 (6.86)	440	62.1	19.52 (29.71)
p – value [1]			0.159			0.839			**< 0.001**			0.472			0.897

[1] Man-Whitney U test ; [2] Kruskal Wallis test; [3] The outcome of this variable needs to be interpreted as part in its relation to the total number of remaining natural teeth.

Table 4. The distribution of treatment need assessment by sociodemographic groups and care dependency in the dentate group (n = 712)

Variables	Fillings needed [3]			Extractions needed [3]			Total treatment need natural teeth [3]			Treatment Index			Restorative index		
	n	%	Mean(SD)	n	%	Mean (SD)	n	%	Mean (SD)	n	%	Mean (SD)	n	%	Mean (SD)
Gender	**707**			**709**			**707**			**702**			**574**		
Male	229	32.4	6.65 (13.80)	231	32.6	38.85 (39.09)	229	32.4	45.79 (38.02)	227	32.3	83.39 (18.29)	198	34.5	24.02 (35.13)
Female	478	67.6	6.82 (14.70)	478	67.4	29.74 (37.84)	478	67.6	36.57 (37.95)	475	67.7	89.05 (14.75)	376	65.5	37.58 (39.96)
p – value [1]			0.661			**0.001**			**< 0.001**			**< 0.001**			**< 0.001**
Age	**707**			**709**			**707**			**702**			**574**		
< Mean age	353	49.9	5.17 (10.76)	353	49.8	28.56 (36.17)	353	49.9	33.74 (36.23)	351	50.0	86.59 (17.32)	289	50.4	36.61 (40.24)
> Mean age	354	50.1	8.36 (17.17)	356	50.2	36.82 (40.24)	354	50.1	45.35 (39.25)	351	50.0	87.83 (14.96)	285	49.7	29.12 (37.11)
p – value [1]			0.113			**0.019**			**< 0.001**			0.558			**0.024**
Care dependency	**705**			**707**			**705**			**700**			**572**		
Low	122	15.9	6.83 (14.19)	123	17.4	30.12 (38.03)	122	15.9	37.12 (37.66)	121	17.2	89.67 (15.30)	100	17.5	35.99 (40.98)
Medium	180	25.5	8.07 (16.79)	181	25.6	27.25 (35.20)	180	25.5	35.45 (35.65)	180	25.6	88.45 (15.19)	140	24.5	33.99 (38.80)
High	403	57.2	6.20 (13.31)	403	57.0	36.06 (39.79)	403	57.2	42.26 (39.35)	399	56.8	85.91 (16.81)	332	58.0	31.35 (38.27)
p – value [2]			0.694			0.071			0.197			**0.035**			0.692
Preferential tariff	**707**			**709**			**707**			**702**			**574**		
No	267	37.8	6.89 (12.97)	269	37.9	29.33 (36.88)	267	37.8	36.39 (37.30)	266	37.9	87.30 (15.43)	224	39.0	38.43 (39.60)
Yes	440	62.2	6.69 (15.23)	440	62.1	34.78 (39.30)	440	62.2	41.47 (38.64)	436	62.1	87.16 (16.64)	350	61.0	29.35 (38.03)
p – value [1]			0.292			0.055			0.067			0.872			**0.002**

[1] Man-Whitney U test; [2] Kruskal Wallis test; [3]The outcome of this variable needs to be interpreted as part in its relation to the total number of remaining natural teeth.

Table 5. General linear mixed-model analysis[1] for different dependent variables in the dentate group (n = 712)

Variables (reference)		Est β	SE β	95% CI β		OR	95% CI OR		p-value
				Lower	Upper		Lower	Upper	
Decayed teeth									
Gender (Female)	Male	0.485	0.17	0.15	0.82	1,62	1,16	2,27	0.004
Age		0.031	0.01	0.01	0.05	1,03	1,01	1,05	0.001
Filled teeth									
Gender (Female)	Male	- 0.57	0.18	- 0.91	- 0.22	0,57	0,40	0,80	0.002
Age		-0.02	0.01	-0.04	-0.00	0,98	0,96	1,00	0.034
Preferential tariff (yes)	No	0.50	0.17	0.17	0.83	1,65	1,19	2,29	0.003
Residual roots									
Gender (Female)	Male	0.55	0.17	0.22	0.88	1,73	1,25	2,41	0.001
Age		0.03	0.01	0.01	0.05	1,03	1,01	1,05	0.001
Extractions needed									
Gender (Female)	Male	0.61	0.17	0.27	0.94	1,84	1,31	2,56	< 0.001
Age		0.03	0.01	0.01	0.05	1,03	1,01	1,05	< 0.001
Care dependency (High)	Medium	-0.46	0.19	- 0.83	- 0.10	0,63	0,44	0,90	0.013
	Low	-0.38	0.22	- 0.81	0.05	0,68	0,44	1,05	0.080
Total treatment need natural teeth									
Gender (Female)	Male	0.64	0.18	0.30	0.99	1,90	1,35	2,69	< 0.001
Age		0.06	0.01	0.04	0.08	1,06	1,04	1,08	< 0.001
Restorative Index									
Gender (Female)	Male	-0.80	0.19	-1.18	-0.43	0,45	0,31	0,65	< 0.001
Age		-0.02	0.01	-0.04	0.00	0,98	0,96	1,00	0.023
Preferential tariff (yes)	No	0.52	0.18	0.16	0.88	1,68	1,17	2,41	0.005
Treatment index									
Gender (Female)	Male	-0.64	0.17	-0.98	-0.31	0,53	0,38	0,73	< 0.001
Care dependency (High)	Medium	0.27	0.18	-0.09	0.63	1,31	0,91	1,88	0.138
	Low	0.55	0.22	0.12	0.97	1,73	1,13	2,64	0.011

[1] The nursing home was introduced as random effect and age, gender, care dependency and preferential tariff as explanatory variables. Only the explanatory variables presenting significant results were included in this table.

Discussion

This study aimed to evaluate the oral health status and treatment needs of nursing home residents with limited access to regular dental care due to frailty and care dependency. Compared to the general nursing home population in Flanders, the present study sample has a lower proportion of residents with low care dependency (17.9% compared to 29.0% in general), and higher proportions of residents with high care dependency (55.3% compared to 42.92% in general; 18). This indicates that the oral healthcare project (Gerodent) reached the predetermined goal of providing oral care to the most vulnerable residents.

In the investigation of the oral health status of the total group, a very high mean D_3MFt level of 27.7 (reference 32 teeth) was observed, dominated by a high number of missing teeth (M = 24.9). These results are comparable to other studies with a D_3MFt ranging from 23 to 27 (6,7,14). Few residents with implants were observed and the prosthetic treatments were mainly focused on removable dentures. There were few filled teeth as compared to missing ones, which reflects the dental treatment options in the past. In the present study, 42% was observed to be edentulous compared to 36% in another Belgian study also representing data from 2010 (12).

In the dentate group, a very high proportion (69.6%) of the residents had carious teeth, many of which were residual roots. As a result, there was a high need for restorative treatment and extraction therapy. These results are comparable to other studies showing carious proportions around 70% (9,14,18). The treatment needs in the present sample show a higher need for extraction therapy (67.7% compared to 45-54% in the international literature; 4,5,15) and a lower restorative treatment need (31.4% compared to 30-47%; 4,5,7,8,15). The present sample showed a lower mean restorative index than a random sample of frail dependent elderly in Belgium during the same period (32.90% compared to 45.1%; 12). Summarizing, the proportion of caries is comparable to other national and international studies but within our sample the caries lesions are more severe resulting in a higher need for extractions compared to restorative treatment.

The need for repair, rebasing or renewal of a denture was strongly indicated in 36.9% of the residents, which is lower than reported in the international literature (4,5,7,15). Comparability is hampered due to the variety of factors considered to define the need for prosthetic treatment.

Residents with a preferential tariff have a higher risk of being edentulous and wearing a denture. The dentate residents with preferential tariff have a lower proportion of filled teeth and a lower restorative index. This was confirmed after the general linear mixed model analysis. The residents with a preferential tariff probably received more extraction therapy, and thus full dentures, whereas those without a preferential tariff received more restorative treatments.

The bivariate analysis showed that residents older than the mean age had significantly fewer teeth and consequently a higher D_3MFt. They also had higher proportion of decay, a higher treatment need and a lower restorative index. The general linear mixed model analysis leads to the conclusion that for each year a resident gets older, the risk of having a worse outcome for all oral health variables increases. Previous research (13) revealed that half of the residents (48.5%) of a random sample in Belgian nursing homes had not received a dental visit during the preceding five years and that the time since the last visit increases with age. Hence, the presence of dental disease possibly increases as the time since the last dental visit increases.

Gender seemed to play an important role in all outcome variables introduced in the mixed model. Male residents had a higher risk of a high proportion of decay and residual roots, a higher treatment need, a low proportion of filled teeth and thus a higher risk of having a lower restorative index and treatment index. Previous studies did not show differences in the amount of dental or denture plaque between male and female residents (11,12). More research is needed to understand and confirm the observed differences.

Limitations

It could be considered a limitation that this study does not include periodontal data. However, the high care dependency level including a high proportion of subjects with dementia and a vast amount of calculus and/or plaque hampered obtaining a reliable CPITN index (Community Periodontal Index of Treatment Needs). However, the dental team did not need a detailed periodontal status to establish the periodontal treatment need because of the limited treatment options (supra gingival scaling or extraction) and the severe stage of periodontal

disease. Future research should nevertheless consider measuring tooth mobility. Due to the lack of periodontal data, it was also impossible to distinguish between extractions needed because of caries and/or periodontitis. Furthermore, the three dentists performing the oral examinations were trained well but not calibrated. They did, however, discuss possible treatment options in case of doubts about the treatment plan.

The study's main strength is the large study sample. Consequently, the authors were able to exceed a descriptive analysis and could perform a bivariate and general linear mixed model analysis to find possible explanations for the observed results. Future quantitative and qualitative research on the explanatory variables for poor oral health will help to establish preventive oral healthcare programmes for frail older people. In a future study, the authors of this publication will focus on the influence of medication intake and morbidity on the oral health status of nursing home residents.

Previous research (11,13,12,19) together with the present study resulted in the development of a global plan for lasting oral care for persons with special needs, including frail elders, ordered by the National Institute for Health and Disability Insurance (NIHDI; 20). This global plan was tested in a pilot study (21). The global plan suggested clear and specific action points to organise oral care for all persons with special needs.

Conclusion

The nursing home residents with limited access to oral healthcare presented a poor overall oral health status and high dental and prosthetic treatment needs. Gender and age were the most important predicting variables for most oral health outcomes. In addition, the level of care dependency and income play a less extensive role in predicting the oral health outcomes of frail nursing home residents.

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Chapter 11

Medication use and its potential impact on the oral health status of nursing home residents in Flanders (Belgium).

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Abstract

Background: Polypharmacy is considered the most important etiological factor of hyposalivation which in its turn can initiate oral health problems.
Objectives: To describe the medication use of nursing home residents, to identify the medications related to hyposalivation and to find possible associations between the different classes of medication, the number of medications and the oral health status of the residents.
Design: A cross-sectional study.
Participants: The study population consisted of the residents of a non-random sample of 23 nursing homes from two Belgian provinces, belonging to the oral healthcare network Gerodent. All residents of the sample visited the Gerodent mobile dental clinic between October 2010 and April 2012.
Measurements: For each resident, oral health data, demographic data and an overview of the total medication intake were collected.
Results: The study sample consisted of 1,226 nursing home residents with a mean age of 83.9 years (SD 8.5). The mean number of medications per person was 9.0 (SD 3.6; range 0-23; median 9.0). Of all prescribed medication, 49.6% had a potential hyposalivatory effect with a mean number per person of 4.5 (SD 2.2; range 0 -15; median 4.0). In the bivariate analyses, associations were found between medication use and oral health of residents with natural teeth: the higher the number of medications (with risk of dry mouth) and the overall risk of medication-related dry mouth, the lower the number of natural teeth ($p = 0.022$; $p = 0.005$ and $p = 0.017$ respectively). In contrast, the total treatment need tended to decrease with rising medication intake, resulting in a clear increase of the treatment index with rising medication intake ($p = 0.003$; $p < 0.001$ and $p = 0.002$). The logistic regression model analysis confirmed that the proportion of carious teeth diminished and the treatment index increased in case of rising medication intake, especially when considering the number of medications with a risk of dry mouth and the overall risk of medication-related dry mouth. A possible explanation for this trend might be the finding that in the group with a high medication use, the teeth most sensitive to caries and plaque retention could already have been extracted at the moment of screening for the study, due to a life-long history of caries pathology.
Conclusions: This study shows a high level of medication use including the substantial intake of medication with a possible hyposalivatory effect. Moreover, clear associations were found between the medication intake and the oral status of the residents.

Introduction

Nursing home residents are characterized by multiple chronic diseases, disability, frailty and considerable care dependency. Correspondingly, the majority of them suffers from cognitive impairment and requires assistance with activities of daily living (ADL). In addition, the complex care for these residents is further challenged by the high prevalence of pain, depression, behavioral and psychological symptoms, urinary incontinence, malnutrition, falls and pressure ulcers (1). Consequently, the pharmacological treatment of nursing home residents often results in polypharmacy (2). Elseviers *et al*. (3) reported that the mean number of medications per resident in Belgium was 8.4 in the year 2010. Only 1% of the residents took no medication and one-third was prescribed 10 or more medications. The most recurrent chronic medication types were hypno-sedatives (61%), antidepressant agents (50%) and laxatives (50%). Similar results were found in other countries (4–7).

Polypharmacy is considered the most important etiological factor of hyposalivation. Other etiological factors are age-related degenerative changes in the salivary glands (8–13) and several systemic disorders such as diabetes, depression, Parkinson's disease, Alzheimer's disease, rheumatoid arthritis and nutritional deficiencies (14–17). Not only the type but also the number of medications has an impact, causing decreasing salivary flow rates as the number of medications increases (18,19).

Previous studies investigated medication use with a hyposalivatory side effect in community-dwelling older people (18–21). However, the only similar study in nursing home residents to date, which measured salivary flow, had a limited sample size (22) and other studies in nursing homes only reported on the prevalence of xerostomia (the feeling of a dry mouth) in relation to medication use (23,24). So far, few studies have discussed the prevalence of salivary gland hypofunction (SGH) in nursing home residents. A study of Glazar *et al*. (25) showed that 27% of the residents suffered from hyposalivation. A second study of van der Putten *et al*. (22) stated that 24% had a unstimulated Whole Salivary Flow (UWS) below 0.1 ml/min. A common and primary symptom of SGH or hyposalivation is xerostomia, the subjective feeling of dry mouth. The prevalence of xerostomia among nursing home residents varies between 36% and 52%, depending on the study (22,24,26,27). Unfortunately, all studies on salivary flow or xerostomia in nursing homes exclude cognitively impaired residents, because they could not

follow instructions to measure salivary flow or answer the xerostomia questions, and therefore these studies cannot be considered representative for the overall nursing home population.

A recent systematic review addressed the oral-health-related clinical implications of medication-induced salivary gland dysfunction in the general population (28). The authors stated that more research on this topic is needed, although several studies indicated a possible relationship between xerogenic medication and caries activity. Two recent studies of Tiisanoja *et al.* (21,29) have uncovered an association between salivary flow and dental caries in older persons taking medication with sedative properties: the higher the sedative load, the higher the caries activity and the lower the salivary flow. Bardow *et al*. (19) demonstrated that low unstimulated flow rates lead to higher levels of both Lactobacilli and tooth demineralization, which risks rapid caries progression. Dental restoration rate, reflection of caries incidence history, and intake of medication have also been indicated to be related: persons taking medication had higher restoration rates compared to those not taking medication (30,31). Moreover, persons taking anti-depressant xerogenic medication had higher restoration rates, compared to those taking non-xerogenic medication (31). In contrast with caries, no clear relationship between salivary flow and periodontal infection or oral mucosal changes has been found (29,32).

As previously stated by several authors (18,30), there is a clear need to further explore medication classes and their potential association with salivary gland hypofunction and impairment of oral health. Moreover, scarce attention has yet been devoted to oral consequences of a dry mouth in nursing home residents. The aim of this study is first to describe the medication use in a sample of nursing home residents in order to identify the medications related to hyposalivation and second, to find possible associations between the different classes and numbers of medications and the oral health status of the residents.

Materials and methods

Study design, study population and study sample

The present study is a cross-sectional study approved by the Ethical Committee of the Ghent University Hospital (B670201318461). The study population consisted of nursing home residents from East- and West Flanders, two Belgian provinces, from which a sample of 23 nursing homes was obtained, which all belong to the oral healthcare network Gerodent. More information on the oral healthcare network is described in a previous article by Janssens *et al*. (33; Chapter 1).

Data collection

One of the tasks of the Gerodent oral healthcare network is providing preventive and curative oral care for nursing home residents. The data for this study were extracted from the oral health records of the nursing home residents attending the mobile dental clinic for a first consultation between October 2010 and April 2012. The oral assessment was performed by one of the three dentists of the Gerodent team (first, fifth and last author), all of whom are experienced in geriatric dentistry and worked as a team. The oral health data included the number of natural teeth, dental caries, residual roots, filled teeth, the D_3MFt (sum of teeth with visually obvious dental decay in the dentine of the tooth D_3, missing teeth M and filled teeth F), the restorative index (F/ (D_3+F)), information about the presence of denture-related pressure ulcers and removable dentures as well as an oral treatment needs assessment comprising the need for fillings and extractions, the treatment index ((F+M)/(D_3 + M +F)) and the need for repair, rebasing or renewal of a removable denture. The oral health status was diagnosed in a fully equipped mobile dental unit with a portable dental operating light (Aseptico) and a mobile X-ray device (Rextar EXO1414). More information on how the data of the oral status were gathered can be found in the previously mentioned study (33; Chapter 1). Subsequently, age, gender, care dependency (KATZ scale; 34; Table 1 p 31) and increased reimbursement were extracted from the medical records of the participating residents, which were kept by the caring staff and physician of the nursing home. Increased reimbursement is a governmental measure for persons whose income is below a certain limit, and whom are thus entitled to a higher reimbursement for healthcare interventions. For the analysis, three levels of care dependency were defined as follows: low (KATZ O and A), medium (KATZ B) and high (KATZ C and Cd).

Only the residents with an overview of the total medication intake in their oral health records were considered for analysis. This overview was obtained by a print of the nursing homes' medication list. For each resident, the medication was classified by the Anatomical Therapeutic Chemical (ATC) classification system from the WHO Collaborating Centre for Drug Statistics Methodology (35). This classification system was designed as a tool for presenting drug utilization statistics and classifies drugs into groups at five different levels: 14 anatomical main groups (level 1), therapeutic/ pharmacological subgroups (level 2), chemical/ pharmacological/ therapeutic subgroups (level 3 and 4) and chemical substance (level 5). Complementary, homeopathic and herbal traditional medicinal products are generally not included in the ATC classification system and were not considered as medication in this study, even if they occurred on the medication list of the resident. For this analysis, the prescribed daily dose and the duration of use were not considered.

Other calculated parameters regarding medication use were the total number of medications, the total number of medications with a risk of dry mouth and the total risk of dry mouth. To define the risk of any hyposalivatory effect of each medication in the database, the search engine of www.drymouth.info was used. This database is a valuable resource which is updated on a yearly basis (36). Sources include the reference guide to drugs and dry mouth of Sreebny *et al*. (37), the U.S. Food and Drug Administration and medical and dental drug reference guides. The search engine also provides information on the risk of the medication to induce oral dryness as a score ranging from 1 to 3 (indicated by cactus symbols). For the purpose of this study, the total risk of dry mouth was defined by the sum of the individual risk scores (1 – 3) of each medication on the residents' medication list.

A study of Smidt *et al*. (18) measuring the salivary flow rates of 688 medicated older persons served as a basis to select specific medication (classes) for the assessment of the association between medication use and impaired oral health. The specific medication (classes) considered were antidiabetics (A10), sulphonamides (A10BB), antithrombotic agents (B01), cardiac therapy (C01), thiazides (C03AA), verapamil (C08DA), antihypertensives and antidiabetics and statins ([C03+/-C07+/-C08+/- C09+/-A12] + A10 + C10A), acetylsalicylic acid and lipid lowering (B01AC06 + C10), antirheumatics (M01AX), opioids (N02AX), psycholeptics (N05), psychoanaleptics (N06), selective serotonin reuptake inhibitors (N06AB), psycholeptics and psychoanaleptics (N05 + N06), respiratory drugs (R03), glucocorticoids (R03BA), and respiratory drugs and antihypertensives (R03 + [C03+/-C07+/- C08+/-C09+/-A12]).

Statistical analysis

Descriptive analyses of the residents' medication use were performed. To explore the impact of the explanatory variables such as age, gender, care dependency and increased reimbursement on the number of medications (with risk of dry mouth) and the overall risk of dry mouth, one-way ANOVA tests were performed. To explore the impact of the explanatory variables on the specific medication classes, as described in the previous paragraph, Chi-squared tests were implemented. Nonparametric Kruskal Wallis tests were conducted to examine the impact of medication use on the dependent variables defined as oral health status and the treatment needs of the dentate residents, as the data did not meet the assumption of normality according to the Shapiro-Wilk normality test. If applicable, the outcome variables were corrected for the number of remaining natural teeth. In this case, they have to be considered as a part in relation to the total number of remaining natural teeth. Finally, a logistic regression model analysis was performed with the nursing home as random effect. Age, gender, care dependency, increased reimbursement, number of medications, number of medications with risk of dry mouth and total risk of dry mouth were introduced as explanatory variables. The outcome variables were corrected for the number of remaining natural teeth and dichotomized by the median value. Tests resulting in *p*-values <0.05 were considered significant. All analyses were carried out using SPSS for windows version 22 (SPSS Inc., Chicago, IL, USA).

Results

The study sample consisted of 1,226 residents of 23 different nursing homes with a mean age of 83.9 years (SD 8.5), of whom 858 (70.0%) were female. The medication list was available for 1,174 residents. The mean number of medications per person was 9.0 (SD 3.6; range 0-23; median 9.0). Of all prescribed medication, 49.6% had a potential hyposalivatory effect with a mean number per person of 4.5 (SD 2.2; range 0-15; median 4.0). Only 1.4% of the study sample took no medication with a potential hyposalivatory effect; one person took no medication at all. There was a significant difference in mean number of medications per resident between the different nursing homes ranging from 7.71 to 10.94 ($p < 0.001$).

Medication use

Table 1 gives an overview of the residents' medication intake with "n" being the number of residents taking one or more medications from the corresponding group of the ATC classification system. Many residents took medication for common age-related disorders such as cardiovascular diseases (C; n = 954; 81.3%), diabetes mellitus type 2 (A10; n = 212; 18.1%), dementia (N06d; n = 191; 16.3%), Parkinson disease (N04; n = 156; 13.3%) and obstructive airway diseases (R03; n = 150; 12.8%).

Of the total study sample, 655 persons (55.79%) took antithrombotic agents (B01) and 92 persons (7.84%) were using medication that affects bone structure and mineralization (M05b), which impacted the dental extraction protocol due to the risk of bleeding and medication related osteonecrosis of the jaw (MRONJ) respectively. A high use of psycholeptics (N05; n = 804; 68.5%), psychoanaleptics (N06; n = 661; 56.3%) and analgesics (N02; n = 547; 46.6%) was registered as well as a considerable intake of medication for constipation (A06; n = 620; 52.8%) and stomach acid related disorders (A02; n = 533; 45.4%).

Bivariate analysis

By assessing the association between gender, age, care dependency, increased reimbursement and the presence of natural teeth and the variables related to the medication intake, this study revealed that gender and presence of natural teeth were not correlated with medication intake (Table 2). In contrast, an association was indeed found between age, care dependency and increased reimbursement: residents older than the mean age took less medication with a risk of dry

mouth ($p = 0.004$) and had a lower overall risk of dry mouth ($p < 0.001$); residents with an increased reimbursement took more medication than those without an increased reimbursement ($p = 0.008$); and a higher care dependency lead to a lower number of medications ($p = 0.009$), a lower number of medication with risk of dry mouth ($p < 0.001$) and a lower overall risk of dry mouth ($p = 0.004$).

Table 1. Number of persons taking one or more drugs from the different groups of the ATC classification system (total n = 1174)[1]

ATC CODE	n	%
ALIMENTARY TRACT AND METABOLISM	**1006**	**85.69**
A02 Drugs for acid related disorders	533	45.4
A03 Drugs for functional gastrointestinal disorders	173	14.74
A06 Drugs for constipation	620	52.81
A07 Antidiarrheals, intestinal anti-inflammatory/anti-infective agents	87	7.41
A10 Drugs used in diabetes	212	18.06
A10a Insulins and analogues	212	18.06
A11 Vitamins	186	15.84
A12 Mineral supplements	219	18.65
BLOOD AND BLOOD FORMING ORGANS	**704**	**59.97**
B01 Antithrombotic agents	655	55.79
B01AA Vitamin K antagonists	127	10.82
B01AB Heparin group	45	3.83
B01AC Platelet aggregation inhibitors excl. heparin	508	43.27
B02 Antihemorrhagics	4	0.34
B03 Antianemic preparations	108	9.2
CARDIOVASCULAR SYSTEM	**954**	**81.26**
C01 Cardiac therapy	310	26.41
C02 Antihypertensives	35	2.98
C03 Diuretics	510	43.44
C07 Beta blocking agents	438	37.31
C08 Calcium channel blockers	217	18.48
C09 Agents acting on the renin-angiotensin system	317	27
C10 Lipid modifying agents	295	25.13
GENITO URINARY SYSTEM AND SEX HORMONES	**130**	**11.07**
G04 Urologicals	109	9.28
SYSTEMIC HORMONAL PREPARATIONS, EXCL. SEX HORMONES AND INSULINS	**178**	**15.16**
H02 Corticosteroids for systemic use	78	6.64
H03 Thyroid therapy	103	8.77
ANTI-INFECTIVES FOR SYSTEMIC USE	**137**	**11.67**
J01 Antibacterials for systemic use	134	11.41

Table 1. Continued

ATC CODE	n	(%)
MUSCULO-SKELETAL SYSTEM	**271**	**23.08**
M01 Anti-inflammatory and antirheumatic products	79	6.73
M04 Antigout preparations	72	6.13
M05 Drugs for treatment of bone diseases	92	7.84
M05b Drugs affecting bone structure and mineralization	92	7.84
M05ba Bisphosphonates	52	4.43
M05BB Bisphosphonates, combinations	20	1.7
M05BX Other drugs affecting bone structure and mineralization	20	1.7
NERVOUS SYSTEM	**1080**	**91.99**
N02 Analgesics	547	46.59
N03 Anti-epileptics	138	11.75
N04 Anti-Parkinson drugs	156	13.29
N05 Psycholeptics	804	68.48
N05a Antipsychotics	393	33.48
N05b Anxiolytics	428	36.46
N05c Hypnotics and sedatives	331	28.19
N06 Psychoanaleptics	661	56.3
N06a Antidepressants	545	46.42
N06d Anti-dementia drugs	191	16.27
RESPIRATORY SYSTEM	**299**	**25.47**
R03 Drugs for obstructive airway diseases	150	12.78
R05 Cough and cold preparations	93	7.92
R06 Antihistamines for systemic use	96	8.18
SENSORY ORGANS	**121**	**10.31**
S01 Ophthalmologicals	119	10.14

[1] **This table only mentions the medications with an intake prevalence higher than 6% or medications related to dental treatment.**

Table 2. The medication intake by socio-demographic groups and care dependency in the total group (n = 1174)

Variables	n	%	Number of medications Mean (SD)	Number of medications with risk of dry mouth Mean (SD)	Risk of dry mouth Mean (SD)
Gender	**1174**				
Male	352	29.98	8.81 (3.57)	4.32 (2.07)	6.19 (3.50)
Female	822	70.02	9.07 (3.64)	4.55 (2.23)	6.50 (3.71)
p – value[1]			0.265	0.089	0.185
Age	**1174**				
< Mean age (83.9 years)	501	42.67	9.21 (3.64)	4.69 (2.26)	6.81 (3.84)
> Mean age (83.9 years)	673	57.33	8.83 (3.59)	4.32 (2.12)	6.10 (3.48)
p – value[1]			0.076	**0.004**	**0.001**
Care dependency	**1170**				
Low (Katz O and A)	205	17.52	9.44 (3.88)	4.97 (2.34)	6.98 (4.06)
Medium (Katz B)	319	27.26	9.28 (3.61)	4.68 (2.20)	6.66 (3.69)
High (Katz C and Cd)	646	55.21	8.70 (3.51)	4.23 (2.10)	6.10 (3.47)
p – value[1]			**0.009**	**< 0.001**	**0.004**
Increased reimbursement	**1174**				
No	378	32.2	8.59 (3.44)	4.35 (2.10)	6.18 (3.46)
Yes	796	67.8	9.18 (3.68)	4.55 (2.23)	6.51 (3.74)
p – value[1]			**0.008**	0.146	0.143
Natural teeth	**1174**				
Yes	688	58.6	8.88 (3.57)	4.50 (2.25)	6.45 (3.80)
No	486	41.4	9.15 (3.67)	4.46 (2.10)	6.35 (3.45)
p – value[1]			0.197	0.748	0.656

[1] One way ANOVA.

Within the group of residents with natural teeth, there was a clear association between the number of teeth and the medication intake: the higher the number of medications (with risk of dry mouth) and the overall risk of dry mouth, the lower the number of natural teeth ($p = 0.022$; $p = 0.005$ and $p = 0.017$ respectively; Table 3). In contrast, the total treatment need tended to decrease in case of increasing medication intake, which resulted in a clear rise of the treatment index in case of increasing medication intake ($p = 0.003$; $p < 0.001$ and $p = 0.002$). No other oral health and treatment need indicators collected in this study were associated with the variables expressing the medication intake.

Table 3. The distribution of oral health indicators and treatment need assessment by medication intake in the dentate group (n = 712)[1]

Variables	Number of natural teeth (n = 688)			Total treatment need natural teeth [2] (n = 683)			Treatment Index (F+M) / (D_3+M+F) (n = 679)		
	n	%	Mean (SD)	n	%	Mean (SD)	n	%	Mean (SD)
Number of medications									
0 – 3	36	5.23	15.97 (9.16)	36	5.27	48.39 (38.24)	36	5.3	79.47 (22.02)
4 - 5	89	12.94	12.60 (8.53)	88	12.88	44.23 (40. 30)	88	12.96	84.85 (17.71)
6 - 7	137	19.91	12.96 (8.44)	136	19.91	40.47 (36.72)	134	19.73	85.16 (17.57)
8 - 9	135	19.62	12.74 (7.68)	133	19.47	37.27 (38.30)	132	19.44	87.87 (15.46)
10 - 13	221	32.12	10.93 (7.39)	220	32.21	39.41 (38.52)	219	32.25	89.35 (14.56)
≥ 14	70	10.17	12.16 (7.88)	70	10.25	29.02 (33.89)	70	10.31	89.97 (13.32)
p – value [3]		**0.022**			0.090			**0.003**	
Number of medications with risk of dry mouth									
0 - 1	51	7.41	16.35 (8.58)	51	7.47	43.95 (34.78)	50	7.36	77.83 (22.03)
2 - 4	307	44.62	12.24 (7.98)	303	44.36	41.39 (38.79)	300	44.18	86.96 (15.59)
5 - 7	267	38.81	11.74 (7.88)	266	38.95	37.76 (37.90)	266	39.18	88.72 (15.46)
≥ 8	63	9.16	11.60 (7.37)	63	9.22	31.29 (36.57)	63	9.28	89.25 (15.44)
p – value [3]		**0.005**			**0.042**			**< 0.001**	
Risk of dry mouth									
0 – 1	43	6.25	16.21 (8.94)	43	6.3	41.01 (33.46)	42	6.19	78.27 (22.56)
2 – 4	186	27.03	12.65 (8.48)	182	26.65	41.35 (38.75)	181	26.66	87.05 (15.89)
5 – 7	231	33.58	11.90 (7.51)	231	33.82	38.36 (37.94)	229	33.73	87.60 (15.57)
8 – 10	134	19.48	12.22 (7.78)	133	19.47	40.19 (39.04)	113	16.64	87.35 (16.38)
≥ 11	94	13.66	10.85 (7.77)	94	13.76	35.13 (37.61)	94	13.84	90.24 (14.16)
p – value [3]		**0.017**			0.509			**0.002**	

[1] Only the outcome variables with significant results ($p < 0.05$) are represented.
[2] The outcome of this variable needs to be interpreted as part in relation to the total number of remaining natural teeth.
[3] Kruskal Wallis test.

Logistic regression model analysis

The logistic regression model analysis, as shown in Table 4, confirmed that the proportion of carious teeth decreased and the treatment index rose in case of increased medication intake, especially when considering the number of medications with a risk of dry mouth ($p < 0.001$ – $p = 0.017$) and the overall risk of dry mouth ($p < 0.001$ – $p = 0.060$).

Table 4. Mixed-effect logistic regression model analysis[1] for the proportion of decayed teeth and the treatment index in the dentate group (n = 712)

Variables (reference)		Est β	OR	95% CI OR		*p*-value
				Lower	Upper	
Proportion decayed teeth						
Gender (Male)	Female	-0.46	0.63	0.45	0.89	**0.009**
Age		0.03	1.03	1.01	1.05	**0.001**
Number of medications (0 – 3)	4 - 5	-0.65	0.52	0.23	1.20	0.124
	6 - 7	-0.41	0.66	0.30	1.46	0.308
	8 - 9	-0.88	0.41	0.19	0.91	**0.028**
	10 - 13	-0.71	0.49	0.23	1.04	0.065
	≥ 14	-0.71	0.49	0.21	1.16	0.104
Number of medications with risk of dry mouth (0 – 1)	2 - 4	-0.78	0.46	0.24	0.87	**0.017**
	5 - 7	-0.78	0.46	0.24	0.88	**0.018**
	≥ 8	-0.98	0.38	0.17	0.83	**0.015**
Risk of dry mouth (0 – 1)	2 – 4	-1.01	0.36	0.18	0.75	**0.006**
	5 – 7	-0.79	0.45	0.22	0.92	**0.029**
	8 – 10	-0.71	0.49	0.23	1.03	**0.060**
	≥ 11	-0.84	0.43	0.20	0.93	**0.033**
Treatment index (F+M) / (D_3+M+F)						
Gender (Male)	Female	0.65	1.92	1.36	2.72	**< 0.001**
Care dependency (Low)	Medium	-0.21	0.81	0.50	1.34	0.412
	High	-0.49	0.61	0.39	0.94	**0.028**
Number of medications (0 – 3)	4 - 5	0.56	1.75	0.76	4.01	0.185
	6 - 7	0.22	1.25	0.57	2.77	0.582
	8 - 9	0.43	1.54	0.70	3.42	0.284
	10 - 13	0.90	2.46	1.15	5.26	**0.020**
	≥ 14	0.76	2.14	0.90	5.05	0.085
Number of medications with risk of dry mouth (0 – 1)	2 - 4	1.25	3.49	1.67	7.32	**0.001**
	5 - 7	1.57	4.81	2.27	10.07	**< 0.001**
	≥ 8	1.58	4.85	2.03	11.70	**< 0.001**
Risk of dry mouth (0 – 1)	2 – 4	1.07	2.92	1.34	6.42	**0.007**
	5 – 7	1.14	3.13	1.45	6.75	**0.004**
	8 – 10	1.12	3.06	1.36	6.82	**0.006**
	≥ 11	1.53	4.62	1.99	10.70	**< 0.001**

[1] The nursing home was introduced as a random effect and age, gender, care dependency, preferential tariff and one medication variable per analysis as explanatory variables. Only the explanatory variables presenting significant results were included in this table.

Discussion

The *first* aim of the present study is to describe the medication use of the nursing home residents in our sample and to identify the hyposalivation-related medication. The results confirm the hypothesized high medication use of nursing home residents in Belgium, previously described in the Prescribing in Homes for the Elderly in Belgium (PHEBE) study (3,38). The mean numbers of medications and the characteristics of the study sample in both studies were comparable. As in the PHEBE study, there were no clear associations between gender and age on the one hand, and medication intake on the other. In contrast, both studies found decreasing medication intake in case of increasing care dependency (including the degree of dementia) and significant differences in medication intake between nursing homes. Based on the data collected in this study, we cannot assess whether the decrease of intake for highly dependent and demented residents was due to considered and justified therapeutic abstinence or under-treatment of certain conditions. Concerning the discrepancy between nursing homes, the PHEBE study observed differences depending on the financial structure, the supplier of the medication and the coordinating physician of the nursing home. The present study did not collect this information, as it was considered to be beyond its scope.

A study of Moore *et al*. (39) identified arterial hypertension, vascular disease, dementia, arthritis, depression, and gastro-esophageal reflux disease as the most prevalent co-morbid conditions in a nursing home setting. The medications to treat these conditions were highly prevalent in the present study. Polypharmacy is associated with potentially inappropriate prescribing which could lead to adverse drug effects and unfavorable health outcomes (40,41). A recent systematic review, only including studies conducted after 2005, reported that 49.8 % of the nursing home residents are exposed to potentially inappropriate medication use (41). Considering the high number of medications in the present study sample, similar results can be assumed. To reduce the inappropriate prescribing, the attitude and nature of care settings and the availability and feasibility of nondrug alternatives need to be investigated (42).

Both the medication use in general and the medication use with a possible effect on dry mouth was exorbitant. These results are similar to another smaller study (22) and confirm the suitability of the web tool on www.drymouth.org to identify medication with a possible hyposalivatory effect.

The *second* aim of the present study is to find possible associations between the different classes of medication, the number of medications and several variables of the residents' oral health status. As a consequence of the high medication use, only one person took no medication and therefore it was not possible to distinguish an appropriate non-medicated control group within the study sample. When considering a subgroup of residents taking a specific type of medication, the medication use was never limited to this specific type. Moreover, it was only possible to compare them with residents not taking the specific medication instead of comparing them to a non-medicated control group. This hampered demonstrating the association between a specific medication class and the clinical outcome variables. Nevertheless, the number of medications with a risk of dry mouth and the total risk of medication related dry mouth were clearly associated with the proportion of carious teeth and the treatment index. The proportion of carious teeth was lower and the treatment index was higher in case of increased medication intake, increased medication intake with a risk of dry mouth and a higher overall risk of dry mouth. In the group with high medication use, the teeth most sensitive to caries and plaque retention could already have been extracted at the moment of screening for the study due to a life-long history of caries pathology. This could explain the lower number of teeth in this group. As a consequence, the remaining teeth may be favorably positioned in the mouth to allow good cleaning. These results indicate the importance of taking preventive measures at the start of medication intake for chronic conditions which can lead to tooth loss. Further research is needed to confirm these results and to find other possible explanations for the observed results.

Strengths and limitations

The strength of this study is its contribution to the actual knowledge about the medication prescribed to nursing home residents. To the authors' knowledge, it was the first study to distinguish the medication with a possible hyposalivatory effect in a large sample of this specific study population. Furthermore, the database and search tool on the website drymouth.info clearly create opportunities for further research. This article also manifestly identifies barriers when performing medication-related research in the nursing home population.

Nevertheless, some limitations characteristic of this study setting should be reported. A cross-sectional record of the medication use alone will probably never result in a clear prediction of the consequences of a low salivary flow rate. A retro- or prospective longitudinal observational design would be more appropriate. Moreover, other possible reasons for SGH-related underlying diseases and/

or non-pharmacological treatments were not considered. Due to the inclusion of many residents with cognitive impairment, it was not possible to measure SFR or the prevalence of xerostomia. Finally, the defined daily dose (DDD), the prescribed daily dose (PDD) or the duration of medication intake were not collected, which may also be considered a limitation as it hampers the possibility to draw conclusions regarding the dose-effect of the medications. The oral health indicators considered in this study are often multifactorial and not exclusively associated with the use of medication or other parameters included in the mixed model analyses. The living circumstances and diet are comparable for the residents within the same nursing home, but important differences in the oral flora and dental plaque might not have been considered.

Future research should clarify if part of the medication intake could be the result of general health problems due to bad oral health. To date, many associations were shown between oral and general health of the adult population up to 65 years old but no causal relationships could be proven and there is a lack of research in this area related to frail older persons.

Conclusion

This study clearly shows the excessive level of medication use including the high intake of medication with a possible hyposalivatory effect and medications influencing dental treatment protocols. The number of teeth and the proportion of decayed teeth were lower and the treatment index was higher in case of increased medication intake, increased medication intake with a risk of dry mouth and a higher overall risk of dry mouth.

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Conflict of interest

All authors declare the originality of authorship and declare they have no conflict of interest. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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Chapter III

The impact of a preventive and curative oral healthcare programme on the prevalence and incidence of oral health problems in nursing home residents.

This chapter is an edited version of the manuscript:
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The impact of a preventive and curative oral healthcare programme on the prevalence and incidence of oral health problems in nursing home residents.
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Abstract

Aims: To assess the impact of a preventive and curative oral healthcare programme in nursing homes on the initial treatment backlog and residents' oral health stability.

Materials and methods: The study is a longitudinal cohort study in nursing home residents in Flanders approved by the Ethical Committee of Ghent University (B670201318461). The oral healthcare programme Gerodent included (1) the introduction of an oral healthcare team, (2) oral health education, (3) the implementation of oral health guidelines and protocols, and (4) regular visits of a mobile dental team. Data were extracted from the oral health records of the nursing home residents who received treatments from the mobile dental team between October 2010 and March 2014.

Results: The study sample consisted of 381 residents from 21 different nursing homes with a mean follow-up period of 22.5 months. The mean age at baseline was 82.4 years and the mean number of consultations per resident was 3.61 during the follow-up period. In the group of residents with natural teeth, the oral healthcare programme reduced the proportion of residents with caries (from 70.5% to 36.5%; $p < 0.001$), residual roots (from 54.2% to 25.1%; $p < 0.001$), and a need for fillings (from 31.9% to 17.1%; $p < 0.001$) and extractions (from 64.3% to 31.6%; $p < 0.001$). In the group with partial or full dentures (n = 223), a major treatment backlog was also observed at baseline: 85 residents (38.1%) needed a repair, rebasing or renewal of their existing dentures. After the follow-up period, this treatment backlog was reduced to 20 residents (9.0%; $p < 0.001$). The number of natural teeth ($p < 0.001$) and the baseline treatment need of these natural teeth ($p = 0.011$) were associated with the treatment need after the follow-up period. Considering the outcome variable 'oral health stability', the number of natural teeth ($p < 0.001$) and the residents' care dependency ($p = 0.018$) at baseline were predicting variables.

Conclusion: The oral healthcare programme Gerodent significantly reduced the treatment backlog from 65.9% to 31.3% of the residents. Furthermore, 53.5% of the residents obtained oral health stability within the oral healthcare programme, which means that they had no additional natural teeth in need of treatment and no need for new prosthetic treatment during the follow-up period.

Introduction

Poor oral health and a high need for treatment are widespread among nursing home residents (1–7; Chapter 1). This situation is mainly the result of many well-reported barriers concerning oral healthcare experienced by dental professionals, nursing home residents and their (informal) caregivers (8–14). It is likely to become more pressing in the future, as a growing number of remaining natural teeth and complex prosthetic rehabilitations will create the need for increasingly complex oral healthcare (6).

To meet these barriers and this need for more complex treatments, mobile and portable dentistry at nursing homes have been suggested as a safe, cost-effective alternative for regular dental clinics (15–18). Nevertheless, there is little information on the implementation of these on-site services. One short regional Austrian report concluded that mobile dentists were active in 51.5% of the nursing homes, but these mobile services were not embedded in a structured programme (19). In contrast, in other countries such as Sweden, a structured programme is already in place at a national level (20).

Although a comprehensive system is often still lacking, general guidelines for mobile and on-site dental care have already been formulated by Helgeson *et al*. (16):

> *"These delivery systems are not simply traditional dental practices located in nursing homes. They are interdisciplinary team efforts designed to address the oral health needs of nursing home residents systematically. The provision of dental care involves not only dental staff, but also nursing staff, primary care physicians, resident representatives, and third-party payers, each of whom has an important role to play. In addition, on-site delivery systems must assist in establishing preventive programmes, provide education for nursing staff, and participate actively in the medical-dental management of medically compromised patients."*

These guidelines have already been applied in some mobile dental clinics (21,22) and have been shown to achieve oral health stability, requiring only diagnostic or preventive services at periodic examination, in up to 44% of the residents (23). The success of the approach has also been illustrated in a study by Sjögren *et al*., which demonstrated that professional domiciliary care, limited to professional cleaning, reduced dental plaque and gingivitis in nursing home residents

(24). Nevertheless, there remains an overall paucity of information on how the implementation of an oral healthcare strategy including a mobile dental team for preventive and curative treatment impacts on the oral health of nursing home residents.

In two provinces of Flanders, Belgium (i.e. East and West Flanders), a preventive and curative oral healthcare programme for nursing homes called 'Gerodent' was introduced in 2010. In line with the guidelines for mobile dental care (16), this programme comprises a preventive protocol at the nursing home level, education for caregivers and preventive and curative care for residents. Previous research on this oral healthcare programme for nursing homes revealed that (1) the nursing home residents' oral health was compromised (2; Chapter 1), (2) the residents' high intake of hyposalivation-related medication affected their oral health (25; Chapter 2), (3) the preventive part of the programme increased the care staffs' oral health-related knowledge (26; Chapter 4 Part 1), and (4) the provision of preventive and curative on-site dental care had an additional positive effect on the care staffs' oral health-related knowledge and attitude (27; Chapter 4 Part 2).

The aim of the present study was to assess how a preventive and curative oral healthcare programme like Gerodent may impact on the initial treatment backlog in nursing homes and how it may affect residents' oral health stability.

Materials and methods

Study design

The present study is a longitudinal cohort study in nursing home residents in Flanders. It was approved by the Ethical Committee of Ghent University (B670201318461) and informed consent was obtained from all nursing homes.

Study population, study sample and study settings

The study population consisted of nursing home residents in East and West Flanders (i.e. two Belgian provinces) who had difficult access to regular oral healthcare due to physical and/or cognitive impairment. The study sample was derived from a previous sample containing residents of 23 nursing homes in the Gerodent oral healthcare network. This sample consisted of 1,226 residents who visited the mobile dental clinic for a first consultation between October 2010 (i.e. when Gerodent started) and April 2012. The socio-demographic characteristics and baseline oral health status of this sample were described in a previous study conducted by the same authors (2; Chapter 1). To be included into the subsample of the present study, the residents needed to have follow-up data in their oral health records for a minimum of 11 months after the first screening.

Exposure

The exposure in this study was Gerodent, a preventive and curative oral healthcare programme for nursing homes. This programme involves (1) the introduction of an oral healthcare team in the nursing home, consisting of one nursing home project supervisor, at least two oral healthcare organizers (nurses or nurses' aides) per ward, a physician, and possibly an occupational or speech therapist; (2) oral health education for the managing director and for the nursing staff; (3) the implementation of the guideline "Oral healthcare Guideline for Older people in Long-term care Institutions" (OGOLI) and the daily oral healthcare protocol derived from this guideline (28–32); and (4) regular visits of a mobile dental team to support the nursing staff and deliver preventive and curative oral healthcare to residents who cannot access regular dental care. The details of the oral healthcare programme have been described in previous articles and will therefore not be repeated here (26,27; Chapter 4 Part 1 and 2).

Data collection

Data were extracted from the oral health records of the nursing home residents receiving oral treatments between October 2010 and March 2014 from the Gerodent mobile dental team. These records include an oral, medical, physical and cognitive assessment. The latter three were performed by the caring staff and physician of the nursing home; the oral assessment was performed by the three dentists of the Gerodent team (first, second and last author), who are all experienced in geriatric dentistry. For the registration of the oral health status, the dentists had a fully equipped mobile dental unit at their disposal with a portable dental operating light (Aseptico). A mobile x-ray device (Rextar EXO1414) was available to ensure a correct diagnosis and draft the most suitable treatment plan. The data considered for this study included (1) demographic variables (i.e. age, gender, nursing home of residence, care dependency and the right to increased reimbursement), (2) medication intake (i.e. the number of (hyposalivation-related) medications), (3) the oral health status (i.e. the number of natural teeth, residual roots, filled teeth and decayed teeth, the presence of implants and removable dentures), (3) an assessment of the treatment need (i.e. the need for fillings and extractions, treatment index, restorative index and the need for rebasing, repair or renewal of dentures), and (4) all the oral treatments provided during the follow-up period. The above-mentioned variables were extensively described in previous studies (2,25; Chapter 1 and 2). The length of the follow-up period was determined by the last dental visit within the study period, while care dependency was based on the Katz index of Independence in Activities of Daily Living (Table 1 p. 31). Increased reimbursement, mentioned in (1), is a governmental measure for people who are entitled to a higher reimbursement for healthcare provision due to their low income. More information on the included data can be found in previous articles (2,25; Chapter 1 and 2).

Outcome and explanatory variables

The outcome variables were the oral health status and treatment need at baseline and at the end of the follow-up period, the extent to which the treatment backlog was eliminated, and the proportion of residents with oral health stability during the follow-up period. The elimination of the treatment backlog was expressed as a reduction in the number and percentage of residents with a need for oral treatment (i.e. a need for fillings, extraction, repair, rebasing or renewal of dentures) from baseline to follow-up. Oral health stability was interpreted as a situation in which no new dental (fillings or extractions) or prosthetic (repair, rebasing, renewal) treatment was needed until the end of the follow-up period. To assess which factors could affect the elimination of the treatment backlog

and the incidence of new oral health problems, the following explanatory variables were registered: the residents' age, gender, care dependency, increased reimbursement for health costs, number of medications, number of hyposalivation-related medications, number of natural teeth at baseline, any presence of a (partial or full) removable denture, and the initial treatment need. More information on the explanatory variables can be found in previous articles (2,25; Chapter 1 and 2).

Statistical analysis

Descriptive analyses were performed of all socio-demographic variables and variables expressing the oral health status or the treatment need at baseline and at the end of the follow-up period. To explore the differences between the oral health status and treatment needs at baseline (T_0) and after follow-up (T_1), the non-parametric Wilcoxon Matched-Pairs Signed-Ranks Test and McNemar test were used. A logistic regression analysis was performed to assess the impact of the explanatory variables on the treatment backlog elimination and the oral health stability. Tests resulting in *p*-values < 0.05 were considered significant. All analyses were performed with SPSS for Windows version 22 (SPSS Inc., Chicago, IL, USA).

Results

The study sample consisted of 381 residents from 21 different nursing homes with a mean follow-up period in the oral healthcare programme of 22.5 months (SD 7.7, range 11 – 70). The mean age at baseline was 82.4 years (SD 8.9, range 30 – 100) and the sample was mainly female (n = 275, 72.2%). The mean number of medications was 9.08 (SD 3.4, range 0 - 22), 4.69 (SD 2.1, range 0 – 12) of which could induce a dry mouth (Table 1). Considering the preventive and curative treatment, the mean number of consultations per resident was 3.61 (median 3.00, SD 3.03, range 1 – 19) during the follow-up period.

Table 1. Baseline socio-demographic data of the participants (total n = 381)

Variable	Mean (median) or Number	SD or %
Age (years)		
Total sample	82.4 (83.8)	8.9
< 65	15	3.9%
65 - 79	92	24.1%
80 - 89	182	47.8%
> 89	92	24.1%
Gender		
Male	106	27.8%
Female	275	72.2%
Increased reimbursement	253	66.4%
Care dependency		
Low (Katz O and A)	75	19.7%
Medium (Katz B)	109	28.7%
High (Katz C and Cd)	196	51.6%
Number of medications	9.1 (9.0)	3.4
Number of hyposalivation-related medications	4.7 (5.0)	2.2

If the residents' oral health status at baseline is compared with their oral health status at the end of the follow-up period, it becomes clear that the oral healthcare programme resulted in fewer natural teeth and more full dentures (Table 2).

If we only consider the residents with natural teeth (n = 263), the mean D_3MFt increased significantly from 23.60 to 25.15 ($p < 0.001$) during the follow-up period. A significant decrease in oral pathology could be observed, as expressed by the number of decayed teeth ($p < 0.001$) and residual roots ($p < 0.001$). As a consequence, the oral healthcare programme resulted in an increased treatment and

restorative index (from 87.24% to 94.09%; $p < 0.001$ and from 31.63% to 64.19%; $p < 0.001$ respectively). The need for treatment at the level of natural dentition was reduced from 3.76 to 1.31 teeth to be filled or extracted ($p < 0.001$; **Table 3**). Approaching these numbers in a dichotomous way, the oral healthcare programme reduced the proportion of residents with caries (from 70.5% to 36.5%; $p < 0.001$), residual roots (from 54.2% to 25.1%; $p < 0.001$), and a need for fillings (from 31.9% to 17.1%; $p < 0.001$) and extractions (from 64.3% to 31.6%; $p < 0.001$). Simultaneously, the proportion of residents with a treatment or restorative index of 100% rose from 29.1% to 63.5% ($p < 0.001$) and from 14.7% to 49.5% ($p < 0.001$), respectively.

Table 2. Residents' general oral health status (total n = 381)

Variable	Baseline (T_0)		Follow-up (T_1)	
	Number or Mean (median)	SD or %	Number or Mean (median)	SD or %
Residents with natural teeth	263	69%	234	61%
Number of natural teeth				
Total Sample	9.0 (7.0)	8.8	7.0 (4.0)	8.8
0 teeth	118	31.0%	147	38.6%
1 - 9 teeth	105	27.6%	112	29.4%
10 - 20 teeth	107	28.1%	90	23.6%
> 20 teeth	51	13.4%	32	8.4%
D_3MFt [1]	26.2 (29.0)	6.8	27.2 (31.0)	6.6
Implants	3	0.8%	8	2.1%
Full denture upper and lower jaw	105	27.6%	113	29.7%
Overdenture upper or lower jaw	10	2.6%	11	2.9%
Full denture upper jaw in combination with natural teeth (and partial denture) lower jaw	66	17.3%	61	16.0%
Full denture lower jaw in combination with natural teeth (and partial denture) upper jaw	12	3.1%	6	1.6%
Natural teeth in combination with partial denture	40	10.5%	37	9.7%

[1] D_3MFT: sum of teeth with obvious dental decay in the dentine of the tooth D_3, missing teeth M and filled teeth F

Table 3. Oral health status and treatment need of residents with natural teeth (total n = 263)

Variable	Baseline (T_0)		Follow-up (T_1)		
	Mean (median) or Number	SD or %	Mean (median) or Number	SD or %	*p*-value[1]
Number of natural teeth					
Total Sample	13.09 (13.0)	7.64	10.16 (9.0)	7.92	< 0.001
0 teeth	0	0	29	11.0	
1 - 9 teeth	105	39.9	112	42.6	
10 - 20 teeth	107	40.7	90	34.2	
> 20 teeth	51	19.4	32	12.2	
D_3MFt	23.60 (25.00)	6.70	25.15 (27.00)	6.71	
Decayed teeth	3.02 (2.00)	4.01	1.40 (2.95)	2.95	< 0.001
Missing teeth	18.90(19.00)	7.64	21.86 (23.0)	7.89	< 0.001
Filled teeth	1.62 (0.00)	2.72	1.89 (1.00)	2.55	0.003
Number of residual roots	1.83 (1.00)	3.35	0.85 (0.00)	2.37	< 0.001
Treatment index ((F + M) / (F + M +D))	87.24 (92.59)	15.71	94.09 (100.00)	12.07	< 0.001
Restorative index (F / (F + D))	31.63 (0.00)	38.54	64.19 (89.20)	41.73	< 0.001
Fillings needed	0.81 (0.00)	1.53	0.37 (0.00)	1.03	< 0.001
Extractions needed	2.95 (1.00)	4.31	1.31 (0.00)	3.30	< 0.001
Total treatment need (fillings + extractions)	3.76 (2.00)	4.44	1.68 (0.00)	3.50	< 0.001

[1] Wilcoxon Matched-Pairs Signed-Ranks Test

During the follow-up period, 79.1% of the residents with natural teeth received fillings and/or extractions with a mean number of 3.86 treated teeth per person (SD 4.07). A considerable part of the residents experienced new pathology during the follow-up period, resulting in 53.2% of the residents requiring new fillings or extractions. The mean number of teeth with pathology occurring during the follow-up period was 1.78 (SD 2.84; Table 4).

Table 4. Dental treatment and new pathology in residents with natural teeth at baseline (n = 261) during the follow-up period (T_0 - T_1)

Variable	n	%	Mean (median)	SD
Fillings	111	42.2	0.98 (0.00)	1.56
Extractions	173	65.8	2.90 (1.00)	3.70
Total treatment (fillings + extractions)	208	79.1	3.86 (2.00)	4.07
New fillings needed during follow up period	86	32.7	0.69 (0.00)	1.34
New extractions needed during follow up period	92	35.0	1.08 (0.00)	2.50
Total new treatment need (fillings + extractions)	140	53.2	1.78 (1.00)	2.84

In the group of residents with partial or full dentures (n = 223), a major treatment backlog was also observed at baseline: 85 residents (38.1%) needed a repair, rebasing or renewal of their existing dentures. This treatment backlog was reduced to 20 residents (9.0%) after the follow-up period ($p < 0.001$; **Table 5**). During the follow-up period, 39 residents (17.5%) received a repair, 63 (28.3%) a rebasing and 21 (9.4%) a renewal of the existing dentures at baseline. In total, 103 residents (46.2%) received some kind of prosthetic treatment.

Table 5. Treatment need of residents with dentures (total n = 223)

Variable	Baseline (T_0)		Follow-up (T_1)		*p*-value[1]
	Number	%	Number	%	
Need for repair	32	14.3	14	6.3	0.006
Need for rebasing	53	14.3	3	1.3	< 0.001
Need for renewal dentures	14	6.3	3	1.3	0.013
Overall treatment need dentures	85	38.1	20	9.0	< 0.001

[1]McNemar test

All the above-mentioned data allow us to assess the extent to which the initial treatment backlog was eliminated and evaluate the oral health stability during the follow-up period. At baseline, there was a treatment backlog for 251 residents (65.9%), which was reduced to 120 residents (31.3%) after the follow-up period. In the group of residents without a treatment need at baseline (n = 130), 13.1% (n = 17) had a treatment need after follow-up. In the group of residents with a treatment need at baseline (n = 251), 40.8% (n = 102) still had a treatment need at follow-up. No less than 204 residents (53.5%) achieved oral health stability during the follow-up period, meaning that there were no new natural teeth with a need for treatment and there was no need for new prosthetic treatment. In the group with baseline treatment needs (n = 251), 50.5% (n = 126) remained stable over time compared to the group without baseline treatment needs (n = 130) where 60.0% (n = 78) remained oral health stability.

To assess the impact of the explanatory variables on the treatment backlog and the oral health stability at the end of the follow-up period (T_1), a logistic regression analysis was performed including the explanatory variables as described in the materials and methods section. The number of natural teeth ($p < 0.001$) and the baseline treatment need of these natural teeth ($p = 0.011$) were predicting variables for the treatment need at T_1: the higher the number of natural teeth and their need for treatment, the more likely it was that there would be a need for treatment at the end of the follow-up period. Oral health stability was associated to, the number of natural teeth ($p < 0.001$) and the residents' care dependency

(p = 0.018) at baseline: the higher the number of natural teeth, the lower the odds that oral health stability would be achieved, with the residents with the highest care dependency being less likely to achieve oral health stability. When only the residents with natural teeth were considered, care dependency was not a predicting variable (Table 6 and 7).

Table 6. Logistic regression analysis for the treatment need at the end of the follow-up period (T_1)

Variables [1]				95% C.I.	
	β	*p*-value	OR	Lower	Upper
Number of natural teeth	-0.11	< 0.001	0.90	0.86	0.94
Total treatment need natural teeth at baseline (T_0)	-0.09	0.011	0.92	0.85	0.98

[1] The variables included in the model were age, gender, care dependency, preferential tariff, the number of medications used, the number of medications that may cause a dry mouth, the number of natural teeth, the total treatment need of the natural teeth at baseline, the presence of a denture and the baseline prosthetic treatment need. Only the explanatory variables rendering significant results were included in the table.

Table 7. Logistic regression analysis for the oral health stability at the end of the follow-up period (T_0 -T_1)

Variables (reference)[1]				95% C.I.	
	β	p-value	OR	Lower	Upper
Number of natural teeth	-0.09	< 0.001	0.91	0.88	0.95
Care dependency (Low)					
Medium	-0.21	0.502	0.81	0.43	1.51
High	-0.66	0.018	0.52	0.30	0.89

[1] The variables included in the model were age, gender, care dependency, preferential tariff, the number of medications used, the number of medications that may cause a dry mouth, the number of natural teeth, the total treatment need of the natural teeth at baseline, the presence of a denture and the baseline prosthetic treatment need. Only the explanatory variables rendering significant results were included in the table.

Discussion

Untreated tooth decay in permanent teeth remains the most prevalent health condition across the globe, with a prevalence of 35.8% in Western Europe and an incidence of 49,344 per 100,000 person years in 2010 (33). In our sample, a high rate of untreated oral pathology could be observed at baseline, with 70.5% of the residents suffering from untreated caries. This high prevalence of untreated caries, also called Frail Elder Caries (FEC) is a serious threat to the overall health and well-being of nursing home residents (34). The oral healthcare programme Gerodent was able to reduce this percentage to 36.5%, a proportion similar to the mean prevalence in Western Europe.

The need for treatment observed in 65.9% of the residents at baseline was halved to 31.3% by the end of the study period. Similarly, Gerritsen *et al*. registered a treatment need in 44.4% of the residents in a nursing home with integrated dental care compared to 86.9% of the residents in a nursing home with incidental dental care (35). In contrast, another study by Gerritsen *et al*., measuring the dental treatment need of 432 residents of nursing homes with integrated oral healthcare, reported 72% of the residents requiring oral treatment. These differences in results can possibly be explained by different interpretations of integrated oral healthcare. In the present study, the need for treatment was reduced by means of basic curative oral healthcare including fillings, extractions and prosthetic treatment. As has been shown by Morgan *et al*., these basic interventions suffice to eliminate most of the dental treatment needs among nursing home residents (36). In the future, more complex treatments may need to be provided due to the increased complexity of oral health status in general.

In addition to a reduced need for treatment, the programme provided oral health stability for a considerable part of the sample (53.5%). A study by Smidt *et al*., measuring oral health stability for 24 months in 868 nursing home residents from 62 nursing homes, examined the effects of a similar oral healthcare programme and observed that 44% of the residents achieved oral health stability during their participation in the programme (23). Although this is less than the percentage obtained in the present study, these results may be explained by the specific study design, as one of the inclusion criteria was the presence of at least one natural tooth. If we apply this inclusion criterion to our own sample, the oral health stability in our sample becomes 43% and thus equal to the study

of Smidt *et al*. Another interesting finding from Smidt *et al*. is that predicting variables for achieving oral health stability were being relatively younger, female, initially exhibiting a low need for treatment and residing in proprietary homes. No correlation was observed with overall care dependency, except for some ADL functions (Activities of Daily Living), and the number of natural teeth at the initial visit was not a predictor either. These findings are not confirmed in the present study, so more research is needed to clarify this inconsistency.

In the present study, a high care dependency (including cognitive impairment) resulted in a higher risk of oral health instability. When only the residents with natural teeth were considered, care dependency was not a predicting variable for oral health stability. Previous research showed that oral care capacity mediates the association between cognition and dental caries severity in older adults (37). Consequently, it is possible that the residents with low oral care capacities having natural teeth received support with their daily oral hygiene and that highly dependent residents with full dentures could benefit from more support to prevent broken or lost dentures.

A study of Chalmers *et al*., observing the caries incidence and increments in dentate nursing home residents in a one-year period, concluded that 72.1% of the residents showed caries increments between baseline and follow-up (38). Coronal caries incidence was 64.4% and root caries incidence 48.5%. This was still an underestimation because some surfaces could not be assessed due to the high plaque levels. In the present study, 53.2% of the dentate residents obtained a new need for dental treatment (i.e. filings or extractions). This proportion is lower than in the study of Chalmers *et al*. and could be attributed to the preventive aspects of the oral healthcare programme. Nevertheless, 53.2% is still a considerable percentage. During the study period, the residents used a 1450 ppm fluoridated toothpaste without any additional fluoride applications. However, the literature recommends a 5000 ppm fluoridated toothpaste or the regular application fluoride varnishes for frail older people (39,40). Applying these recommendations could further improve the outcomes of the oral healthcare programme.

Limitations

The design of the present study did not allow us to compare the results with a control group that did not participate in the oral healthcare programme. However, not providing dental treatment to a control group during a mean period of 22 months in a study sample of frail older nursing home residents would definitely have raised ethical considerations due to the high mortality rates in nursing homes and the effect on their well-being and quality of life.

Furthermore, for feasibility reasons, no plaque measurements were performed in this study. The changes in oral hygiene levels could have provided more insight into the incidence of caries during the follow-up period. Moreover, co-morbidity and nutritional intake were not taken into account as an explanatory variable.

Conclusion

The oral healthcare programme Gerodent significantly reduced treatment backlog from 65.9% to 31.3% of the residents. Within the oral healthcare programme, 53.5% of the residents obtained oral health stability, indicating that there were no new natural teeth with a need for treatment and no need for new prosthetic treatment during the follow-up period.

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Chapter IV

The impact of an oral healthcare programme on the knowledge and attitude of nurses and nurses' aides.

Part I:

Effect of an oral healthcare protocol in nursing homes on care staffs' knowledge and attitude towards oral healthcare: a cluster-randomized controlled trial.

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Abstract

Objective: To explore the impact of a supervised implementation of an oral healthcare protocol, in addition to education, on nurses' and nurses' aides' oral health related knowledge and attitude.

Materials and methods: A random sample of 12 nursing homes, accommodating a total of 120 to 150 residents, was obtained using stratified cluster sampling with replacement.The intervention included the implementation of an oral healthcare protocol and three different educational stages. One of the investigators supervised the implementation process, supported by a dental hygienist. A 34-item questionnaire was developed and validated to evaluate the knowledge and attitude of nurses and nurses' aides at baseline and six months after the start of the intervention. Linear mixed model analyses were performed to explore differences in knowledge and attitude at 6 months after implementation.

Results: At baseline, no significant differences were observed between the intervention and the control group for both knowledge ($p = 0.42$) and attitude ($p = 0.37$). Six months after the start of the intervention, significant differences were found between the intervention and the control group for the variable knowledge in favor of the intervention group ($p < 0.0001$) but not for the variable attitude ($p = 0.78$). Out of the mixed model with attitude as the dependent variable, it can be concluded that age ($p = 0.031$), educational level ($p = 0.009$) and ward type ($p = 0.014$) have a significant effect. The mixed model with knowledge as the dependent variable, resulted in a significant effect of the intervention ($p = 0.001$) and the educational level ($p = 0.009$).

Conclusion: the supervised implementation of an oral health protocol significantly increased the knowledge of nurses and nurses' aides. In contrast, no significant improvements could be demonstrated in attitude.

Introduction

Many studies demonstrate the poor oral health status of institutionalized elderly (1-6). Deterioration of the activities of daily living, cognitive impairment and co-morbidity make frail elderly vulnerable to oral health problems. As care dependency and cognitive impairment increases, oral hygiene and oral health deteriorates (7-9). Daily oral hygiene is about the most important factor contributing to good oral health. A number of barriers to provide this daily oral hygiene are described by nurses and nurses' aides in previous research. Common are a lack of knowledge and skills, a lack of time and staff, resistant behavior of the residents and a negative staff attitude toward oral health. These barriers hamper the integration of oral healthcare into daily care and contribute to the poor oral health status of dependent elderly (10-16).

The guideline "*Oral health care Guideline for Older people in Long-term care Institutions*" (OGOLI) was developed to facilitate the integration of oral healthcare into daily nursing care (17,18) and a practically feasible daily oral healthcare protocol was derived from this guideline. This protocol was implemented in a random sample of nursing homes in Flanders (Belgium) and The Netherlands and evaluated in a cluster randomized controlled trial, the ABRIM study (= Actief Begeleide Richtlijn Implementatie Mondzorg – Actively Supervised Implementation of an Oral Healthcare Guideline; 19-21).

Changing knowledge and attitude of nurses and nurses' aides for the benefit of residents' oral health and oral hygiene has been the main objective of many studies included in two recent systematic reviews (22,23). To achieve these changes research to date has tended to focus on providing theoretical and practical education rather than considering the education to be part of a daily oral healthcare protocol (22,23). In addition, it has been emphasized that knowledge and attitude are necessary but insufficient tools for generating sustained behavioral change (22).

The aim of the present study was to explore the impact of a supervised implementation of the above-mentioned oral healthcare protocol, in addition to education, on nurses' and nurses' aides' oral health related knowledge and attitude. The Belgian data from the ABRIM survey were used to test the hypothesis that the intervention increases the knowledge of nurses and nurses' aides and improves their attitude.

Materials and methods

Study design

The present study is a multicenter, cluster-randomized controlled trial, with the nursing home being the unit of randomization and the nurses and nurses' aides being the unit of analysis. The study was approved by the Ethical Committee of Ghent University (OG017- approval 2008/440) and consent was obtained from all nursing homes prior to the start of the study. The nurses and nurses' aides gave their individual consent when they filled out the questionnaire.

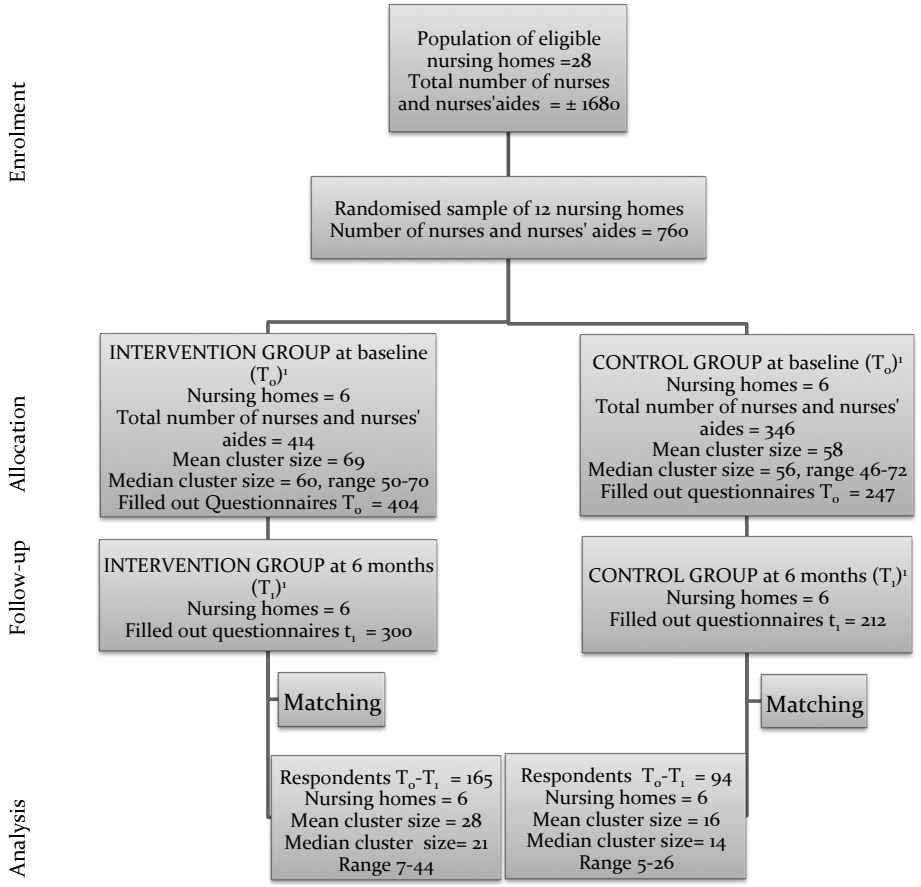
Study population and study sample

The study population consisted of the nurses and nurses' aides employed in nursing homes accommodating a total of 120 to 180 residents. A nursing home was excluded if one of the following five criteria were applicable: (1) it had mainly wards accommodating less than 20 residents, (2) the nursing home included only somatic or psycho-geriatric wards, (3) an oral healthcare guideline or protocol had previously been introduced and implemented, (4) nurses and nurses' aides had received special training on oral healthcare during the last 2 years and (5) more than five other major care innovation projects had been implemented during the last 2 years.

According to the above mentioned exclusion criteria, a random sample of 12 nursing homes was obtained using stratified (geographical distribution) cluster sampling with replacement. They were randomly allocated to the intervention (n = 6) or the control group (n = 6) using computer-aided tools (Figure 1). All nurses and nurses' aides (n = 760) working in these nursing homes constituted the study population. There was a low variability in the number of nurses and nurses' aides per ward between the different wards of the nursing homes.

Sample size was calculated based on the mean differences of both outcome variables and the population variance. Aiming an improvement in knowledge and attitude of 5%, with a power of 80% and an alpha level of 0.05, the calculation resulted in a sample size of 150 individuals in both the intervention and the control group.

Figure 1. Flow chart of the trial



Adapted from: Campell et al. (31)[1] (T_0) refers to the start of the study, (T_1) refers to the moment that the effect of the intervention was measured

Study settings

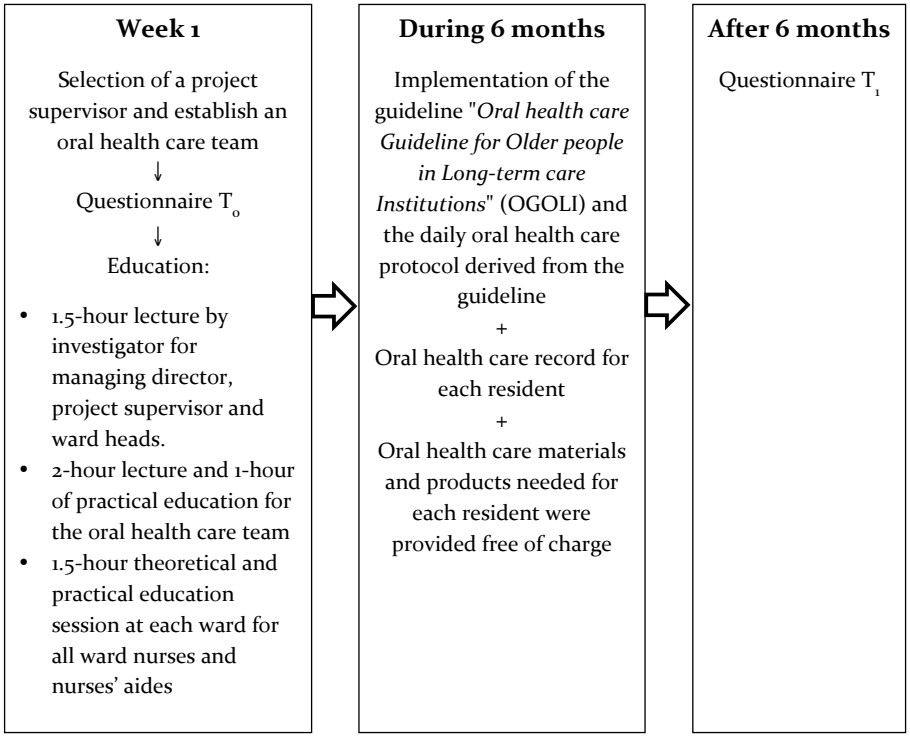
All nursing homes were situated in the two Belgian provinces East and West Flanders, with half of the nursing homes situated in provincial towns (33,000-117,000 citizens) and the other half situated in villages (8,317-24,000 citizens). The nursing homes employed between 46 and 72 nurses and nurses' aides, depending on the number of residents accommodated and their care dependency.

Intervention

The intervention (Figure 2) consisted of a supervised implementation of the guideline "*Oral health care Guideline for Older people in Long-term care Institutions*"

(OGOLI) and the daily oral healthcare protocol derived from the guideline (17-21). In each nursing home of the intervention group, a project supervisor with managerial capacities was selected. This could either be the managing director, a staff member or a registered nurse. An oral healthcare team was assembled in each nursing home and made responsible for the implementation process. This team comprised the project supervisor, at least two Ward Oral healthcare Organizers (WOO) per ward, a coordinating physician and optionally an occupational and/or speech therapist. The WOOs were mainly nurses or nurses' aides, but could also be occupational or speech therapists and were responsible for the implementation of the protocol on their ward.

Figure 2. Flowchart intervention



The intervention included three different educational stages with a pyramid-based structure. First, a 1.5-hour informative oral presentation on the guideline, the daily oral healthcare protocol, and the supervised implementation was given by the investigator (second author) before the start of the study. This presentation addressed the managing director, the project supervisor and the ward heads

with the objective to lay a strong institutional basis for the implementation project and the study. Second, a 2-hour lecture and 1-hour of practical education on the theoretical and practical essentials of the guideline were presented by the investigator and the dental hygienist for all members of the oral healthcare team. The participants were trained to practically educate and encourage the nurses and nurses' aides of their own wards to establish a train-the-trainer concept. Finally, the WOOs gave a 1.5-hour theoretical and practical education session at each ward for all ward nurses and nurses' aides. A summary of the guideline was presented and all oral hygiene actions, such as tooth brushing, were taught and demonstrated with ward residents on site. The WOOs had the additional task to encourage and assist the nurses and nurses' aides regularly in the daily delivery of oral healthcare. The investigator provided all tools and information needed for this education. When all educational stages were carried out, the oral health protocol was applied in the whole nursing home within a week.

The intervention also included setting up an oral healthcare record for each resident. For this purpose, the nurses and nurses' aides were trained during the practical education. This record consisted of an oral health status and an individualised oral healthcare plan. All oral healthcare materials and products needed for each resident were provided free of charge.

One of the investigators (second author) supervised the implementation process, supported by a dental hygienist (fourth author). This supervision consisted of monitoring visits every 6 weeks during which the project supervisor and the WOOs discussed the implementation process and study problems. For ethical reasons the intervention was implemented to the control nursing homes after completion of the data collection.

Data collection

The study was conducted during the first six months of 2010. A 34-item validated questionnaire evaluated the knowledge and attitude of nurses and nurses' aides. Data were gathered at baseline before the educational sessions (T_0) and 6 months after the start of the study (T_1) in both the intervention and the control group by inviting and stimulating all nurses and nurses' aides (n = 760) to complete the questionnaire. The pre- and post-questionnaires were matched through a unique code that anonymously identified the enquired person. If matching was impossible the respondent was considered a non-respondent.

The questionnaire contained three parts. The first part covered 15 personal items including age, gender, education, year of graduation, function at work, years of experience, ward and work scheme. The second part measured attitude through a set of four statements. The reliability of this part of the questionnaire was measured by a test-retest procedure in a comparable nursing home not involved in the study. The third part was composed of 15 statements assessing knowledge about oral pathology and oral hygiene. Content and construct validity was assessed by experts in the field of gerodontology including one dental hygienist and three dentists. Some examples of statements to measure knowledge and attitude were: "The symptoms of gingivitis are red, swollen and bleeding gums" (knowledge), "I consider it as my responsibility to take care of the residents' daily oral hygiene" (attitude).

Outcome variables

The primary outcome variables analyzed are nurses' and nurses' aides' knowledge on oral health and oral hygiene and their attitude towards it. Knowledge was assessed by summing the results of the 15 statements from the third part of the questionnaire. Options for response were "true", "false" and "I don't know". A correct answer was given score 1, a wrong answer score -1, "I don't know" and missing answers were given score 0. Results were standardized to 100, a high score corresponding to a high level of knowledge. Attitude was assessed by summing the results from the four statements of the second part of the questionnaire. Response options for the 3-point Likert scale were "agree", "neither agree or disagree" and "disagree", giving scores from 1 (disagree) to 3 (agree). Negatively worded statements were reverse-coded. Results were standardized to 100; the higher the total score, the better the attitude. The outcomes were assessed at an individual level at baseline and six months after the start of the study.

Explanatory variables

Several items were used as relevant explanatory variables in the analyses. First, group allocation (intervention or control) and personal items including age of nurses and nurses' aides (continuous variable dichotomized by the mean value), gender and level of education (nurses versus nurses' aides) were registered. Second, characteristics of the work situation comprising ward type (somatic, psycho-geriatric or mixed ward), work scheme (day, day-early-late, night, day-night) and working hours per week (continuous variable) were questioned. In addition, data were collected on theoretical and practical education on oral healthcare (not at all, insufficient, sufficient, more than sufficient, unknown), presence of instructions on oral healthcare at work (not at all, insufficient, sufficient, more than

sufficient, unknown) and possibility to improve or maintain skills on oral healthcare at work (not at all, insufficient, sufficient, more than sufficient, unknown) or extra training on oral healthcare outside the nursing home (never, rarely, sometimes, frequently, unknown). Finally, the personal oral hygiene habits were registered by tooth brushing and interdental cleaning frequency (less than once a day, once a day, twice a day, more than twice a day, unknown), the use of fluoridated toothpaste (never, rarely, sometimes, frequently, unknown) and dental attendance pattern (at least once a year, if aware need, if pain, irregular).

Statistical analysis

In the present study, the institution was the unit of randomization and the nurses and nurses' aides were the units of analysis. At baseline, differences between the variables of the control group and the intervention group were analyzed. Group means and medians were calculated for the primary outcome variables. For the bivariate analyses, non-parametric test were used and differences between the intervention and the control group were explored using the Mann–Whitney U test. Wilcoxon matched-pairs signed-ranks-test was used to explore differences between the outcome variables knowledge and attitude at baseline and after six months for both the intervention and the control group. Finally, linear mixed model analyses with random nursing home effect were performed to explore differences in knowledge and attitude at 6 months after implementation owing to the intervention and the predictive value of other relevant explanatory variables. Research data were analyzed using PASW statistics 18 (SPSS IBM cie).

Results

Of the total population of nurses and nurses' aides employed in the 12 nursing homes (N = 760), 651 (86%) filled out the questionnaire at baseline (T_0): 404 in the intervention group and 247 in the control group (**Figure 1**). Six months after the study started (T_1), 512 (67%) persons filled out the questionnaire: 300 in the intervention group and 212 in the control group. After matching by a unique code, 259 (34%) respondents were found, 165 belonging to the intervention group and 94 to the control group. All respondents were analyzed in the groups to which they were originally allocated (intention to treat analysis). In the group of respondents, the mean cluster size was 28 in the intervention group (range 7-44) and 16 in the control group (range 5-26). There were no significant differences between the respondents (n = 259) and non-respondents (n = 392) for the explanatory and outcome variables. Therefore, the group of respondents can be considered as a representative sample of the total group at baseline.

As shown in **Table 1**, 95 % of the total survey respondents at baseline were female and the mean age of all participants was 38.28 years (SD = 10.54). Almost two thirds of the participants (62.4%) were nurses' aides. The mean working experience in the nursing home was 13.52 years (SD = 9.27) and the mean working time 31.03 hours a week (SD = 7.77). Sixty-one percent reported they never received theoretical education concerning oral healthcare or reported that it was insufficient. Two third (66.0%) did not get (enough) instructions on oral health nor any practical education (70.1%) at their work place and only 3.9% received sometimes or frequently training on oral healthcare outside the nursing home. Fifty two percent (52%) of the participants in the intervention group indicated that they did not participate in the educational part of the intervention.

At baseline, no significant differences were observed between the intervention and the control group for both knowledge ($p = 0.42$) and attitude ($p = 0.37$; **Table 2**). Six months after the intervention, significant differences were found between the intervention and the control group for the variable knowledge in favor of the intervention group ($p < 0.0001$) but not for the variable attitude ($p = 0.78$; **Table 3**).

Table 1. Comparison of groups at baseline: personal characteristics, general knowledge and attitude towards own oral health

Variables	Total (n = 259)	Intervention (n = 165)	Control (n = 94)
PERSONAL ITEMS			
Age in years	**n = 259**	**n = 165**	**n = 94**
Mean (SD)	38.28 (10.54)	37.78 (10.69)	39.17 (10.26)
Gender	**n = 259**	**n = 165**	**n = 94**
Female	246 (95%)	156 (94.5%)	90 (95.7%)
Male	13 (5.0%)	9 (5.5%)	4 (4.3%)
Education	**n = 250**	**n = 157**	**n = 93**
Nurse	94 (37.6%)	56 (35.7%)	38 (40.9%)
Nurses' aide	156 (62.4%)	101 (64.3%)	55 (59.1%)
WORK SITUATION			
Working experience in present nursing home in years	**n = 254**	**n = 163**	**n = 91**
Mean (SD)	13.52 (9.27)	13.28 (9.79)	13.96 (8.26)
Working hours a week	**n = 248**	**n = 159**	**n = 89**
Mean (SD)	31.03 (7.77)	31.47 (7.42)	30.24 (8.34)
Ward	**n = 259**	**n = 165**	**n = 94**
Somatic	159 (61.4%)	94 (57.0%)	65 (69.1%)
Psycho-geriatric	82 (31.7%)	62 (37.6%)	20 (21.3%)
Mixed	18 (6.9%)	9 (5.5%)	9 (9.6%)
Work scheme	**n = 259**	**n = 165**	**n = 94**
Day	56 (21.6%)	27 (16.4%)	29 (30.9%)
Night	4 (1.5%)	0	4 (4.3%)
Day-early-late	173 (66.8%)	117 (70.9%)	56 (59.6%)
Day – night	26 (10.0%)	21 (12.7%)	5 (5.3%)
EDUCATION AT WORK			
Theoretical education on oral healthcare	**n = 258**	**n = 164**	**n = 94**
Not at all	65 (25.2%)	46 (28.0%)	19 (20.2%)
Insufficient	94 (36.4%)	67 (40.9%)	27 (28.7%)
Sufficient	66 (25.5%)	30 (18.3%)	36 (38.3%)
More than sufficient	20 (7.8%)	13 (7.9%)	7 (7.4%)
Unknown	13 (5.0%)	8 (4.9%)	5 (5.3%)
Instructions on oral healthcare at workplace	**n = 256**	**n = 163**	**n = 93**
Not at all	58 (22.7%)	40 (24.5%)	18 (19.4%)
Insufficient	111 (43.4%)	72 (43.6%)	39 (41.9%)
Sufficient	73 (28.5%)	42 (25.8%)	31 (33.3%)
More than sufficient	10 (3.9%)	7 (4.3%)	3 (3.2%)
Unknown	4 (1.6%)	2 (1.2%)	2 (2.2%)

Table 1. Continued

Variables	Total (n = 259)	Intervention (n = 165)	Control (n = 94)
EDUCATION AT WORK			
Practical education on oral healthcare	**n = 258**	**n = 164**	**n = 94**
Not at all	85 (32.9%)	63 (38.4%)	22 (23.4%)
Insufficient	96 (37.2%)	61 (37.2%)	35 (37.2%)
Sufficient	52 (20.2%)	25 (15.2%)	27 (28.7%)
More than sufficient	17 (6.6%)	11 (6.7%)	6 (6.4%)
Unknown	8 (3.1%)	4 (2.4%)	4 (4.3%)
Improve/maintain skills on oral healthcare at workplace	**n = 250**	**n = 158**	**n = 92**
Not at all	35 (14.0%)	25 (15.8%)	10 (10.9%)
Insufficient	84 (33.6%)	57 (36.1%)	27 (29.3%)
Sufficient	96 (38.4%)	51 (32.3%)	45 (48.9%)
More than sufficient	23 (9.2%)	15 (9.5%)	8 (8.7%)
Unknown	12 (4.8%)	10 (6.3%)	2 (2.2%)
Extra training on oral healthcare outside nursing home	**n = 254**	**n = 163**	**n = 91**
Never	213 (83.9%)	141 (86.5%)	72 (79.1%)
Rarely	22 (8.7%)	12 (7.4%)	10 (11.0%)
Sometimes	8 (3.1%)	4 (2.5%)	4 (4.4%)
Frequently	2 (0.8%)	1 (0.6%)	1 (1.1%)
Unknown	9 (3.5%)	5 (3.1%)	4 (4.4%)
PERSONAL ORAL HYGIENE HABITS			
Tooth brushing frequency	**n = 256**	**n = 162**	**n = 94**
< once a day	4 (1.6%)	4 (2.5%)	0 (0.0%)
Once a day	52 (20.3%)	32 (19.8%)	20 (21.3%)
Twice a day	166 (64.8%)	105 (64.8%)	61 (64.9%)
> twice a day	34 (13.3%)	21 (13.0%)	13 (13.8%)
Interdental cleaning	**n = 252**	**n = 160**	**n = 92**
< once a day	49 (19.4%)	31 (19.4%)	18 (19.6%)
Once a day	94 (37.3%)	61 (38.1%)	33 (35.9%)
Twice a day	79 (31.3%)	51 (31.9%)	28 (30.4%)
> twice a day	25 (9.9%)	14 (8.8%)	11 (12.0%)
Unknown	5 (2.0%)	3 (1.9%)	2 (2.2%)
Use of fluoridated toothpaste	**n = 251**	**n = 163**	**n = 92**
Never	7 (2.7%)	5 (3.1%)	2 (2.2%)
Rarely	8 (3.1%)	4 (2.5%)	4 (4.3%)
Sometimes	63 (24.7%)	40 (24.5%)	23 (25.0%)
Always	166 (65.1%)	107 (65.6%)	59 (64.1%)
Unknown	11 (4.3%)	7 (4.3%)	4 (4.3%)

Table 1. Continued

Variables	Total (n = 259)	Intervention (n = 165)	Control (n = 94)
PERSONAL ORAL HYGIENE HABITS			
Dental attendance pattern	**n = 257**	**n = 164**	**n = 93**
At least once a year	202 (78.6%)	127 (77.4%)	75 (80.6%)
If aware need	24 (9.3%)	18 (11.0%)	6 (6.5%)
If pain	16 (6.2%)	9 (5.5%)	7 (7.5%)
Irregular	15 (5.8%)	10 (6.1%)	5 (5.4%)

Table 2. Measurement scores for knowledge and attitude at baseline for both the intervention and the control group[1]

Variables	Control	Intervention	*p*-value
KNOWLEDGE			
n	84	140	
Mean (SD)	63.38 (11.10)	65.52 (11.57)	0.423
Range [min - max]	[30.0 - 96.7]	[40.0 - 100.0]	
ATTITUDE			
n	86	154	
Mean (SD)	50.73 (15.02)	51.95 (13.79)	0.369
Range [min - max]	[25.0 - 100.0]	[25.0 - 87.5]	

[1] The higher the score, the better the corresponding outcome variable

Table 3. Measurement scores for knowledge and attitude at six months1 for both the intervention and the control group[1]

Variables	Control	Intervention	*p*-value
KNOWLEDGE			
n	83	147	
Mean (SD)	68.31 (12.87)	83.83 (9.09)	**< 0.0001**
Range [min - max]	[33.3 - 100.0]	[60.0 - 100.0]	
ATTITUDE			
n	87	149	
Mean (SD)	54.57 (14.39)	54.86 (13.36)	0.780
Range [min - max]	[25.0 - 87.5]	[25.0 - 87.5]	

[1] The higher the score, the better the corresponding outcome variable

Table 4 shows the estimated differences between the intervention and control group means for knowledge and attitude after 6 months follow-up compared to baseline values, together with the 95% confidence intervals. These differences have been adjusted for the corresponding baseline value. The results confirmed the significant increase of knowledge ($p < 0.0001$) in the intervention group.

Table 4. Adjusted[1] differences between intervention and control group over a period of 6 months

Outcome	n	Baseline (SD) [Range]	After 6 months (SD) [Range]	Adjusted [1] difference (95% CI)	*p*-value
KNOWLEDGE					
Intervention	127	65.54 (11.84) [40.0 - 100.0]	83.91 (8.96) [60.0 - 100.0]	15.35 (12.58;18.11)	**< 0.0001**
Control	76	63.60 (10.94) [30.0 - 96.67]	67.85 (12.67) [33.0 - 100.0]		
ATTITUDE					
Intervention	139	52.61 (13.42) [25.0 - 87.5]	54.49 (13.45) [25.0 - 87.5]	-0.56 (-4.15;3.03)	0.76
Control	81	50.6 (15.3) [25.0 - 100.0]	54.41 (14.2) [25.0 - 87.5]		

[1] adjusted for corresponding baseline value as covariate; positive values indicate benefit for the intervention group.

Out of the mixed model with attitude at six months as the dependent variable it can be concluded that age is an important determinant, participants older than the mean age of 38 years have a better attitude than those younger than the mean age ($p = 0.031$). Further significant determinants for attitude at six months were educational level and ward with a better attitude for nurses' aides compared to nurses ($p = 0.009$) and for those working on a psycho-geriatric ward compared to those working on a mixed ward ($p = 0.014$; Table 5). The mixed model with knowledge at six months as dependent variable resulted in a positive significant effect of the intervention ($p = 0.001$) and the educational level ($p = 0.009$) with nurses showing higher knowledge than nurses' aides (Table 6). Other parameters did not have any significant effect on the knowledge nor the attitude after 6 months.

Table 5. Linear mixed model analysis for dependent variable attitude at six months

Parameter	Estimate	Std. Error	*p*-value
Intervention			
Control group	-0.02	1.91	0.992
Intervention group	0[1]	0	
Age			
< Mean age	-3.91	1.80	**0.031**
>Mean age	0[1]	0	
Education			
Nurse's aide	4.97	1.87	**0.009**
Nurse	0[1]	0	
Ward			
Somatic ward	6.96	4.12	0.093
Psycho-geriatric ward	10.61	4.29	**0.014**
Mixed ward	0[1]	0	
Work scheme			
Work scheme day	2.56	3.51	0.466
Work scheme night	5.07	10.58	0.632
Work scheme day-early-late	0.91	3.05	0.765
Work scheme day-night	0[1]	0	

[1] This parameter is set to zero because it is redundant

Table 6. Linear mixed model analysis for dependent variable knowledge at six months

Parameter	Estimate	Std. Error	*p*-value
Intervention			
Control group	-16.22	3.61	**0.001**
Intervention group	0[1]	0	
Age			
< Mean age	-0.66	1.31	0.616
>Mean age	0[1]	0	
Education			
Nurse's aide	-4.55	1.32	**0.001**
Nurse	0[1]	0	
Ward			
Somatic ward	2.10	3.04	0.491
Psycho-geriatric ward	5.28	3.21	0.101
Mixed ward	0[1]	0	
Work scheme			
Work scheme day	3.09	3.16	0.330
Work scheme night	12.02	6.45	0.064
Work scheme day-early-late	-1.27	2.80	0.649
Work scheme day-night	0[1]	0	

[1] This parameter is set to zero because it is redundant

Discussion

Few controlled studies exist measuring the increase of knowledge in an intervention group compared to a control group (24,25). The results of the present study show a significant improvement of knowledge in both study groups with this increase being significantly higher in the intervention group compared to the control group. A study of Phu Le *et al*. (24) also showed increased knowledge in both the intervention and the control group but without significant group differences. A possible explanation for the knowledge improvement in the control group might be the Hawthorne effect: drawing attention to a topic such as oral health and knowing that one participates in a study, encourages enhancement of knowledge. In addition, low baseline knowledge is a facilitating factor to achieve also increased knowledge in the control group. The study of Frenkel *et al*. (25) resulted in significant group differences for the composite knowledge score, in favor of the intervention group ($p < 0.0001$). This is similar to the results of the present study, however, the study of Frenkel did not give separate results for each group. In addition, a few studies measuring changes in knowledge have used an uncontrolled before-after design (14,26), all of them with significant improvements in knowledge after education. In this study, besides the intervention, the level of education was the only predicting co-variable for the knowledge on oral healthcare. This result differs from Frenkel *et al*. (25) where age and dental attendance pattern were predicting co-variables.

Despite the intervention, there was no significant difference ($p = 0.76$) in the increase of attitude between the control and the intervention group. This could be due to the limited power (66%) resulting from the low number of matches between the pre- and post-questionnaires in the control group. With the exception of the study of Frenkel *et al*. (25), methodological differences between our study and previous reported studies with attitude as an outcome variable (16,26,27), hamper us to compare results. In contrast to the present study, Frenkel *et al*. (25) reported significant differences in the increase of attitude after six months between both study groups. A professional health promoter with certificates in health and dental health education and 20 years of experience presented the intervention (25). Appeal to these professionals for oral health education needs to be considered, as it could have an important influence on the attitude. After the education session, the participants in the above mentioned study had the opportunity to discuss their feelings about oral health. These discussions might also improve attitude (22).

Attitudes are very complex and intertwined with a variety of factors (28). The mixed model analysis revealed three predicting variables for attitude: the age, the educational level of the participants and the ward they were working at. Unlike the findings reported in the study of Frenkel *et al*. (25), participants older than the mean age of 38 years appear to have a better attitude compared to their younger counterparts. This could suggest a positive influence of a long career as nurse or nurses' aide in a nursing home on attitude towards oral health. In addition, it might also suggest that the lack of theoretical and practical education on oral health can result in a negative attitude of recently graduated caring staff. Although nurses demonstrated a higher knowledge on oral healthcare compared to their aides, they appear to have a less favorable attitude. The better attitude of nurses' aides could be explained by the nurses' aides being more involved in the daily oral care of the residents compared to nurses. Being responsible for the oral hygiene of the residents may influence the attitude towards it. The above-mentioned finding about the knowledge and the attitude of nurses demonstrates that these are two separate parameters given that an increased knowledge does not necessarily lead to an increased attitude. Consequently, they may need to be addressed in a different way. Furthermore, nurses and nurses' aides working on a psycho-geriatric ward had a better attitude than those working on a mixed ward. For now, we do not have sufficient information to explain this result. It might be due to differences in the oral health status of the residents or the ability of the caring staff working on a psycho-geriatric ward to cope with resistant behavior of the residents. Further qualitative research may be useful to gain more insight in this finding.

Limitations

The educational part of the intervention had a pyramid-based structure: The WOOs passed their knowledge and skills, obtained during the education for the oral healthcare team, to the nurses and nurses' aides of their ward. After the intervention, only half of the participants in the intervention group (48%) reported that they participated in the educational programme. Similar findings on low coverage efficiency of a pyramid-based educational programme, was shown in previous research of MacEntee *et al.* (29). Frenkel *et al.* (25) did not apply a pyramid based structure and reported an attendance to the oral health education of 65%. Consequently, this structure might not have been ideal to achieve the maximum effect of the intervention applied in the present study. Other reasons for the low level of attendance to the educational programme might be the high workload, the work scheme, the low priority given to oral healthcare and the absence of an obligation to attend the educational sessions. All the above-men-

tioned issues might have resulted in bias. The direction of the error caused by the bias can never be known with certainty, the most that can be said is that the result is probably underestimated because with an increasing degree of participation in the intervention group, knowledge should have increased accordingly. However, the difference in increase of knowledge between the intervention and control group was significant ($p < 0.0001$), in favor of the intervention group, suggesting a lot of informal sharing of knowledge during work.

By matching the questionnaires, we avoided selection bias. Despite the high response rates in both study groups, only 259 matches were found between the questionnaires at T_0 and T_1. Yet, it can be considered as a representative sample of the population of caring staff as there were no significant differences at baseline between the respondents (matched) and non-respondents (not matched) for the explanatory and the outcome variables. The participants had to fill in a unique code before completing the questionnaire consisting of two parts: the initials of the participants' name and a date of birth, not necessarily their own. After 6 months many of the participants didn't remember the code they chose at baseline. In future research, a better method should be applied to anonymously match forms obtained at different moments in time. Before the start of the study, a sample size of 150 pairs was calculated to obtain a power of 80% for attitude but the low number of matches in the control group resulted in a limited power of 66%.

In this study, attitude was measured by only four questions, which might have led to a poor discriminant validity of this part of the questionnaire. When implementing further research on this topic, a more extensive questionnaire could be considered similar to the one of Frenkel *et al*. (25) consisting of 25 statements.
In a previous article (19), improvements in dental, denture and tongue plaque between baseline and after six months were measured. No statistical differences were found between both study groups for dental plaque and tongue plaque, only for denture plaque. Together with the results of the present study, this indicates rather strongly that behavioral change cannot be obtained only by an increased knowledge. Adequate oral healthcare also requires awareness of the importance of establishing a good oral health status and even more important, the right attitude towards it. Significant differences in denture and tongue plaque in residents were found between the different nursing homes suggesting that individual factors, difficult to assess in a quantitative approach and characteristic for each institution, will play an important role in the final outcome.

The study of Weening-Verbree *et al.* (22) indicated that of all strategies improving oral health those addressing a combination of knowledge, self-efficacy and facilitation of behavior are the most successful ones. The educational part of the present intervention was mainly focused on the increase of knowledge and self-efficacy. The oral healthcare behavior was facilitated by several aspects of the intervention such as the installation of an oral healthcare team, the implementation of an oral healthcare protocol, the provision of oral healthcare materials, the introduction of oral healthcare records and the supervision during the trial. Nevertheless, these aspects did not seem to improve the attitude. As a consequence of the finding that attitude and knowledge might be two independent variables that need to be addressed in a different way, qualitative research was performed in the same group of nurses and nurses' aides that participated in this study (30). This qualitative research revealed attitude of nurses and nurses' aides as one of the important barriers towards oral hygiene support. As a consequence, future oral healthcare interventions should focus on these barriers.

Based on the results of the present study and previous research (19,30) future research on changes in knowledge and attitude is planned. This research will focus on more extensive and individualized education and (personal) coaching at the level of the residents and the staff. Additionally, preventive and curative treatment of the residents will be provided on site by regular visits of a dental team with a mobile unit. The changes in both knowledge and attitude will be measured by a more extensive questionnaire.

Conclusion

The intervention applied in this study significantly improved knowledge in both study groups with the increase being significantly higher in the intervention group compared to the control group. In contrast, no significant improvements could be demonstrated in attitude. As a consequence, the hypothesis of an increased knowledge in the intervention group can be accepted while the hypothesis of an improved attitude in the intervention group should be rejected. More in depth research on the improvement of attitude of care staff is needed.

Acknowledgements

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Chapter IV

The impact of an oral healthcare programme on the knowledge and attitude of nurses and nurses' aides.

Part II:

Effect of an oral healthcare programme on care staff knowledge and attitude regarding oral health: a non-randomised intervention trial

This chapter is an edited version of the manuscript:
Janssens B, Vanobbergen J, Lambert M, Schols JMGA, De Visschere L.
Effect of an oral healthcare programme on care staff knowledge and attitude regarding oral health: a non-randomised intervention trial.
Clinical Oral Investigations. 2017. doi: 10.1007/s00784-017-2110-6

Abstract

Objectives: To evaluate the effect of an oral healthcare programme in nursing homes on care staff knowledge and attitude regarding oral health.
Methods: The study sample consisted of the nurses and nurses' aides from 63 nursing homes, which either received an oral healthcare programme including mobile dental care or were on a waiting list to receive this programme. A validated questionnaire completed at baseline and again after the study period assessed the care staff knowledge and attitude. Paired t-test, independent t-test, general linear and linear mixed models were used to examine the changes in attitude and knowledge scores.
Results: In total, 546 questionnaires were completed by the same people from 36 nursing homes at baseline and on completion of the study. After the intervention period, knowledge significantly improved in both study groups (I: $p < 0.001$; C: $p < 0.001$), the intervention group significantly showing the largest increase ($p < 0.001$). The outcome variable attitude only showed a significant improvement in the intervention group ($p < 0.001$). The mixed models confirmed the impact of some aspects of the intervention on the attitude and the knowledge of the caregivers.
Conclusions: The oral healthcare programme including a mobile dental team resulted in a significant increase of the care staff knowledge and attitude regarding oral health.
Clinical relevance: The integration of a dental professional team in nursing home organisations should be encouraged because it could be valuable to tackle barriers for the provision of daily oral hygiene and to support the continuous integration of oral healthcare into general care.

Introduction

Poor oral health among nursing home residents due to insufficient oral hygiene is a widespread and well-reported problem (1–5). Impaired nursing home residents frequently depend on the care staff's goodwill to provide them with good oral hygiene. Nurses and nurses' aides tend to say they give good oral healthcare (6–9) but when they are observed at work, they seem to be unable to act upon their intentions (10).

To change the nurses' and nurses' aides behaviour, it is necessary to overcome barriers to the provision of good daily oral healthcare. Much attention has been given in the literature to the identification of these barriers (6,9,11–15). A lack of knowledge of oral health and a negative attitude towards oral healthcare are two important barriers that have been addressed by educating the nurses and nurses' aides. Various studies of such education programmes have indicated that due to this education, knowledge improved, but reported conflicting results regarding changes in attitude (16–20). A recent systematic review and meta-analysis by Wang *et al*. (21) found limited evidence that oral health education for caregivers may be effective for improving the oral health of the older people. In contrast, the systematic review by De lugt-Lustig *et al*. (22) stated that there was no scientific evidence for the potential association between oral healthcare education and the improvement of the oral hygiene skills of the nursing home staff. A study by Zenthöfer *et al*. (23) suggests that to obtain a long-term effect, a more continuous intervention is needed at different levels within the nursing home.

Besides the barriers to providing good daily oral hygiene, a number of studies have reported on the barriers to adequate professional dental care for nursing home residents. Dentists are often unwilling to treat the residents outside of their offices because of a lack of mobile dental equipment and adequate financial remuneration. In addition, they do not feel confident about their knowledge on the treatment of frail older people. There is a lack of cooperation between the nursing home staff and families to arrange dental visits and there are financial concerns among the nursing home staff, the residents and their families (24–28). On the other hand, nursing home directors, nursing staff, residents and their families are increasingly requesting dental professionals to treat the residents on site (29–31).

A long-term pilot study by Wårdh *et al*. (32–34) revealed that introducing oral care aides in nursing homes could have a positive long-term effect on the oral health of the residents and on individual experiences concerning oral healthcare among the nursing staff. In the pilot project studied by Wårdh *et al*., oral care aides were responsible for the communication with the dental professionals; they ensured that each resident recieved an oral health assessment and an oral healthcare plan; they informed staff of oral healthcare issues at staff meetings; they were available for questions regarding oral healthcare put by other staff and residents or their relatives; they documented the oral healthcare provided; and, were responsible for the equipment needed for daily oral hygiene (32). Another pilot study by Pronych *et al*. (35) demonstrated the achievement of similar results by introducing oral health coordinators with tasks similar to those of the oral care aides.

Taking into account the above-mentioned barriers and pilot study findings, the BENECOMO research group (Flemish-Netherlands Geriatric Oral Research Group) developed a preventive and curative oral healthcare programme for nursing homes. The programme, which was first implemented in 2010, included: (1) the introduction of an oral healthcare team in the nursing home, consisting of oral care aides at the different wards of the nursing homes and one oral health coordinator per nursing home to coordinate and improve communication between the oral care aides and to take responsibility for the oral healthcare programme (32–35); (2) the education for the managing director, and for the nurses and nurses' aides, including hands-on training to promote knowledge and self-efficacy (36,37); (3) the implementation of the guideline "*Oral healthcare Guideline for Older people in Long-term care Institutions*" (OGOLI) and the daily oral healthcare protocol derived from the guideline (38–42); (4) regular visits of a mobile dental team to support the nursing staff and to deliver preventive and curative oral healthcare for nursing home residents who could not access regular dental care.

Previously conducted research, revealed that the introduction of the first three aspects of the programme significantly improved the knowledge of the nurses and nurses' aides six months after the education was given. In contrast, no significant differences could be found in their attitude (17; Chapter 4 part 1).

As far as the authors are aware, little is known about the impact of the fourth aspect of the programme – regular visits of the mobile dental team, supporting the nursing staff with both preventive and curative care – on the knowledge and attitude of nurses and nurses' aides.

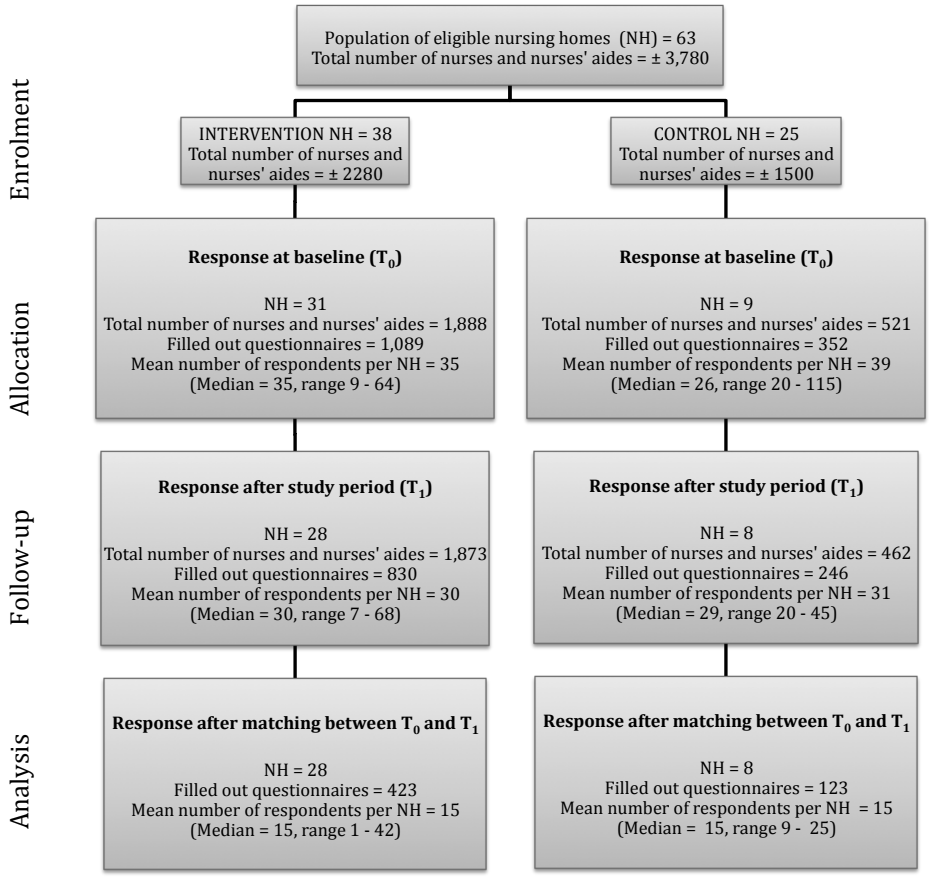
The present research paper aims to evaluate the additional long-term effect of a preventive and curative oral healthcare programme including the support of a mobile dental team on the knowledge and the attitude of nurses and nurses' aides, and to identify the variables influencing possible changes in knowledge and attitude.

Materials and methods

Study design, study population, study sample and study settings

The present study is a non-randomised controlled intervention trial. The study population for this trial consisted of nurses and nurses' aides of 63 nursing homes in two Flemish provinces in Belgium (= 18% of the nursing homes in these provinces) and these nursing homes were divided into two groups. The first group (intervention group) implemented the preventive and curative oral health-care programme as described above and received preventive and curative oral healthcare by the mobile dental team (38 nursing homes) and the second group (control group) was on a waiting list to start all aspects of the oral healthcare programme, (25 nursing homes). There were no additional exclusion or inclusion criteria for the nursing homes to participate in the study. The nursing homes were contacted by telephone to invite their participation. In total, 40 nursing homes (63% of the total population of eligible nursing homes) employing 2,409 nurses and nurses' aides were willing to participate in the study: 31 in the intervention group (1,888 nurses and nurses' aides) and 9 in the control group (521 nurses and nurses' aides). The nursing homes employed between 29 and 134 nurses and nurses' aides, depending on the number of residents accommodated and their care dependency (**Figure. 1**).

Figure 1. Flow chart of the trial, adapted from: Campell et al. [47]



Intervention

All four aspects of the oral healthcare programme as described briefly in the introduction comprised the intervention of this study. The first three parts of the intervention in this study were similar to the intervention described in an earlier research paper (17; Chapter 4 Part 1). In each nursing home of the intervention group, an oral healthcare team was installed and assigned responsibility for the implementation of the guideline "Oral healthcare Guideline for Older people in Long-term care Institutions" (OGOLI) and the daily oral healthcare protocol derived from the guideline (38–42). This oral healthcare team comprised one oral health coordinator and at least one oral care aide per ward in each nursing home, all members of the oral healthcare team were already existing nursing home staff willing to take the responsibility. The oral health coordinators were

mainly nurses or nurses' aides but could also be occupational or speech therapists, whilst the oral care aides were nurses or nurses' aides. As described in the introduction, the oral care aides and the oral health coordinators had a crucial role to play in improving and coordinating communication on oral health at all levels in the nursing home.

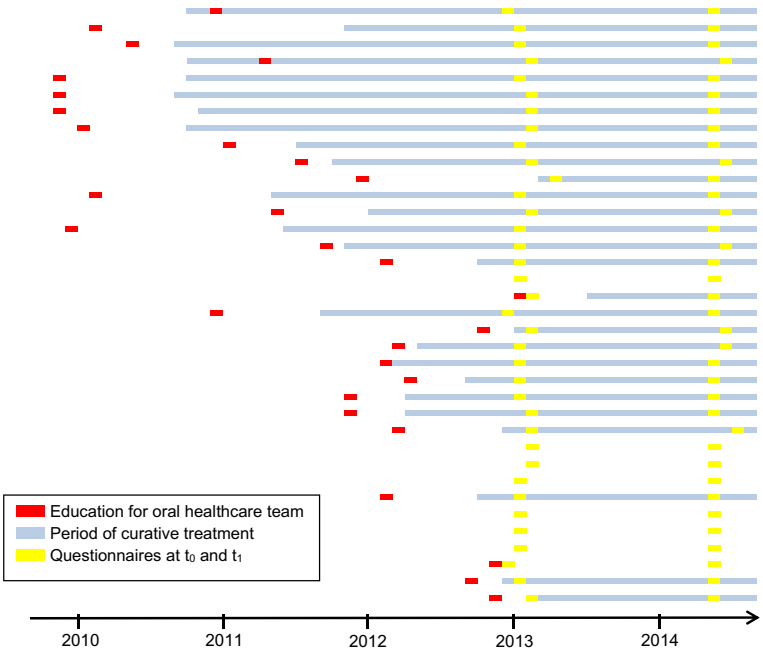
In addition, education was given at three levels. First, theoretical background on the guideline and the oral healthcare protocol was provided to the managing director, the oral health coordinator and the ward heads. Second, the oral healthcare team received theoretical background on oral health (common oral pathologies and prosthetic devices, oral hygiene equipment and protocols), along with practical advice and training on how to perform oral hygiene with the residents of the nursing home on site. Members of the research team gave the first two levels of education. Finally, the oral care aides educated the nurses and nurses' aides on their own wards (train-the-trainer concept). The oral care aides were asked to make an oral health record for each resident of the nursing home, including the resident's oral status, the need for oral treatment, the equipment needed to perform daily oral hygiene, and the decision on who would deliver the daily oral healthcare. The presence of an oral healthcare record aimed to facilitate behaviour and to mobilize the social norm.

The final part of the intervention consisted of a mobile dental team visiting the nursing homes to support the implementation of the oral healthcare protocol and to deliver preventive and curative treatment on site to those residents who were unable to visit regular dental service facilities due to physical or cognitive impairment. The mobile dental team consisted of one or two dentists from the research team and one or two dental assistants, depending on the day of the week, and worked inside the nursing homes for at least one full day at a time. The amount of days the mobile dental team was active depended on the emancipatory preventive and curative treatment needs of the residents. The dental team was fully equipped to permit all basic treatments of a regular dental clinic. The mobile dental team applied during their visits in the nursing homes of the intervention group strategies that were emphasised in previous research. They focused on 1) increasing memory through discussions, answering questions and clarifying information, 2) feedback on clinical outcomes, and 3) mobilizing the social norm (37). The mobile dental team discussed the oral health of the residents with the residents themselves, the care staff, and if possible, family members; they answered questions and clarified information. The dental team gave feedback on the clinical outcomes of the daily oral healthcare by oral and

written communication. The mobile dental team worked in the presence of a member of the oral healthcare team of the nursing home to put the residents at ease. As a consequence, an informal repeated education approach was established, as already suggested in a previous study (43).

Figure 2 illustrates the intervention on a time scale for each nursing home included in this study, showing the start of the education process and the period that the mobile dental team was active in the nursing home. A phased approach was used to implement the 4 aspects of the oral healthcare programme. These four phases are typically sequential, where the prior phase is completed before the beginning of the next phase. Before the start of the study period, in the nursing homes of the intervention group, the oral healthcare programme had on average been implemented for a 21-month period (SD = 12.42) during which the mobile dental team had on average been present for a 15-month period (SD = 10.16), delivering oral care on an average of 11 days a year (SD = 7.59). Nursing homes belonging to the control group did not receive any aspect of the intervention.

Figure 2 Visualisation of the study, with each nursing home represented by a different line in the figure



Data collection

Data collection took place at the beginning (T_0) and at the end (T_1) of a study period averaging 16 months (ranging from 13 to 18 months depending on the moment when the nursing homes handed out the questionnaires to the nurses and nurses' aides; Figure 2). Data collection was performed using a validated questionnaire, disseminated by post, assessing the knowledge and attitude of the nurses and nurse aides. Only those nursing homes participating at baseline were invited to distribute the questionnaires at the end of the study period. The pre- and post- questionnaires were matched through a unique code that anonymously identified the respondent. If matching was impossible, the respondent was considered a non-respondent.

The questionnaire was divided into three parts. The first part of the questionnaire covered demographic variables and variables related to the working situation and the intervention. The second part included 15 questions assessing knowledge of oral pathology and oral hygiene and the third part measured attitude towards oral health through a set of 28 statements. Information on the validation process for the knowledge items can be found in a previously conducted study (17; Chapter 4 part 1), and for the items on attitude, in an upcoming article of Lambert *et al*.

Outcome variables

The primary outcome variables were nurses' and nurses' aides' knowledge and attitude. Knowledge was assessed by summing the results of the 15 statements from the second part of the questionnaire. The response options were 'true', 'false' and 'I don't know'. A correct answer was given a score of 1, a wrong answer, a score of -1, and 'I don't know', a score of 0. Results were standardised to 100, with a high score corresponding to a high level of knowledge. Attitude was assessed by summing the results of the 28 statements from the third part of the questionnaire. Response options formed a 4-point Likert scale consisting of 'strongly agree', 'agree', 'disagree' and 'strongly disagree', giving scores ranging from 1 (strongly disagree) to 4 (strongly agree). Negatively worded statements were reverse coded. Results were standardised to 100: the higher the total score, the better the attitude. The outcomes were assessed at an individual level at the beginning and at the end of the study period.

Explanatory variables

Several explanatory variables were considered to be relevant in the analysis. First, group allocation (intervention or control) and personal items of the nurses and nurses' aides such as age, gender and level of education (nurse or nurse's aide)

were used as explanatory variables. Second, aspects related to the work situation of the nurses and nurses' aides were used, including their working experience in the present nursing home and the type of ward they were working at (somatic, psycho-geriatric or mixed ward). Finally, data related to the intervention were considered, comprising the presence of an oral healthcare team, being a member of the oral healthcare team, education on oral healthcare, personal contact with members of the mobile dental unit, the total duration of the oral healthcare project in months, the total duration of curative oral healthcare by the mobile dental team, the time since the last visit of the mobile dental unit in months, the duration of the study period in months, and the number of days and times the mobile dental unit was present in the nursing home during the study period.

Statistical analysis

All the analyses were performed at the level of the nurses and nurses' aides, adjusting for the random effect of the nursing home. At baseline, descriptive analyses of all explanatory variables were performed to compare the intervention and control groups. To avoid loss of data due to incomplete questionnaires, multiple imputation was performed. Data were missing at random and a pooled dataset was generated based on multiple-imputed datasets. This pooled dataset was used to calculate total knowledge and attitude scores and to perform further analyses on the outcome variables.

Differences in knowledge and attitude within and between the intervention group and the control group were explored by means of a paired t-test and an independent t-test respectively. A general linear-model, univariate procedure was utilised to examine the differences in attitude and knowledge scores between the intervention and control groups, with baseline scores included as a covariate. Finally, linear mixed model analyses with random nursing home effect were performed to explore the differences in knowledge and attitude after the study period owing to the intervention and the predictive value of other relevant explanatory variables. Tests resulting in p-values <0.05 were considered significant. All analyses were performed using SPSS for windows version 22 (SPSS Inc., Chicago, IL, USA).

Results

At the level of the nursing homes, the response rate was 63% at baseline (40 of the 63 nursing homes) and 57% at the end of the study period (36 of the 63 nursing homes; Figure 1). At the level of the nurses and nurses' aides, the response rate was 38% at baseline (1,441 of the 3,780 nurses and nurses' aides) and 28% after the study period (1,076 of the 3,780 nurses and nurses' aides). In total, the questionnaires of 546 nurses and nurses' aides from 35 nursing homes, 423 in the intervention group and 123 in the control group, could be matched between both moments of data collection through a unique code consisting of the nurses and nurses' aides initials and birthdays. These nurses and nurses' aides were considered the respondents in this study. All respondents were analysed in the groups to which they were originally allocated (intention to treat analysis). In the group of respondents, the mean number of nurses and nurses' aides per participating nursing home was 15 both in the intervention group (range 1–42) and the control group (range 9–25).

Comparing the group of respondents (n = 546) with the non-respondents (n = 895), significant differences were found in education and knowledge at baseline. Among the respondents, a higher proportion of nurses ($p < 0.05$) and a higher knowledge ($p < 0.001$) were observed compared to the group of non-respondents.

Table 1 shows a mean age of 38.90 years (SD = 10.86) of the respondents, almost all of them being women (93.2%). Out of the total group, 317 (58.2%) persons were educated as a nurse's aide and 228 (41.8%) as a nurse, mainly working on a mixed ward (57.4%) with a mean working experience in the nursing home of 12.17 years (SD = 10.43). There were no significant differences between the intervention and the control group for these variables. In the intervention group, 409 (96.7%) respondents knew there was an oral healthcare team present in the nursing home, 69 (16.3%) were members of this team and 302 (68.5%) received education on oral health. At the end of the study period, 35% of the nurses and nurses' aides confirmed they had personal contact with one of the members of the mobile dental team. During the study period averaging 16 months, the mobile dental team had on average been present for 6 days (SD = 2.15).

There was a statistically significant difference between the two study groups for the baseline value of the outcome variable 'knowledge' ($p < 0.001$) in favour of the intervention group (Table 2), whereas no significant differences could

be found for 'attitude' (p = 0.13). After the study period, the outcome variables of both knowledge and attitude scored significantly higher in the intervention group compared to the control group ($p < 0.001$). Knowledge showed significant improvement in both study groups (I: $p < 0.001$; C: $p < 0.001$), with the intervention group significantly showing the largest increase ($p < 0.001$) after adjustment for baseline values. The outcome variable 'attitude' only showed a small but significant improvement in the intervention group ($p < 0.001$).

Table 1. Comparison of groups at baseline: personal characteristics and work situation[1]

Variables	Total (n = 546)	Intervention (n = 423)	Control (n = 123)
Age in years	**n = 543**	**n = 421**	**n = 122**
	38.90 (10.86)	38.62 (10.90)	39.87 (10.70)
Gender	**n = 546**	**n = 423**	**n = 123**
Female	509 (93.2%)	393 (92.9%)	116 (94.3%)
Male	37 (6.8%)	30 (7.1%)	7 (5.7%)
Education	**n = 545**	**n = 422**	**n = 123**
Nurse	228 (41.8%)	171 (40.5%)	57 (46.3%)
Nurse's aide	317 (58.2%)	251 (59.5%)	66 (53.7%)
Working experience in present nursing home in years	**n = 545**	**n = 423**	**n = 122**
	12.17 (10.43)	11.71 (10.17)	13.75 (11.17)
Ward	**n = 545**	**n = 422**	**n = 123**
Somatic	76 (13.9%)	67 (15.9%)	9 (7.3%)
Psycho-geriatric	156 (28.6%)	136 (32.2%)	20 (16.3%)
Mixed	313 (57.4%)	219 (51.9%)	94 (76.4%)
Oral healthcare team in nursing home	**n = 546**	**n = 423**	**n = 123**
Yes	431 (78.9%)	409 (96.7%)	22 (17.9%)
No	115 (21.1%)	14 (3.3%)	101 (82.1%)
Member of the oral healthcare team	**n = 546**	**n = 423**	**n = 123**
Yes	75 (13.7%)	69 (16.3%)	6 (4.9%)
No	471 (86.3%)	354 (83.7%)	117 (95.1%)
Education on oral healthcare for oral healthcare team	**n = 546**	**n = 441**	**n = 105**
Yes	94 (17.2%)	94 (21.3%)	0 (0.0%)
No	452 (82.8%)	347 (78.7%)	105 (100.0%)
Education on oral healthcare by oral healthcare team	**n = 546**	**n = 441**	**n = 105**
Yes	212 (38.8%)	208 (47.2%)	4 (3.8%)
No	334 (61.2%)	233 (52.8%)	101 (96.2%)

[1] Data are means (SD) or numbers (%).

Table 2. Measurement scores for knowledge and attitude for both the intervention group and the control group[1] and the adjusted[2] differences between intervention group and control group over the study period

Outcome	*n*	Baseline (mean(SD)) [Range]		After study period (mean(SD)) [Range]		Adjusted[2] difference (95% CI)	*p*-Value
Knowledge							
Intervention	423	49.44 (18.74) [-6.67 – 86.67]	***	67.22 (18.23) [0.00 – 100.00]	***	10.98 (7.19 to 14.77)	**< 0.0001**
Control	123	41.84 (21.45) [-13.33 – 86.67]		52.63 (27.68) [-33.33 – 100.00]			
Attitude							
Intervention	423	77.36 (5.89) [55.36 – 97.32]		78.49 (6.05) [59.82 – 95.54]	***	1.93 (0.97 to 2.90)	**< 0.0001**
Control	123	76.45 (5.61) [65.18 – 93.75]		76.01 (5.59) [61.61 – 90.18]			

[1] The higher the score, the better the corresponding outcome variable.
[2] Adjusted for corresponding baseline value as covariate; positive values indicate benefit for the intervention group.
*** $p < 0.0001$

The mixed model with 'knowledge improvement' as the dependent variable revealed a positive significant effect of educational level ($p < 0.001$), with nurses demonstrating a better knowledge than nurses' aides (Table 3). Also, the presence of an oral healthcare team in the nursing home ($p = 0.037$) and having personal contact with the mobile dental team ($p = 0.005$) had a significant impact on knowledge improvement. Having high scores, at the start of the study period, for acquired knowledge and attitude ($p < 0.001$; $p = 0.001$) proved to be a predictive value for knowledge improvement. The higher the number of days the mobile dental team was present during the study period and the longer the study period, the higher the level of knowledge improvement ($p = 0.006$). An interaction was observed showing that the effect of acquired knowledge and attitude at the start of the study period on knowledge at the end of the study period varied across the level of presence of the mobile dental team ($p = 0.041$; $p = 0.022$). Significant determinants for the improvement of attitude were being a member of the oral healthcare team ($p = 0.021$) and the attitude at the start of the study period ($p < 0.001$), with a high value resulting in a higher level of improvement (Table 4). The other parameters did not significantly affect the improvement of knowledge and attitude.

Table 3. Linear mixed model analysis for dependent variable 'difference in knowledge between T_0 and T_1'

Parameter	Estimate [95% CI]	SE	*p*-Value
Intervention			
Control group	6.44 [-7.34; 20.21]	7.03	0.360
Intervention group	0[1]	.	.
Age	-0.03 [-0.30; 0.23]	0.14	0.801
Gender			
Female	4.46 [-1.59; 10.50]	3.08	0.148
Male	0[1]	.	.
Education			
Nurse's aide	-5.71[-8.92; -2.49]	1.64	**< 0.001**
Nurse	0[1]	.	.
Number of years since graduation	0.12 [-0.13; 0.38]	0.13	0.338
Ward			
Mixed ward	0.85 [-2.74; 4.43]	1.83	0.643
Somatic ward	0.18 [-4.77; 5.13]	2.52	0.944
Psycho-geriatric ward	0[1]	.	.
Oral healthcare team			
Not present	-8.03 [-15.58; -0.47]	3.85	**0.037**
Present	0[1]	.	.
Member of oral healthcare team			
No	-0.82 [-5.96; 4.32]	2.62	0.754
Yes	0[1]	.	.
Education on oral healthcare			
No education	-3.58 [-8.19; 1.03]	2.34	0.127
Education during intervention	2.73 [-2.00; 7.46]	2.40	0.257
Education before intervention	0[1]	.	.
Contact with mobile dental team			
Yes	5.70 [1.71; 9.69]	2.03	**0.005**
No	0[1]	.	.
Time since last visit of mobile dental team			
No visits	0[1]	.	.
> 6 months	2.23 [-4.59; 9.04]	3.48	0.521
< 6 months	0[1]	.	.
Baseline knowledge	-0.55 [-0.69; -0.42]	0.07	**<0.001**
Baseline attitude	0.81 [0.31; 1.31]	0.25	**0.001**
Number of days the mobile dental team was present during the study period	10.49 [3.06; 17.93]	3.79	**0.006**
Number of times the mobile dental team was present during the study period	0.76 [-5.01; 6.53]	2.95	0.796
Duration of the study period	3.38 [0.72; 6.04]	1.36	**0.013**

Table 3. Linear mixed model analysis for dependent variable 'difference in knowledge between T_0 and T_1'

Parameter	Estimate [95% CI]	SE	*p*-Value
Total duration of oral healthcare project	0.38 [-0.05; 0.81]	0.22	0.086
Total duration of curative oral healthcare by mobile dental team	-0.36 [-0.89; 0.18]	0.27	0.192
Attitude at baseline * Number of days the mobile dental team was present during the study period	-0.11 [-0.21; -0.02]	0.05	**0.022**
Knowledge at baseline * Number of days the mobile dental team was present during the study period	-0.03 [-0.06; 0.00]	0.01	**0.041**
[1] This parameter is set to zero because it is redundant.			

Table 4. Linear mixed model analysis for dependent variable 'difference in attitude between T_0 and T_1'

Parameter	Estimate [95% CI]	SE	*p*-Value
Intervention			
Control group	-0.95 [-4.34; 2.43]	1.73	0.581
Intervention group	0[1]	.	.
Age	0.05 [-0.03; 0.12]	0.04	0.234
Gender			
Female	0.53 [-1.22; 2.27]	0.89	0.551
Male	0[1]	.	.
Education			
Nurse's aide	-0.62 [-1.51; 0.27]	0.46	0.173
Nurse	0[1]	.	.
Number of years since graduation	-0.04 [-0.11; 0.03]	0.04	0.222
Ward			
Mixed ward	0.59 [-0.42; 1.60]	0.52	0.254
Somatic ward	-0.11 [-1.57; 1.35]	0.74	0.884
Psycho-geriatric ward	0[1]	.	.
Oral healthcare team			
Not present	0.21 [-1.75; 2.17]	1.00	0.832
Present	0[1]	.	.
Member of oral healthcare team			
No	-1.64 [-3.04; -0.25]	0.71	**0.021**
Yes	0[1]	.	.
Education on oral healthcare			
No education	-0.08 [-1.27; 1.11]	0.61	0.894
Education during intervention	-0.54 [-1.88; 0.80]	0.68	0.429
Education before intervention	0[1]	.	.
Contact with mobile dental team			
Yes	0.68 [-0.43; 1.80]	0.57	0.230
No	0[1]	.	.

Table 4. Linear mixed model analysis for dependent variable 'difference in attitude between T_0 and T_1'

Parameter	Estimate [95% CI]	SE	*p*-Value
Time since last visit of mobile dental team			
No visits	0[1]	.	.
> 6 months	1.03 [-0.62; 2.69]	0.85	0.222
< 6 months	0[1]	.	.
Baseline knowledge	0.00 [-0.03; 0.04]	0.02	0.835
Baseline attitude	-0.39 [-0.53; -0.25]	0.07	**< 0.001**
Number of days the mobile dental team was present during the study period	0.71 [-1.41; 2.83]	1.08	0.512
Number of times the mobile dental team was present during the study period	0.81 [-0.54; 2.17]	0.69	0.239
Duration of the study period	-0.12 [-0.77; 0.53]	0.33	0.719
Total duration of oral healthcare project	0.00 [-0.10; 0.10]	0.05	0.951
Total duration of curative oral healthcare by mobile dental team	-0.03 [-0.15; 0.10]	0.06	0.670
Attitude at baseline * Number of days the mobile dental team was present during the study period	-0.01 [-0.04; 0.02]	0.01	0.452
Knowledge at baseline * Number of days the mobile dental team was present during the study period	0.00 [-0.01; 0.01]	0.00	0.778

[1] This parameter is set to zero because it is redundant.

Discussion

An essential part of the oral healthcare programme that provided the context for the present study was the introduction of a mobile dental team offering on-site support at the level of education, prevention and oral treatment.

The oral healthcare programme including the support of a mobile dental team resulted in a significant improvement of knowledge and attitude among the nurses and nurses' aides. At baseline, the intervention group showed a higher knowledge which can be explained by the different aspects of the oral health-care programme the intervention group already received prior to the baseline knowledge measurement. This finding makes the results on knowledge even more powerful. In the control group, knowledge also significantly improved which is in agreement with the results obtained by previous studies (17,44; Chapter 4 Part 1). This might be the consequence of the Hawthorne effect: drawing attention to a topic such as oral health and participating in a study, encourages the enhancement of knowledge. Nevertheless, the improvement in knowledge between baseline and the end of the study period was significantly higher in the

intervention group. This present study also confirms previous results revealing that the care staff with the highest educational level shows the highest knowledge improvement (17; Chapter 4 Part 1).

In contrast with knowledge, the baseline attitude was comparable between both study groups, despite the received education, the implementation of the oral healthcare protocol, and the presence of an oral healthcare team in the intervention group before the start of the study period. This finding seems to be consistent with previously conducted research (17; Chapter 4 Part 1). A recent systematic review on the effect of oral healthcare education on care home nurses' oral healthcare knowledge and attitude concluded that the evidence is still very weak (22). In addition, other medical fields also reported similar findings about attitude improvements after education (45). The latter study by Ford *et al.* concluded that workplace education has no independent association with therapeutic attitude. The most important determinants of nurses' therapeutic attitude were role support, followed by the interaction between role support and workplace education and experience with the patient group (46). An effect of education on therapeutic attitude only takes place when nurses have at least a moderate level of role support of someone in the nurses' clinical field and the attitude improvement was potentiated by moderate to high levels of role support (45). These findings on the impact of a combination of education and role support could explain why the attitude improved after the study period and why being member of the oral healthcare team was a significant determinant for attitude improvement. The mobile dental team provided a high level of role support for the members of the oral healthcare team.

As mentioned above, having experience with the patient is another important determinant for therapeutic attitude (46) and could be a second explanation for the attitude improvements in the present study. This was already confirmed in the dental field by a study of Wårdh *et al*. (33). If nurses' aides and nursing assistants combined traditional oral healthcare education with a dental auscultation period at a dental clinic and received responsibilities at their ward, they felt responsible for the oral healthcare provision, expressed courage, the capacity to cope with reality, confirmation and empathy after one year.

As far as the authors know, no studies have previously been conducted on the effect of an oral healthcare programme, including a mobile dental team offering preventive and curative treatment, on nursing staff knowledge and attitude regarding oral healthcare. Therefore, these data are valuable, although more

research on this topic is needed before the association between the presence of dental professionals and nursing staff knowledge and attitude can be more clearly understood.

Limitations

At baseline, there was an initial dropout of 36% (23 of the 63 nursing homes) and there was no information available about these nursing homes. As a consequence, the analysis of non-respondents was limited to the nurses and nurses' aides who answered the first questionnaire.

Many more nursing homes participated in the intervention group than in the control group. This might be because the first author (BJ) was a member of the mobile dental team. When the nursing homes of the intervention group were contacted to ask them to enrol in the study, they were more willing to participate because of the personal connection they had with the mobile dental team. This limitation possibly resulted in a weakened power but did not impede the authors to obtain significant results.

No true baseline values were collected on the knowledge and attitude of the nurses and nurses' aides in the intervention group before the start of any intervention. As a consequence, there is no information about the effect of the oral healthcare programme before the start of the study period even though it could have provided interesting information. For that reason a correction for baseline values was performed in our analyses. Nevertheless, an exposure-response relationship could be assumed. The longer the oral healthcare programme is implemented and the more comprehensive it is, the better the knowledge and attitude of the nurses and nurses' aides.

A significant improvement in attitude was observed, although it was still a small effect size. As a result, the clinical relevance of this improvement could be questioned. Therefore, more research is needed with also a focus on clinical outcomes at the residents' level such as plaque level or development of carious lesions.

Conclusion

The presence of an oral healthcare programme, including a mobile dental team, resulted in a significant increase in the nurses' and nurses' aides' knowledge of oral health and their attitude towards it. The integration of a dental professional team in nursing home organisations should be encouraged because it could be valuable to take away barriers for the provision of daily oral hygiene and to support the continuous integration of oral healthcare into general care.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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Ethical approval

The study was approved by the Ethical Committee of Ghent University Hospital (B670201318460) and has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments.

Informed consent

Consent was obtained from all nursing homes prior to the start of the study. The nurses and nurses' aides gave their individual informed consent when they filled out the questionnaire.

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General discussion

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The aims of this doctoral thesis were to assess (1) the oral health status and need for treatment of nursing home residents in Flanders (Chapter I); (2) the medication intake of nursing home residents in Flanders and its possible impact on oral health (Chapter II); (3) the impact of an oral healthcare programme on the oral health status and treatment backlog of nursing home residents in Flanders (Chapter III); and (4) the impact of an oral healthcare programme on the knowledge and attitude of nurses and nurses' aides in nursing homes (Chapter IV).

Chapter I

The oral health status of the residents was characterised by a high number of missing teeth and a high proportion of dentate residents with untreated caries. These results are comparable with other studies; nevertheless, in the present study sample there was a higher need for extractions which could indicate more severe caries lesions. This could be the consequence of the non-random sample. The oral healthcare programme (Gerodent) had the predetermined goal of providing oral healthcare to the most vulnerable residents which is reflected by higher levels of care dependency compared to the general nursing home population in Flanders. Previous research demonstrated that persons with dementia have more caries compared to persons without dementia and that time since last dental attendance increases as care dependy gets higher (1,2,5). The analysis showed that the number of teeth that needed to be extracted was higher and the treatment index was lower with higher care dependency. This could explain the higher need for extractions in the present sample.

Gender seemed to play an important role in all outcome variables introduced in the mixed model. Male residents showed an increased risk of a high proportion of decay and residual roots, higher treatment need, low proportion of filled teeth and as a consequence, increased risk of having lower restorative index and treatment index. Previous studies performed in nursing homes in Flanders did not show differences in the amount of dental or denture plaque between male and female residents (3,4). Moreover, no difference in medication intake between both groups was found (Chapter II). More research is needed to understand and confirm the observed differences. A possible reason could be a lower dental attendance of home-dwelling men during the years before becoming frail.

The analysis leads to the conclusion that with ageing, residents have an increased risk of impaired oral health (i.e. fewer natural teeth, a higher D_3MFt, a higher proportion of decay, a higher treatment need and a lower restorative index). Previous research (5) revealed that half of the residents (48.5%) of a random sample in Belgian nursing homes did not visit a dentist during the preceding five years and that the time since the last visit increased with age. Hence, due to its cumulative character, the presence of dental disease possibly increases as the time since the last dental visit increases.

The large majority of the residents have the right for increased reimbursement (68.1%), which is a governmental measure for persons whose income is below a certain limit to improve access to healthcare. These residents have a higher risk of being edentulous and wearing dentures, they have a lower proportion of filled teeth and a lower restorative index. This outcome is the result of previous dental treatments. The residents with increased reimbursement probably received more extraction therapy and full dentures, whereas those without a preferential tariff received more restorative treatments. It seems therefore, that this governmental measure was not capable to eliminate the oral health inequalities in this population.

Chapter II

Besides the poor oral health status and high need for treatment, the nursing home residents in the present sample were also characterized by a high intake of medications, including medications with a risk of inducing dry mouth. The high medication intake was in agreement with the previously reported Prescribing in Homes for the Elderly in Belgium (PHEBE) study (6,7). One of the aims of Chapter II was to find possible associations between medication intake and several characteristics of the residents' oral health status. The number of medications with a risk of dry mouth and the total risk of medication related to dry mouth were clearly associated with the number of teeth, the proportion of carious teeth and the treatment index. The number of natural teeth and the proportion of carious teeth were lower and the treatment index was higher in case of increased medication intake, increased medication intake with a risk of dry mouth and a higher overall risk of dry mouth. In the group with high medication use, the teeth most sensitive to caries and plaque retention might already have been extracted at the time of screening for the study due to a life-long history of caries pathology. This could explain the lower number of teeth in this group. Consequently, the remaining teeth may be favorably positioned in the mouth, allowing good cleaning. These findings indicate the importance of taking preventive measures before the start of medication intake for chronic con-

ditions that can lead to tooth loss, probably at a younger age when a person still lives at home. Further research is required to confirm these results, specifically looking at the pattern of tooth loss and to find other possible explanations for the observed results such as differences in the oral microbiome.

Chapter III

After the baseline measurements of the oral health status and the need for treatment (Chapter I), a longitudinal follow-up study was performed to assess how the preventive and curative oral healthcare programme Gerodent impacted on the initial treatment backlog in nursing homes and how it affected residents' oral health stability. The study sample consisted of 381 residents from 21 different nursing homes with a mean follow-up period of 22.5 months (Chapter III).

At baseline, 65.9% of the total sample (n = 251) was in need for oral treatment. This was halved to 31.3% (n = 120) by the end of the study period. In the group of residents with no treatment need at baseline (n= 130), 13% (n = 17) showed a treatment need at the end of the follow-up period. In the group of residents with a treatment need at baseline (n = 251), 40.8% (n = 102) still had a treatment need at the end of the follow-up period. Clinical status and treatment need of the residents at baseline were associated to their treatment need at the follow-up. More specifically, the higher the number of natural teeth and the higher the level of treatment need at baseline, the more likely were the residents to be in need of treatment at the end of the follow-up period.

Within the oral healthcare programme, 53.5% of the residents remained clinically stable, indicating that there were no additional natural teeth with a need for treatment and was no need for additional prosthetic treatment during the follow-up period. A high number of natural teeth at baseline and high care dependency (including cognitive impairment) resulted in a higher risk of oral health instability. In contrast, when considering only the residents with natural teeth, care dependency was not a predicting variable for oral health stability. Previous research showed that oral care capacity mediates the association between cognition and dental caries severity in older adults (8). The education of the caregivers at the start of the programme emphasized the importance of brushing the natural teeth and helping the residents to do so. Consequently, it is possible that the dentate residents with low oral healthcare capacities received support with their daily oral hygiene and that highly dependent edentate resident with full dentures could benefit from more support to prevent broken or lost dentures.

During the follow-up period, 53.2% of the residents with natural teeth at baseline (n = 261) had additional need for dental treatment due to caries. This proportion is 18.9% lower when compared with the observational study, by Chalmers et al., with one year follow-up (1). This could be due to the preventive aspects of the oral healthcare programme, nevertheless, 53.2% is still a considerable percentage. During the study period, the residents used a 1450 ppm fluoridated toothpaste without any additional fluoride applications, as recommended for an adult population in general. However, the literature recommends a 5000 ppm fluoridated toothpaste or the regular application of fluoride varnishes for frail older people (9,10). Applying these recommendations could further improve the outcomes of the oral healthcare programme.

In this study, the medication intake at baseline did not predict the oral health stability at follow-up. This finding strengthens our assumption that the teeth most sensitive to caries were already extracted in the groups with high medication intake (Chapter II). Nevertheless, these findings do not justify that medication intake in the older adults can be ignored when studying oral health. It is possible that the upcoming generations have better oral hygiene habits that might postpone the impact of medication intake on oral pathology. As a consequence, it could become even more crucial to support these persons with their daily oral hygiene when they become care dependent.

Chapter IV

The fourth aim of the thesis was to assess the impact of the oral healthcare programme on the knowledge and attitude of nurses and nurses' aides. This was performed in two stages. Firstly, the effect of only the preventive part of the programme was studied in a randomised controlled trial (Part I). The preventive part included (1) the formation of an oral healthcare team; (2) education of the members of the oral healthcare team on oral health and oral hygiene including hands-on training. Members of this oral healthcare team had to educate the nurses and nurses' aides on each ward using the train-the-trainer principle; (3) the implementation of an oral health guideline and concomitant protocols and (4) the integration of oral healthcare into daily nursing care based on the individual risk profile of the resident. Secondly, the additional effect of the curative part of the programme was assessed by a non-randomised intervention trial (Part II).

The preventive part of the programme significantly improved knowledge in the intervention group but at the same time knowledge levels had also improved in the control group as well; however, the improvement was significantly higher

in the intervention compared to the control group (Part I). Adding the curative aspect to the oral healthcare programme provided by a mobile dental team, the knowledge at the end of the follow-up period was additionally improved in the intervention group but also in the control group with a significantly higher increase in the intervention group compared to the control group. In contrast to Part I, the baseline knowledge of the intervention group was higher. This can be explained by the different aspects of the oral healthcare programme the intervention group already received prior to the baseline knowledge measurement. However, this finding makes the results on knowledge of the second study (Part II) even more powerful.

A possible explanation for the knowledge improvement in the control group of both studies might be the Hawthorne effect: drawing attention to a topic such as oral health and knowing that one participates in a study encourages enhancement of knowledge. In addition, low baseline knowledge is a facilitating factor to achieve also increased knowledge in the control group. In the first study, apart from the intervention, the level of education was the only predicting covariate for the knowledge on oral healthcare, with nurses demonstrating a better knowledge than nurses' aides. In the second study, we found some additional predicting variables for the improvement of knowledge related to and in favor of the additional curative aspect of the programme.

In the first study (Part I), there was no significant difference ($p = 0.76$) in the increase of attitude between the control and the intervention group. Similarly, there were no baseline differences in attitude between both study groups in the second study despite the received education, the implementation of the oral healthcare protocol, and the presence of an oral healthcare team in the intervention group before the start of the study period. In contrast, at the end of the study, the attitude significantly improved in the intervention group ($p < 0.001$). Studies performed in other medical fields also reported similar findings about attitude improvements after education. A study by Ford *et al.* concluded that workplace education has no independent association with therapeutic attitude (11). The most important determinants of nurses' therapeutic attitude were role support, followed by the interaction between role support and workplace education and experience with the patient group (12). Education can only be effective in changing therapeutic attitudes when nurses have at least a moderate level of support in carrying out their role; moreover, the improvement in their therapeutic attitudes is facilitated and amplified as the levels of role support get from moderate to high (11). These findings on the impact of the combination of education

with role support could explain why the attitude improved after the study period of the second study and why being member of the oral healthcare team was a significant determinant for attitude improvement. The mobile dental team provided a high level of role support for the members of the oral healthcare team.

As mentioned above, having experience with the patient care is another important determinant for therapeutic attitude (12) and could be a second explanation for the attitude improvements in the present study. This was already confirmed in the dental field by a study of Wårdh *et al.* (33). If nurses' aides and nursing assistants combined traditional oral healthcare education with a practical dental auxiliary training period and received responsibilities at their ward, then they felt responsible for the oral healthcare provision, expressed courage, the capacity to cope with reality, confirmation and empathy after one year. After the implementation of the curative aspects of the programme in our study, being younger than the mean age and being a nurse were not anymore predicting variables for lower levels of attitude, as was seen in Part I. Again, this might be explained by the oral health experiences during the study period: the gap in experience between older and younger care staff disappeared and the nurses were more involved in the oral healthcare of the residents after the curative treatments.

Sixteen out of the 21 nursing homes providing the data for the follow-up study of the oral health status of the residents (Chapter III), also participated in the second study about the changes in knowledge and attitude (Chapter IV part II). As a consequence, one could postulate that the increased knowledge and the significant, but limited increase in attitude (Chapter IV, Part II) resulted clinically in the oral health stability of 53.5% of the residents during the same period (Chapter III).

The above-mentioned findings about knowledge and attitude demonstrate that these are two separate parameters that can evolve independently given an increased knowledge does not necessarily lead to an increased attitude and vice-versa. Consequently, both aspects should be addressed in a different way in future research. As far as the author knows, no studies have previously been conducted on the effect of an oral healthcare programme, including a mobile dental team offering preventive and curative treatment, on nursing staff knowledge and attitude regarding oral healthcare. Therefore, these data are valuable, although more research on this topic is needed before the association between the presence of dental professionals and nursing staff knowledge and attitude can be more clearly understood. Moreover, although after a follow-up period of 16 months the oral healthcare programme obtained good results, it remains

uncertain if the results will be maintained over time since the educational part of the programme only took place at the start but was not repeated afterwards.

Methodological considerations

Chapters I, II and III have some common strengths and limitations. The main strength is the large study sample and the collection of different explanatory variables. Consequently, the study had sufficient power and could take into account confounding factors for the obtained results.

Chapter II contributed to the actual knowledge about the medication prescribed to nursing home residents. To the authors' knowledge, it was the first study to separately focus on the medication with a possible hyposalivatory effect in a large sample of nursing home residents.

Dropout of residents due to mortality, compromised health and unwillingness to participate is a serious problem that should always be taken into consideration when planning a study in a nursing home setting. In this thesis, there was a dropout of 68.9% between the studies from Chapter I and II and the longitudinal study presented in Chapter III.

The fact that the present research does not include data on periodontal disease, could be considered a limitation. However, the high care dependency level including a high proportion of subjects with dementia and a vast amount of calculus and/or plaque hampered obtaining a reliable CPITN index (Community Periodontal Index of Treatment Needs). Moreover, the dental team did not need a detailed periodontal status to establish the periodontal treatment need because of the limited treatment options (supra gingival scaling or extraction). Future research should nevertheless consider measuring tooth mobility to be able to distinguish between extractions needed because of caries and/or periodontal disease.

Furthermore, the three dentists performing the oral examinations were well trained but not calibrated. However, the dentists discussed possible treatment options in cases of doubt in the treatment plans.

The lack of a control group in both Chapters II and III could also be considered a limitation. However, it should be noted that due to the high levels of medication use (only one resident was medication free) it was not at all possible to distinguish an appropriate non-medicated control group within the study sample. When considering a subgroup of residents taking a specific type of medication, they

used this medication often combined with other medications. Therefore, it was only possible to compare them with residents not taking the specific medication instead of comparing them to a non-medicated control group. This hampered the demonstration of an association between specific medication classifications and the clinical outcome variables.

Having a control group in Chapter III would have provided more information on the effectiveness of the oral healthcare programme. However, not providing dental treatment to a control group during a mean period of 22 months in a study sample of frail older nursing home residents would definitely have raised ethical considerations due to the high mortality rates in nursing homes and the effect on their well-being and quality of life.

Concerning the study design in Chapter II, a cross-sectional record of the medication use alone will probably never result in a clear prediction of the consequences of a low salivary flow rate. A retro- or prospective longitudinal observational design would be more appropriate. Therefore, the medication variables were also included in the longitudinal study in Chapter III.

The oral health indicators considered in Chapters I, II and III are often multifactorial and not exclusively associated with the included explanatory variables such as age, gender, care dependency, preferential tariff and medication intake. The living circumstances and diet are comparable for the residents within the same nursing home, but possibly important differences in the oral flora, dental plaque and co-morbidities have not been considered. Moreover, the onset of the observed oral pathology often takes place already before the admission to the nursing home.

A limitation of both studies in Chapter IV is the high dropout of eligible nursing homes before the start of the intervention and of nurses and nurses' aides between the baseline and follow-up questionnaires. The latter occurred mainly due to the matching of the questionnaires to avoid selection bias. In the first study, often the participants did not remember the code to identify themselves. In the second study, the code was simplified but the follow-up period was much longer resulting in more staff turnover. Moreover, many questionnaires were not completely filled out. To assess the impact of selection bias, one had to consider of whether data were missing at random or not. To deal with missing data, in some analyses multiple imputation methods were used.

A second limitation of both studies in Chapter IV was the low participation in the train–the-trainer part of the educational programme of both studies. The educational part of the intervention had a pyramid-based structure (train-the-trainer): the ward oral health organisers passed their knowledge and skills, obtained during the education of the oral healthcare team, to the nurses and nurses' aides of their ward. Similar findings on low coverage efficiency of a pyramid-based educational programme, were shown in previous research of MacEntee *et al.* (29). Consequently, this structure might not have been ideal to achieve the maximum effect of the intervention applied in the present study. Other reasons for the low level of attendance to the educational programme might be the high workload, the work scheme, the low priority given to oral healthcare and the absence of an obligation to attend the educational sessions.

In Part I of Chapter IV, attitudes were assessed through only four questions, which might have led to a poor discriminant validity for this part of the questionnaire. Therefore, in Part II, attitudes towards oral health were measured through a set of 28 statements. However, this resulted in an additional limitation because two different questionnaires hamper the comparison of the attitude results between the two studies.

Gerodontology is not a new area in dentistry but is certainly an area in which there is a lack of scientific evidence. In general, nursing homes are challenging research settings. Besides the drop-out of care staff and residents, the active participation of the residents is limited due to cognitive and physical impairment. This can create difficulties when using questionnaires and measurements such as saliva flow or to obtain informed consent. Moreover, each individual resident has complex medical circumstances and histories. Researchers are often faced with difficulties in recording the outcome and explanatory variables and many different conditions in different residential settings. This sometimes hampers the comparison of results.

The main merit of this doctoral thesis is that it demonstrates that the studied oral healthcare programme is an effective method to improve knowledge and attitude of the care staff and the oral health status of the residents. This has been achieved by eliminating barriers for the provision of daily oral hygiene and supporting the continuous integration of oral healthcare into general care. Moreover, this thesis gave new insights in the determinants of caries prevalence and incidence in care dependent older persons.

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Relevance of the work and future perspectives

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The ageing population has put western societies on the eve of some major challenges concerning the feasibility and affordability of their healthcare systems. As a consequence, healthy ageing has become an important topic on the agenda of policymakers all over the world. Considering the importance of oral health for healthy ageing and the actual alarming oral health status of frail elders in many countries, we are facing a major public health problem which will only become more complex and urgent if no action is undertaken.

The Liverpool Declaration[1] on the promotion of oral health for the 21st century highlighted nine areas of work which should be strengthened by the year 2020. In the context of this doctoral thesis 3 areas are important: (1) ensure access to primary oral healthcare with emphasis on prevention and health promotion, (2) strengthen promotion of oral health for the growing numbers of older people, aiming at improving their quality of life and (3) formulate policies for oral health as an integral part of national health programmes. In 2017, the aging population was the main theme of the inauguration ceremony of Prof. Dr. Angus Walls as the new president of IADR (the International Association of Dental Research). During his speech, he emphasised the priority that the research community should give to the oral health of the ageing population.

This doctoral thesis addresses the existing gap in knowledge of the oral healthcare for frail older people and hopes to inspire healthcare workers and policy makers to put this item on their agenda in their working area.

The focus of this thesis is the oral health of nursing home residents, which is in urgent need of improvement. Obviously, the implementation of a feasible and adequate oral healthcare programme in nursing homes alone will not solve all oral health related problems in frail elders because their oral health started declining long before the admission to a nursing home. Moreover, nowadays, there is a trend towards aging at home, meaning that frail older people remain in their own living environment and their admission to a nursing home is postponed as long as possible.

Therefore, to maintain good oral health during the last decades of life, there is a need to introduce some changes in the healthcare system, including the workforce planning:

- The oral healthcare system should evolve from a curative to a more preventive approach. In the current system there is less or no reimbursement for primary prevention in older persons. However, due to threatening comorbidities, disabilities and medication intake, they are more in need of primary prevention compared to other patient groups.
- At the level of secondary prevention, there should be reimbursement for the periodical application of fluoride varnishes and there should be better access to highly fluoridated toothpastes for the prevention of caries lesion progression and the promotion of remineralisation. Elderly people should be aware of the extra benefits compared to regular toothpaste.
- Oral health promotion should not be only focussed towards young children but should continue during the entire lifespan. Oral health promotion for older persons should be embedded in the already existing structures providing care for older people such as domiciliary care, day care centres, nursing homes and other health promotion programmes such as frailty prevention programmes for community dwelling older persons. To date, there is little oral health awareness within these structures. General practitioners, nurses, social workers and informal carers (e.g. family members) can play a crucial role in referring to a dental professional, in providing or supporting daily oral healthcare. If the dental awareness of older persons is not improved by the efforts of the caregivers and by health promotion, none of the previously mentioned preventive measures will lead to oral health improvement.
- There should be more attention given to the impact of oral health on of the daily nutritional intake of older persons. To tackle under- and malnutrition one should start with a healthy mouth to avoid having eating difficulties and facilitate the intake of a healthy diet. Also the effects of sugar in food, the food consistency and intake frequency should not be underestimated at old age.
- Dental professionals should be aware of their social accountability to providing oral healthcare to older persons by making their practices available and acceptable for this growing part of the population. Overtreatment as well as under treatment should be avoided.
- There should be better remuneration for dental professionals providing mobile and portable dentistry for both home dwelling and institutionalised elderly people.
- The current trend to make oneself responsible for his or her own health, happiness and achievements in life is very dangerous if it extends to frail persons of any age. The current Belgian oral healthcare system expects patients to be proactive, on the other hand, if they are not, they receive less reimbursement if curative oral treatment is needed. This system cannot be applied to frail older

persons if there are no structures and arrangements to facilitate their access to oral care.
- An interdisciplinary team approach, including dental professionals (dentists and oral hygienists), is necessary to more accurately identify oral healthcare needs, to give the necessary preventive and curative role support and to raise awareness of the impact of oral health on healthy aging.

The education on gerodontology and geriatrics for dentists, general practitioners, dental hygienists, nurses and nurses' aides will be essential to make them competent to take up their role.

Finally, in many domains of gerodontology, more research is needed. Some domains for future research deserving special attention are the relationship between oral health and general health in old age groups, cost-utility studies of oral healthcare programmes aiming to improve the oral health of frail elderly people and qualitative research to better understand the current barriers for good oral healthcare.

References

1 **The Liverpool Declaration:** Promoting Oral Health in the 21st Century www.who.int/oral_health/events/orh_liverpool_declaration_05.pdf

Summary

Summary

Globally, the population over the age of 65 is the fastest growing one and is expected to more than double by 2050 and more than triple by 2100. The "World Report on Ageing and Health" by the World Health Organisation (WHO) stated in 2015 that *"Oral health is a crucial and often neglected area of healthy ageing"*. Maintaining good oral health will become a challenge for older persons, especially those facing comorbidities, poly-pharmacy, frailty and care dependency such as nursing home residents. This challenge will be augmented by the increased number of people with remaining natural teeth.

In 2010, an oral healthcare programme named "Gerodent" was initiated to promote oral health in nursing homes by integrating oral healthcare in daily nursing home care. This oral healthcare programme was based on previous research taking into account the barriers for good oral healthcare for frail older persons. It pursues patient-centred care and aims to achieve adequate oral health for residents at least for as long as possible in a multidisciplinary care approach. Currently, the oral healthcare programme operates in 56 nursing homes in Flanders (Belgium).

Gerodent integrates both preventive and curative aspects of care. The preventive aspects include (1) the formation of an oral healthcare team in the nursing home with one nursing home project supervisor, at least two oral healthcare organisers (nurses or nurse aides) per ward, a physician, and optionally an occupational or speech therapist; (2) education of the members of the oral healthcare team on oral health and oral hygiene including hands-on training. Members of this oral healthcare team have to educate the nurses and nurses' aides on each ward using the train-the-trainer principle; (3) the implementation of "*The Oral healthcare Guideline for Older people in Long-term care Institutions*" (OGOLI), which was developed to facilitate the integration of oral healthcare into daily nursing care, and concomitant protocols and (4) the integration of oral healthcare into daily nursing care based on the individual risk profile of the resident.

The curative component of the programme starts after the implementation of the preventive level and consists of a mobile dental team offering oral healthcare to residents with limited access to regular dental care. During dental treatment, the caring staff is involved and additional individual preventive measures are delivered to the residents if needed.

Related to this oral healthcare programme, this thesis has been performed aiming to answer the following research questions:

What is the oral health status and what are the treatment needs of nursing home residents in Flanders (Belgium)? (Chapter I)

The studied nursing home residents presented a poor overall oral health status and high dental and prosthetic needs for treatment. The study sample consisted of 1,226 residents belonging to 23 nursing homes in which the oral healthcare programme was implemented. The residents had a mean age of 83.9 years and 858 (70%) were female. In total, 514 participants (41.9%) were edentulous. The mean D_3MFt (sum of teeth with obvious dental decay in the dentine of the tooth D_3, missing teeth M and filled teeth F) in the dentate group was 24.5 and 77% needed extractions or fillings. In the group of residents wearing removable dentures, 36.9% needed repair, rebasing or renewal of the denture. The mixed model analysis demonstrated that with each year a resident gets older, the oral health outcomes get worse and that men have worse oral health and higher treatment needs than women. In addition, the level of income and care dependency had a less extensive role in predicting the oral health outcomes.

What are the most commonly prescribed medications in nursing home residents? (Chapter II)

Polypharmacy is considered the most important etiological factor of hyposalivation which in turn can initiate oral health problems. Moreover, medication intake can have an impact on dental treatment protocols. This study showed that the mean number of medications per resident was 9.0 (SD 3.6; range 0-23) indicating a high prevalence of polypharmacy. Of all prescribed medication, 49.6% had a potential hyposalivatory effect; this referred to an average of 4.5 (SD 2.2; range 0 - 15) medications per person. Only 1.4% of the study sample took no medication with a potential hyposalivatory effect; only one resident took no medication at all. Many residents took medication for common age-related disorders such as cardiovascular diseases (n = 954; 81.3%), diabetes mellitus type 2 (n = 212; 18.1%), dementia (n = 191; 16.3%), Parkinson disease (n = 156; 13.3%) and obstructive airway diseases (n = 150; 12.8%).

Of the total study sample, 655 persons (55.8%) took antithrombotic agents and 92 persons (7.8%) were using medication that affects bone structure and mineralization, which impacted the dental extraction protocol due to the risk of bleeding and medication related osteonecrosis of the jaw (MRONJ) respectively. A high use of psycholeptics (n = 804; 68.5%), psychoanaleptics (n = 661; 56.3%)

and analgesics (n = 547; 46.6%) was registered as well as a considerable intake of medication for constipation (n = 620; 52.8%) and stomach acid related disorders (n = 533; 45.4%).

Do the number and type of medications influence the oral health status and treatment needs? (chapter II)

Within the group of residents with natural teeth (n = 712), there was a clear association between the number of teeth and the medication intake: the higher the number of medications (associated with risk of dry mouth) and the overall risk of dry mouth, the lower the number of natural teeth ($p = 0.022$; $p = 0.005$ and $p = 0.017$ respectively). In contrast, the total treatment need tended to decrease in case of increasing medication intake, which resulted in a clear rise of the treatment index ((F+M)/(D+F+M)) in case of increasing medication intake ($p = 0.003$; $p < 0.001$ and $p = 0.002$). The logistic regression model analysis confirmed that the proportion of carious teeth was lower and the treatment index was higher in case of rising medication intake, especially when considering the number of medications with a risk of dry mouth and the overall risk of medication-related dry mouth. A possible explanation for this trend might be the finding that in the group with a high medication use, the teeth most sensitive to caries and plaque retention could already have been extracted before screening for the study, due to a life-long history of caries pathology.

Does an integral preventive and curative oral healthcare programme with on-site oral healthcare delivery (Gerodent) have an impact on the treatment needs of nursing home residents and provide oral health stability? (Chapter III)

A group of 381 residents was selected out of the study sample of chapter I with a minimum follow-up of 11 months (mean follow-up 22.5 months). The oral healthcare programme Gerodent significantly reduced the treatment backlog in this group from 65.9% to 31.3% of the residents. In the group of residents with natural teeth, the oral healthcare programme reduced the proportion of residents with caries (from 70.5% to 36.5%; $p < 0.001$), residual roots (from 54.2% to 25.1%; $p < 0.001$), and a need for fillings (from 31.9% to 17.1%; $p < 0.001$) or extractions (from 64.3% to 31.6%; $p < 0.001$). In the group with partial or full dentures (n = 223), a major treatment backlog was also observed at baseline: 85 residents (38.1%) needed a repair, rebasing or renewal of their existing dentures. After the follow-up period, this treatment backlog was reduced to 20 residents (9.0%; $p < 0.001$). The number of natural teeth ($p < 0.001$) and the baseline treatment need of these natural teeth ($p = 0.011$) were associated with the treatment need after the follow-up period. Within the oral healthcare programme, 53.5%

of the residents obtained oral health stability, which means that they had no additional natural teeth in need of treatment and no need for new prosthetic treatment during the follow-up period. The number of natural teeth ($p < 0.001$) and the resident's care dependency ($p = 0.018$) at baseline were associated with oral health stability. Overall, within the limitations of the study design, we may conclude that Gerodent reduces the treatment backlog and provides oral health stability for a considerable part of the residents.

Will the preventive part of the oral healthcare programme have an impact on the knowledge and the attitude of the nurses and nurses' aides in nursing homes? (Chapter IV part I)

In order to answer this research question, a random sample of 12 nursing homes was obtained. In six nursing homes the preventive part of the oral healthcare protocol was implemented and the other six served as a control group. A questionnaire evaluated the knowledge and attitude of nurses and nurses' aides at baseline and six months after the start of the intervention. At baseline, no significant differences were observed between the intervention and the control group for both knowledge ($p = 0.42$) and attitude ($p = 0.37$). After six months, significant differences were found between the intervention and the control group for knowledge in favor of the intervention group ($p < 0.0001$) but not for attitude ($p = 0.78$). Regarding attitude, it can be concluded that age is an important determinant, participants older than the mean age of 38 years had a better attitude than those younger than the mean age ($p = 0.031$). Further significant determinants for attitude at six months were educational level and ward with a better attitude for nurses' aides compared to nurses ($p = 0.009$) and for those working on a psycho-geriatric ward compared to those working on a mixed ward ($p = 0.014$). At the level of knowledge, there was a positive significant effect of the intervention ($p = 0.001$) and the educational level ($p = 0.009$) with nurses showing higher knowledge than nurses' aides.

Will there be an additional effect of on-site preventive and curative oral healthcare delivery to nursing home residents on the knowledge and attitude of the nurses and nurses' aides? (Chapter IV part II)

For this study, the complete oral healthcare programme was implemented in 31 nursing homes (intervention group) and in 9 nursing homes, only the preventive part of the programme was implemented (control group). A questionnaire evaluated the changes in the knowledge and attitude. After a mean follow up of 16 months, 546 questionnaires were completed by the same people from 36 nursing homes at baseline and on completion of the study. At the end of the

study period, knowledge significantly improved in both study groups (I: $p < 0.001$; C: $p < 0.001$), with the intervention group improvement being significantly higher than the control group ($p<0.001$). The outcome variable attitude only showed a significant improvement in the intervention group ($p < 0.001$). The mixed models confirmed the impact of some aspects of the intervention on the attitude and the knowledge improvement of the caregivers.

Final conclusion

Nursing home residents in Flanders have inadequate oral health and worryingly high treatment needs. Moreover, they present a high intake of medication with a negative impact on their oral health status. The preventive and curative oral healthcare programme resulted in a reduction of the need for treatment and could provide oral health stability for a considerable proportion of the residents. Simultaneously, it improved the knowledge and attitude of the nurses and nurses' aides. The integration of a dental professional team in nursing home organisations should be encouraged because it could be valuable to address barriers for the provision of daily oral hygiene and support the continuous integration of oral healthcare into general care.

Samenvatting

Samenvatting

Wereldwijd neemt de bevolkingsgroep van 65 jaar en ouder het snelst toe en er wordt verwacht dat deze groep zal verdubbelen tegen het jaar 2050 en verdrievoudigen tegen 2100. Het "World Report on Ageing and Health" van de Wereldgezondheidsorganisatie (WGO) uit 2015 vermeldt dat mondgezondheid een cruciaal en vaak genegeerd onderdeel is van gezond ouder worden. Het behoud van een goede mondgezondheid wordt een uitdaging voor ouderen omwille van het behoud van meer natuurlijke gebitselementen, in het bijzonder voor ouderen met comorbiditeit, polyfarmacie, kwetsbaarheid en zorgafhankelijkheid, allen kenmerken van bewoners van woonzorgcentra (WZC's).

In 2010 werd vanuit het Universitair Ziekenhuis Gent een zorgpad opgestart met de naam "Gerodent". Het doel van Gerodent is het verbeteren van de mondgezondheid van de bewoners van woonzorgcentra door het integreren van mondzorg in de algemene dagdagelijkse zorg. Dit mondgezondheidsprogramma is gebaseerd op voorgaand onderzoek en houdt rekening met de drempels tot mondzorg bij kwetsbare ouderen. Het streeft ook naar patiënt gecentreerde zorg en heeft als doel de mondgezondheid zo lang als mogelijk te behouden door middel van een multidisciplinaire aanpak. Momenteel is Gerodent actief in 56 WZC's verspreid over Oost- en West-Vlaanderen.

Het mondgezondheidsprogramma integreert zowel preventieve als curatieve zorg: Het preventieve luik omvat (1) het oprichten van een mondzorgteam in de WZC's met een projectleider, minstens twee mondzorgverantwoordelijken per afdeling, een coördinerende raadgevende arts (CRA) en optioneel een ergotherapeut of logopedist; (2) vorming van de leden van het mondzorgteam over mondgezondheid en mondhygiëne, inclusief een praktijkgericht onderdeel. De leden van het mondzorgteam dienen de overige verpleeg- en zorgkundigen op elke afdeling te vormen via het 'train-the-trainer' principe; (3) het toepassen van "*De Richtlijn Mondzorg voor ouderen in zorginstellingen*" die werd ontwikkeld ter bevordering van de integratie van mondzorg in de dagelijkse verpleegkundige zorg en het uitvoeren van de bijhorende protocollen en; (4) het opstellen van een preventief mondzorgdossier voor elke bewoner gebaseerd op zijn individueel risicoprofiel. Het curatieve luik start na het uitvoeren van het preventieve luik en bestaat uit een mobiele tandheelkundige eenheid die mondzorg verleent aan de bewoners waarvan de toegang tot de reguliere zorg beperkt of quasi onmogelijk is. Het personeel van het WZC wordt betrokken tijdens het uitvoeren van de curatieve

mondzorg en indien relevant wordt de preventie geïndividualiseerd.

Dit doctoraat heeft wetenschappelijk onderzoek uitgevoerd rond dit mondzorgprogramma en probeerde een antwoord te vinden op de volgende onderzoeksvragen:

Hoe ziet de mondstatus van bewoners van woonzorgcentra in Vlaanderen eruit en welke zijn de behandelnoden? (Hoofdstuk I)
De bewoners uit dit onderzoek hadden een ondermaatse mondstatus en een hoge dentale en prothetische behandelnood. De steekproef bestond uit 1,226 bewoners uit 23 WZC's waar het mondzorgprogramma werd uitgevoerd. De bewoners hadden een gemiddelde leeftijd van 83.9 jaar en 858 bewoners (70%) waren vrouwen. In totaal waren 514 bewoners (41.9%) tandeloos. De gemiddelde D_3MFt (som van de tanden met visueel duidelijk waarneembare cariës D_3, de ontbrekende tanden M en de gevulde tanden F) in de groep met natuurlijke tanden was 24.5 en 77% had nood aan vullingen of extracties. In de groep bewoners met een uitneembare (totale of partiële) gebitsprothese had 36.9% nood aan een herstelling, rebasing of vernieuwing van de bestaande gebitsprothese. De analyses van de data toonden aan dat voor elk jaar dat een bewoner ouder wordt, zijn mondgezondheid erop achteruitgaat en dat mannen een slechtere mondgezondheid hebben en een hogere behandelnood dan vrouwen. Bijkomend had het inkomensniveau en de zorgafhankelijkheid een beperkte rol in het voorspellen van de mondgezondheid.

Welke zijn de meest frequent voorgeschreven medicijnen bij bewoners van woonzorgcentra? (Hoofdstuk II)
Polyfarmacie wordt beschouwd als de voornaamste oorzaak van een droge mond, dit kan dan op zijn beurt weer leiden tot het ontstaan van mondgezondheidsproblemen. Bovendien kan de medicatie inname een impact hebben op de tandheelkundige behandelprotocollen. Deze studie toonde aan dat de bewoners gemiddeld 9 soorten medicatie innamen (SD 3.6; spreiding 0-23) wat een indicatie is voor een hoge prevalentie van polyfarmacie. Van alle medicatie gaf 49.6% een risico op droge mond als mogelijke bijwerking, met een gemiddeld aantal van 4.5 per persoon (SD 2.2; spreiding 0-15). Slechts 1.4% van de bewoners nam geen medicatie met een risico op droge mond en slechts één persoon nam helemaal geen medicatie. Veel bewoners namen medicatie voor veelvoorkomende ouderdomsziekten zoals cardiovasculaire aandoeningen (n = 954; 81.3%), diabetes type 2 (n = 212; 18.1%), dementie (n = 191; 16.3%), de ziekte van Parkinson (n = 156; 13.3%) en obstructieve longziektes (n = 150; 12.8%).

Van de totale steekproef namen 655 bewoners (55.8%) antitrombotica en 92 bewoners (7.8%) namen geneesmiddelen die de botstructuur en botmineralisatie beïnvloeden. Deze geneesmiddelen hebben een directe impact op het extractieprotocol omwille van het respectievelijke risico op bloeding en op medicatie gerelateerde osteonecrose van de kaak (MRONJ). Een frequent gebruik van psycholeptica (n = 804; 68.5%), psychoanaleptica (n = 661; 56.3%) en pijnstillers (n = 547; 46.6%) werd ook waargenomen, naast een hoge inname van medicatie bij obstipatie van de darmen (n = 620; 52.8%) en zuur gerelateerde afwijkingen van de maag (n = 533; 45.4%).

Hebben het aantal en het type medicatie een impact op de mondstatus en de behandelnood van de bewoners? (Hoofdstuk II)

Binnen de groep bewoners met natuurlijke tanden (n = 712) werd een duidelijk verband waargenomen tussen het aantal tanden en de medicatie inname: hoe hoger het aantal medicijnen (met een risico op droge mond) en het mogelijk cumulatief globaal risico op een droge mond omwille van het innemen van meerdere medicijnen met effect op droge mond, hoe lager het aantal tanden (p = 0.022; p = 0.005 en p = 0.017 respectievelijk). Echter, de totale behandelnood (vullingen + extracties) had de neiging om af te nemen bij een hogere medicatie inname, wat resulteerde in een duidelijke stijging van de behandelindex ((F+M)/(D+F+M)) bij een toename van de medicatie inname (p = 0.003; p < 0.001 en p = 0.002). Dit werd bevestigd door de logistische regressie analyse die aantoonde dat de proportie gecarieerde tanden daalde en de behandelindex toenam bij stijgend medicatiegebruik, vooral wanneer men het aantal medicijnen beschouwt met een risico op een droge mond en het totale risico op een droge mond gerelateerd aan de medicatie inname. Mogelijk is dit het resultaat van een soort natuurlijke selectie waarbij de meest cariësgevoelige tanden al geëxtraheerd werden gedurende de jaren voorafgaand aan het moment van deze dataverzameling, dit als gevolg van een accumulatie van risicofactoren.

Heeft een preventief en curatief mondgezondheidsprogramma, inclusief de toediening van curatieve zorg ter plaatse (Gerodent) een impact op de behandelnood van de bewoners en kan het de stabiliteit van de mondgezondheid borgen? (Hoofdstuk III)

Binnen de steekproef van bewoners met een opvolgperiode van minsten 11 maanden en gemiddeld 22.5 maanden (n = 381) daalde de behandelnood van de bewoners van 65.9% naar 31.3%. In de groep bewoners met natuurlijke tanden, daalde de proportie bewoners met cariës van 70.5% naar 36.5% (p < 0.001), de proportie bewoners met wortelresten van 54.2% naar 25.1% (p < 0.001), de

nood aan vullingen van 31.9% naar 17.1% ($p < 0.001$) en extracties van 64.3% naar 31.6% ($p < 0.001$). Ook in de groep bewoners met een partiële of totale gebitsprothese (n = 223) werd een grote behandelnood waargenomen aan het begin van de studie: 85 bewoners (38.1%) hadden een herstelling, rebasing of vernieuwing van hun bestaande prothese nodig. Na de opvolgperiode werd deze behandelachterstand gereduceerd tot 20 bewoners (9.0%; $p < 0.001$). Het aantal natuurlijke tanden ($p < 0.001$) en de oorspronkelijke behandelnood van de natuurlijke tanden ($p = 0.011$) waren voorspellend voor de behandelnood na de opvolgperiode. Binnen de steekproef bleef de mondgezondheid van 53.5% van de bewoners stabiel, met andere woorden, ze hadden tijdens de opvolgperiode geen bijkomende gecarieerde tanden of nieuwe prothetische behandelnood. Het aantal natuurlijke tanden ($p < 0.001$) en de zorgafhankelijkheid van de bewoners ($p = 0.018$) waren voorspellende variabelen voor de stabiliteit van de mondgezondheid. In het algemeen kan geconcludeerd worden dat het Gerodent zorgpad de behandelnood reduceert en een stabiele situatie kan bewerkstelligen voor een belangrijk aandeel van de bewoners.

Heeft het preventieve luik van het mondgezondheidsprogramma een impact op de kennis en de attitude van de verpleeg- en zorgkundigen in de woonzorgcentra? (Hoofdstuk IV deel I)

Om een antwoord te kunnen bieden op deze vraag werd een random sample van 12 WZC's geselecteerd. In zes WZC's werd het preventieve luik van het mondgezondheidsprogramma geïmplementeerd en de andere zes werden gebruikt als controlegroep. De kennis en de attitude van de verpleeg- en zorgkundigen werd gemeten met behulp van een gevalideerde vragenlijst aan het begin van de studie en 6 maanden na de start van de interventie. Vóór de interventie werden er geen significante verschillen waargenomen in kennis ($p = 0.42$) en attitude ($p = 0.37$) tussen beide studiegroepen. Na zes maanden werd er een significant kennisverschil ($p< 0.0001$) waargenomen tussen de interventie en de controlegroep, in het voordeel van de interventiegroep, maar geen verschil in attitude ($p = 0.78$). De voorspellende determinanten voor kennis waren de interventie zelf ($p = 0.001$) en het opleidingsniveau van de zorgverleners ($p = 0.009$). De verpleegkundigen hadden een betere kennis dan de zorgkundigen. Op het niveau van attitude was de leeftijd een voorspellende determinant, zorgpersoneel ouder dan de gemiddelde leeftijd van 38 jaar had een betere attitude dan zij die jonger waren dan de gemiddelde leeftijd ($p = 0.031$). Verder hadden zorgkundigen een betere attitude dan verpleegkundigen ($p = 0.009$) alsook het personeel werkend op een psycho-geriatrische afdeling in vergelijking met een gemengde afdeling ($p = 0.014$).

Zal het toedienen van preventieve en curatieve mondzorg met een mobiele eenheid voor de bewoners in het woonzorgcentrum verder bijdragen aan de toename van kennis en attitude van de zorg- en verpleegkundigen? (Hoofdstuk IV deel II)

Voor deze studie werd het volledige mondgezondheidsprogramma uitgerold in 31 WZC's (interventiegroep) en in negen WZC's werd enkel het preventieve luik uitgevoerd (controle groep). Opnieuw werd een gevalideerde vragenlijst gebruikt om de wijzigingen in kennis en attitude te meten. Na een opvolgperiode van gemiddeld 16 maanden werden 546 vragenlijsten weerhouden die zowel bij het begin als op het einde van de studieperiode ingevuld werden door dezelfde personen. Op het einde van de studieperiode, werd een significante verbetering in kennis waargenomen in beide studiegroepen (I: $p < 0.001$; C: $p < 0.001$). De interventiegroep vertoonde hierbij een significant hogere kennistoename dan de controlegroep ($p < 0.001$). De uitkomstvariabele attitude vertoonde enkel in de interventiegroep een significante verbetering *(*$p < 0.001$). Verdere analyses bevestigden de positieve impact van enkele determinanten eigen aan de interventie op de kennis en de attitude toename.

Eindconclusie

Bewoners van WZC's in Vlaanderen hebben een zorgwekkende mondgezondheid en een erg hoge behandelnood. Bovendien nemen ze heel veel medicatie met een negatieve impact op hun mondgezondheid. Het preventieve en curatieve mondgezondheidsprogramma resulteerde in een daling van de behandelnood en kon een stabiele mondgezondheid bewerkstelligen voor een groot deel van de bewoners. Tegelijkertijd werd de kennis en de attitude verbeterd van de zorg- en verpleegkundigen. De integratie van een team van professionele mondzorgverleners binnen de werking van woonzorgcentra moet aangemoedigd worden. Dit omdat het waardevol kan zijn bij het reduceren van de barrières die waargenomen worden voor het verlenen van de dagelijkse mondzorg en het de integratie van mondzorg binnen de algemene zorg bevordert.

Curriculum Vitae

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Education	
2000-2005	Bachelor and Master in Dentistry, Ghent University, Belgium
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Working experience	
2005-2006	Private practice: Centro Dental Multiespecialista *Granada, Spain*
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2009-present	Private practice: Liedent *Liedekerke, Belgium*
2010-present	University Hospital Ghent: Gerodent (Mobile dental unit for nursing home residents) *Ghent, Belgium*
2010-present	University Ghent: Volunteer at the Department of Community Dentistry and Oral Public Health *Ghent, Belgium*

Poster presentations at national and international congresses

2011 JGG Paris: "The introduction of a manutention method of manual patient handling in domiciliary oral health care in nursing homes"

2011 ECG Ghent: "Manual patient handling in domiciliary oral health care in nursing homes"

2011 ECG Ghent: "Effect of a supervised implementation of an oral health care protocol in nursing homes on care providers' knowledge and attitude towards oral health care: a cluster randomised control trial"

2011 EADPH Rome: "The effect of a preventive oral health care protocol in nursing homes on care staffs' knowledge and attitude towards oral health care."

2012 EADPH London: "Treatment backlog in nursing homes assessed within a mobile dental unit project"

2013 VVT Oostende: "Zorgachterstand bij kwetsbare ouderen in woonzorgcentra"

2013 VVT Oostende: "Multidisciplinaire benadering van een maxillaire osteonecrose: een case report"

2013 EADPH Malta: "The oral health condition of frail institutionalized elderly people in Flanders (Belgium)"

2013 ECG Graz: "The oral health condition a large sample of frail institutionalized elderly people in Flanders (Belgium)"

2015 EADPH Istanbul: "Effect of a mobile dental team on care staff knowledge and attitude regarding oral health: a non-randomised intervention trial."

2017 ECG Malta: "Polypharmacy and hyposalivatory medication use in nursing home residents in Flanders (Belgium)"

2017 EADPH Vilnius: "Medication use and its potential impact on the oral health status of nursing home residents in Flanders (Belgium)"

2017 VVT Oostende: Polyfarmacie en de impact op de mondgezondheid van bewoners van woonzorgcentra.

Oral presentations at international congresses

2014 IADR-PER Dubrovnick: Oral health symposium on frail elderly. "Relationship between oral health and general health in frail elderly."

2015 EADPH Istanbul: Gerodontology working group: "Oral health – general health"

2015 ECG Belfast: "Effect of a mobile dental team on care staff knowledge and attitude regarding oral health: a non-randomised intervention trial."

2017 ECG Malta: "Overcoming barriers in the prevention and treatment of caries and periodontal disease in older adults"

2017 ECG Malta: "Polypharmacy in nursing home residents"

2017 EADPH Vilnius: "Polypharmacy and its impact on the oral health of nursing home residents"

Awards

2013 VVT congress: prize of the public for the poster "Multidisciplinary approach of a maxillary osteonecrosis: a case report"

2013 National prize of the Red Cross for excellence in hospital management with the project Gerodent.

2015 Colgate award for young researchers in the field of gerodontolgy from the European College of Gerodontology for the presentation: "Effect of a mobile dental team on care staff knowledge and attitude regarding oral health: a non-randomised intervention trial."

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Dankwoord
Nawoord

Acknowledgements - Dankwoord - Nawoord

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In 2009, na 4 jaar werken als algemeen tandarts kreeg ik één gedachte niet meer uit mijn hoofd: "Moet ik hier de komende 40 jaar doorbrengen tussen deze 4 muren?" Ik had het gevoel dat de meest interessante patiënten de weg niet vonden naar de voordeur van de praktijk. Zo woonde er bij ons in de straat een zwaar zorgbehoevende man die niet meer de kracht had om zijn prothese op locators vast te klikken en toen ik op een dag een herstelling terugbracht naar een WZC in de buurt kreeg ik plots te zien hoe kwetsbaar de vrouw was die twee dagen voordien nog bij mij op de stoel zat. En ze was niet alleen, ze zat daar samen met meer dan honderd andere lieve mensen die ik niet meteen naar de tandarts zag wandelen. Ik dacht: als ik nu eens naar hen toeging op regelmatige basis? Dan zijn zij op hun gemak en kom ik wat meer buiten!

Stilaan begon ik te broeden op het idee van mijn praktijk "op wieltjes". Ik had echter geen kaas gegeten van praktijkorganisatie en wist weinig over de ouderenzorg. Ik herinnerde mij wel nog uit mijn studententijd dat Prof. De Visschere en Prof. Vanobbergen onderzoek deden bij ouderen in woonzorgcentra (die vuile gebits-protheses die we moesten poetsen stonden nog steeds op mijn netvlies gebrand). Op 9 augustus 2009 stuurde ik mijn eerste e-mail naar Prof. Vanobbergen en 4 dagen later zat ik op het bureau van de Maatschappelijke Tandheelkunde voor "een constructief gesprek". Bleek dat ook zij al een tijdje aan het broedden waren op een gelijkaardig idee. Al snel werd mij de vraag gesteld of ik wou meebouwen aan hun project dat even later geboren werd onder de naam "Gerodent". Ik zei ja. (neen stond toen nog niet in mijn woordenboek)

Na enkele dagen officieel in dienst (ja, dagen!) kwam Jackie plotseling met een statement: "Het werk in een universitair ziekenhuis zou toch steeds moeten samengaan met een zekere interesse voor onderzoek. Ik ben je resultaten uit de opleiding tandheelkunde nog eens gaan opzoeken, zou jij niet willen doctoreren?" Ik zei ja. (neen stond nog steeds niet in mijn woordenboek)

Zo begon ik aan een avontuur over bergen en door diepe dalen. Een avontuur waarvan ik nooit had gedacht dat het voor mij weggelegd was. Als student was ik immers liever met de praktijk dan met de theorie bezig. Gelukkig had ik een nonkel, een nicht en vooral mijn opa die ooit reeds (meermaals) hetzelfde traject hadden afgelegd. Als zij dat konden, dan kon ik het ook...

Dat het over kwetsbare ouderen zou gaan stond in de sterren geschreven: op mijn 17de ging mijn scriptie voor het vak Nederlands over de Ziekte van Alzheimer en in mijn opleiding tandheelkunde maakte ik een literatuurstudie over de mondhygiëne in woonzorgcentra. Toen ik aan mijn doctoraat begon was ik het onderwerp van die literatuurstudie al vergeten en toch kwam ik weer uit bij hetzelfde onderwerp. Mijn mémé die gedurende al die jaren aan de Ziekte van Alzheimer leed heeft er ongetwijfeld veel mee te maken.

Tijdens mijn doctoraatstraject heb ik erg veel bijgeleerd, vooral van de mensen waarmee ik heb kunnen samenwerken. Een doctoraat maak je immers nooit alleen. Onderweg kruisen erg veel mensen je pad die elk op hun manier bijdragen aan het eindresultaat. Hieronder een bloemlezing:

Mijn oorspronkelijke promotor en later copromotor Em. Prof. Dr. Jacques Vanobbergen: Jackie, laten we eerlijk zijn, zonder jou lag dit boekje hier nu niet op tafel. Je passie voor de wetenschap, je maatschappelijk engagement en je werklust zijn onmeetbaar. Ik besef dat ik heel erg veel geluk heb gehad met jou aan mijn zijde. Je was altijd en overal bereikbaar, we werkten ook meestal in dezelfde ruimte, een uniek privilege. Je was een laatbloeier in de wetenschap waardoor je ondanks je leeftijd nog steeds het enthousiasme van een jonge dertiger hebt. Je hebt mij enorm veel geleerd over de wetenschap en de maatschappij waarbinnen we ons beroep als tandarts uitvoeren. Ik was in het begin een nogal hulpbehoevend schaap (na 5 jaar in het werkveld was ik de inhoud uit je lessen al lang vergeten...). Het voordeel hiervan is dat het dan alleen maar beter kan gaan naarmate de jaren verlopen. Ik heb mijn best gedaan.

Mijn oorspronkelijke copromotor en later promotor Prof. Dr. Luc De Visschere: Luc, toen ik een aantal maanden bij Gerodent aan het werk was verdedigde jij je eigen doctoraat. Ondertussen ben je zelf ook al “een professor” en lever je een eerste doctoraat af als promotor. Je eenvoud en bescheidenheid sieren je, je hebt het hart op de juiste plaats. Je was er altijd wanneer het water mij aan de lippen stond en bood steeds een luisterend oor voor mijn verzuchtingen. Mijn doctoraat is volledig voortgebouwd op het jouwe en ik moet je dan ook heel erg

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Mijn copromotor Prof. Dr. Jos Schols: Jos, ik denk dat jij de meest enthousiasmerende en charismatische persoon bent van al mijn begeleiders. Je was steeds een inspirerend figuur met interessante commentaren en veel opbouwende kritiek. Als verpleeghuisarts kwamen je medische inzichten ook steeds van pas. Ook de Bourgondiër in jou kan ik wel appreciëren. Ik hoop dat we in de toekomst nog vaak kunnen samenwerken!

Prof. Dr. Wolfgang Jacquet: Na enkele jaren ploeteren kwam je plots op de kar gesprongen. Je was van onschatbare waarde om enkele statistische obstakels uit de weg te ruimen en bracht het doctoraat in een zekere stroomversnelling. Je bent voor mij een klassiek voorbeeld van de verstrooide professor en ik heb erg genoten van je filosofische insteek wat betreft de statistiek. Statistische analyses uitvoeren op een groep kwetsbare ouderen brengt altijd uitdagingen met zich mee...

Prof. Dr. Mirko Petrovic: Geriaters zoals jij, daar zouden er meer van moeten zijn! Je bent een innemend persoon waarachter een enorme kennis schuilt. Bedankt om je door mijn medicatiedatabase te worstelen en voor de feedback die je me hebt gegeven.

De leden van de examencommissie Prof. Dr. M. De Bruyne, Prof. Dr. J. Duyck, Dr. C. Wierinck, Prof. Dr. N. Van Den Noortgate, Dr. Nico De Witte, Prof. Dr. R. Cauwels, Prof. Dr. L. Marks: Het was niet bepaald zomerse lectuur vandaar een welgemeende "dank u wel" om de afgelopen zomer de tijd en moeite te nemen om het doctoraat door te nemen en het te voorzien van de nodige feedback om het zo tot een hoger niveau te tillen.

De leden van de onderzoeksgroep BENECOMO (Belgisch-Nederlands Consortium voor Onderzoek over Mondzorg van Ouderen) Drs. Nelleke P.C. Bots-van 't Spijker, Em. Prof. Dr. Cees de Baat, Kersti H.M.E. de Lugt-Lustig, Prof. Dr. Joke Duyck, Dr. Vanessa Hollaar, Dr. Dominique Niesten, Em. Prof. Dr. Rob Schaub, Dr. Claar D. van der Maarel-Wierink, Dr. Gert-Jan van der Putten, Prof. Dr. Jos M.G.A. Schols, Em. Prof. Dr. Jacques Vanobbergen en Prof. Dr. Luc M.J. De Visschere: de BENECOMO samenkomsten waren steeds dagen om naar uit te kijken tijdens mijn doctoraatstraject ,die inspirerend werkten en mij zin gaven om verder te

doen. De expertise van over de grens in een vakgebied dat in België nog in zijn kinderschoenen staat was steeds welkom. Bedankt voor de fijne tijd!

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Alle woonzorgcentra binnen het Gerodent netwerk (directie en leden van het mondzorgteam in het bijzonder): Zonder jullie medewerking en motivatie had dit doctoraat er niet gelegen. Jullie hebben mij goed vooruit geholpen met het onderzoek rond kennis en attitude en doen steeds al het mogelijke om het Gerodent bezoek in goede banen te leiden. Dagelijks de mondhygiëne van de vele bewoners verzorgen naast al jullie andere taken is zeker niet evident. Dit gebeurt dan ook met veel vallen en opstaan. Ik hoop dat dit doctoraat een voedingsbodem mag zijn voor verdere ideeën en ondersteuning binnen de sector om dagelijkse mondzorg op een kwaliteitsvolle manier te kunnen aanbieden waarbij jullie beloond worden voor de reeds geleverde inspanningen.

Alle bewoners van de woonzorgcentra binnen het Gerodent netwerk: Dit doctoraat heb ik niet voor mezelf geschreven maar voor jullie. De schrijnende en

hopeloze situaties die ik zag in jullie monden waren mijn grootste drijfveer om verder te gaan met dit doctoraat. Dit doctoraat is mijn proteststem waarmee ik het voor jullie opneem en ik hoop dat het helpt om jullie op een dag de mondzorg te kunnen bieden die jullie echt verdienen. Zorg zoals ik ze voor mezelf ook zou willen. Ik hoop dat jullie in de toekomst elke dag met een frisse, pijnvrije en functionele mond kunnen doorbrengen die geen hindernis meer vormt voor sociaal contact. Dit zou een evidentie moeten zijn want mondzorg is basiszorg, helaas is de realiteit vaak nog anders. Tijdens de Gerodent bezoeken geniet ik steeds van de praatjes die we maken, jullie humor en levenswijsheid. Ook jullie dankbaarheid na het tandartsbezoek is steeds hartverwarmend.

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