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Institute of Dentistry, Faculty of Medicine, University of Tartu, Tartu, Estonia

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The contribution of author Minh Son Nguyen to original publications:
Paper I–VII: Conception and design, literature search, performed clinical studies, data, acquisition, statistical analysis, and manuscripts writing.

LIST OF ABBREVIATIONS

A	Subspinale point
Ans	Anterior nasal spine
Ar	Articulare point
B	Supramentale point
CAL	Clinical attachment loss
CI	Confidence interval
Co	Condylion
CPI	Community Periodontal Index
DC/TMD	Diagnostic Criteria for Temporomandibular Disorders
DMFT	Dental caries experience index
DT	Decayed teeth
JFLS-20	20-item Jaw Function Limitation Scale
FH	Frankfort horizontal plane
FT	Filled teeth
FTU	Functional tooth unit
GAD-7	7-item Generalized Anxiety Disorder Scale
Gn	Gnathion
Go	Gonion point
Me	Menton point
MP	Mandibular plane
MT	Missing teeth
N	Nasion point
OBC-21	21-item Oral Behaviour Checklist
Or	Orbitale point
OR	Odds ratio
OU	Occlusal unit
OPTG	Orthopantomography
P	p-value
PHQ-9	9-item Patient Health Questionnaire
PHQ-15	15-item Patient Health Questionnaire
Pns	Posterior nasal spine point
PPD	Periodontal pocket depth
Pog	Pogonion point
Po	Porion point
RDC/TMD	Research Diagnostic Criteria for Temporomandibular Disorders
S	Sella point
SD	Standard deviation
TMD	Temporomandibular disorders
TMJ	Temporomandibular joint
WHO	World Health Organization

1. INTRODUCTION

According to the World Health Organization (WHO, 2012), oral health is a state of being free from mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal disease, tooth decay, tooth loss, and other diseases and disorders that limit an individual's capacity of biting, chewing, smiling, speaking, and psychosocial well-being.

General health and oral health share similar causal and behavioural mechanisms. People in poorer health suffer more impact from oral health problems; in turn, oral health status has been considered as a mirror reflecting general health, in particular among older people who are impacted by multiple-factor risks of ageing (Sheiham & Watt, 2000; Brennan & Singh, 2011, Pärna et al., 2017). The changes in the stomatognathic system with ageing affect the quality of life (Petersen & Ogawa, 2012). Oral diseases influence not only masticatory ability, nutrients, communication, and psychological disorders but also the risk of mortality among the elderly (Holmlund et al., 2010; Watt et al., 2012). Dental caries and periodontitis are common oral diseases affect most of the global elderly population and significantly associated with systemic diseases such as Alzheimer's disease, bacterial pneumonia, cardiovascular diseases, cancer, diabetes, etc. (Bansal et al., 2013; Bracci, 2017; Silvestre et al., 2017; Cardoso et al., 2018).

Health of the stomagnathic system is also related to the status of dental occlusion and temporomandibular structures, and WHO (2013) recommends twenty or more natural teeth in the life of the elderly to maintain their oral function. The variation in the conditions affecting the anatomic and functional characteristics of temporomandibular structures is known as temporomandibular disorders (TMD) (Schiffman et al., 2014). TMD signs such as limited mouth opening, clicking, and crepitus tend to increase with age. The TMD complications are major causes for pains and masticatory impairment among the elderly that affect daily activities (Voog-Oras et al., 2003; Jagur et al., 2012). Lack of occluding pairs in dentition due to tooth loss is a concern for the health of the elderly. About 48–95% of the elderly population lost at least one occlusal support zone in their dentition (Hiltunen et al., 1997; Ikebe et al., 2008). People with extensive tooth loss prefer food that is soft, rich in saturated fats and cholesterols, which is associated with various medical conditions (Laurin et al., 1992; Kossioni & Dontas, 2007).

The latest oral health survey in Vietnam in 1999 reported a moderate level of dental diseases for the adult population, but not for the elderly population as well as other oral-related diseases (Roberts-Thomson & Spencer, 2010). To the best of our knowledge, the report on dental diseases, TMD and occlusal status are still lacking for the elderly Vietnamese population. The Vietnamese elderly experienced the Vietnam War (1945–1975) and economic difference schemes, these upheavals can affect their life quality and health status. It is necessary to

collect updated oral health data of the elderly to plan appropriate care and to observe the overall effects of these services on the population.

This is a preliminary study focusing on the population of 65–74 years of age. The study was carried out in Danang, one of the biggest cities in Vietnam. Danang consists of six urban and two rural districts with a population of more than one million inhabitants, and 3% of them are older adults (General Statistics Office of Vietnam, 2016). The main purpose of the study is to identify the prevalence of dental diseases and temporomandibular disorders, and to find their risk factors. The outcome of the study provides specific information contributing to the development of the oral health care system for elderly people in Vietnam.

2. REVIEW OF LITERATURE

2.1. Oral health status of the elderly

Oral health is a description of the healthy status of dentition, occlusion, and masticatory structures. Oral health affects the quality of life of the elderly because of its impact on eating, comfort, appearance, and socializing. Globally, it has been estimated that over 90% of the elderly population experienced oral diseases which are often connected with the systemic diseases (Petersen et al., 2010; Arigbede et al., 2012; Friedman et al., 2017). Persons who being edentulous at age seventy are at significantly higher risk of disability and mortality; in addition, the implications of oral diseases indirectly induce the top causes of mortality in the elderly (Kossioni & Dontas, 2007; Holm-Pedersen et al., 2008).

The lifespan of people in many countries has been over 65 years; the cumulative risk factors of ageing have been reflected by poor oral status which frequently leads to an increase in dental diseases. The dental caries experience is recorded by the mean of the decayed, missing, and filled teeth index (DMFT). High levels of DMFT occur not only in the elderly population of developing countries but also in developed countries (Müller et al., 2007). Caries is affected by different reasons such as medicines, gingival recession, xerostomia, salivary changes, and periodontal diseases; whereas, an increase in the number of remaining teeth may increase oral infection foci in the elderly (Närhi et al., 2000). The obvious consequence of dental diseases in the elderly is tooth loss. Prevalence of the edentulous population is high and different between geographic regions: 26–58% in North America, 7–46% in eastern Mediterranean, 13–78% in Europe, 16–37% in South-East Asia, and 11–57% in western Pacific (Table 1) (Petersen et al., 2010).

The periodontal disease is defined as a chronic disease that destroys the surrounding structures of a tooth such as alveolar bone and ligaments, and it is often triggered with the manifestation of swollen gingiva, hyperaemia, and bleeding. More than 80% of the elderly population have signs of periodontal diseases; it is a particular concern for the elderly in the neighbouring countries of Vietnam where nearly 100% of elderly had periodontal diseases (Amarasena et al., 2002; Na et al., 2014; Natto et al., 2014). The advanced periodontal disease increases the risk of developing dental caries, tooth loss, reduced masticatory performance, affects oral health-related quality of life and systemic diseases (Petersen & Ogawa, 2012; Jansson et al., 2014; Scannapieco & Cantos, 2016).

Table 1. Prevalence of edentulousness of 65–74-year-olds reported for selected countries throughout the world (Petersen et al., 2010)

Country	Edentulousness (%)
Austria	15
Cambodia	13
China	11
Denmark	27
Iceland	15
India	19
Italy	19
Lebanon	20
Lithuania	14
Madagascar	25
Poland	25
Romania	26
Slovakia	44
Sri Lanka	37

2.2. Temporomandibular disorders

2.2.1. Anatomy of the temporomandibular joint

The temporomandibular joint (TMJ) is formed by a mandibular condylar head that fits into the glenoid fossa of the temporal bone. The convex shape of the articular disc is inserted between the biconcave shapes of the condylar head and the articular eminence of the temporal bone. The articular disc which consists of dense connective tissue divides the joint into superior and inferior joint compartments. The articular surfaces of the condyle and the temporal bones comprise of the synovial membrane and fibrous connective tissue that resist the loading force and are capable of repair (Okeson, 2014).

TMJ is enclosed by a capsule that incorporates the articular eminence. The capsule is a fibrocartilage tissue and is lined by endothelial cells, which produce synovial lubrication to fill the articular compartments. The thickened lateral portion of the capsule creates the temporomandibular ligament that defines the border movements of the mandible. Blood supply of TMJ mostly originates from the superficial temporal artery and the maxillary artery, which are branches of the external carotid artery. Other branches of the external carotid artery such as the deep auricular artery, the anterior tympanic artery, and the ascending pharyngeal artery also contribute to the blood supply of the TMJ (Leibur et al., 2013).

The movements of the mandible depend on cooperation between the masticatory muscles. The masseter, anterior and middle boundaries of temporalis, and

the medial pterygoid muscles respond to elevating the mandible (closing the mouth). The initial stage of the depressed mandible (open mouth) is controlled by contraction of the lateral pterygoid muscles and is then continued with the assistance of the digastric, mylohyoid, and geniohyoid muscles. The protrusive mandible is the bilateral contraction of the lateral pterygoid muscles. The retrusion of the mandible is a result of the contraction of the middle and posterior parts of the temporalis muscle. The laterotrusion (side to side) is the contraction of the ipsilateral temporalis muscle and the contralateral inferior lateral pterygoid muscle (Alomar et al., 2007; Shaffer et al., 2014).

2.2.2. Classification of temporomandibular disorders

Temporomandibular disorder is a variety of anatomic and functional characteristics of the TMJ and is classified as a disorder of the musculoskeletal group according to the Medical Subject Heading (U.S. National Library of Medicine, 2018). The first classification of TMD was reported by Helkimo (1974). The Helkimo index evaluates symptoms of TMJ dysfunction, muscular pain, and mandibular mobility. The index grades clinical TMJ dysfunction into four groups according to the level of dysfunction severity (D_i0 = absence of clinical symptoms, D_i I = minor dysfunction, D_i II = moderate dysfunction, D_i III = severe dysfunction).

Truelove et al. (1992) proposed a clinical diagnostic criteria tool allowing multiple diagnoses of TMD, and Dworkin and LeResche (1992) then developed them into the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). The RDC/TMD system consists of two axes; axis I is related to the clinical aspect of TMD and is divided into three diagnostic groups. Axis II analyses the psychological aspect of TMD. The evaluation of axis II is based on giving a score of mandibular functional limitation, intensity of pain, and degree of psychosocial disability.

Regarding the RDC/TMD instrument, Schiffman et al. (2014) described the rationale and methodology underlying the changes from the RDC/TMD to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) by supplementing diagnostic tools. Axis I of DC/TMD covers the most commonly occurring TMD conditions that comprise pain disorders and joint disorders (Table 2) while axis II supplement instruments assesses pain, mandibular function, and psychosocial aspects.

Table 2. Classification of Diagnostic Criteria of Temporomandibular Disorders DC/TMD axis I according to Schiffman et al. (2014)

Disorder	Classification	Sub-classification
Pain disorders		
	Myalgia	
		Local myalgia
		Myofascial pain
		Myofascial pain with referral
	Arthralgia	
	Headache attributed to TMD	
Joint disorders		
	Intra-articular joint disorders	
		Disc displacement with reduction
		Disc displacement with reduction, with intermittent locking
		Disc displacement without reduction, with limited opening
		Disc displacement without reduction, without limited opening
	Degenerative joint disease	
	Subluxation	

2.2.3. Epidemiology and risk factors of temporomandibular disorders

Temporomandibular disorders varies among the general population, ranging between 13–25% in children (Wu & Hirsch, 2010; Fernandes et al., 2015), 11–32% in adults (Rantala et al., 2003; Hirsch et al., 2008; Abrahamsson et al., 2009; Gillborg et al., 2017), and 33–62% in the older age group (Murrieta et al., 2016; Nguyen et al., 2017). Prevalence of TMD often increases from adolescence to middle age and is comparatively low in the old adults (Manfredini et al., 2010; Ogura et al., 2012; Gillborg et al., 2017). With respect to the old-age population, the main sign of TMD is TMJ sounds that affect 17–38% of the population. Limited mandibular movements tend to increase with age whereas pain symptoms of TMD are comparatively less prevalent in the elderly than in the other age groups (Schmitter et al., 2007; Unell et al., 2012).

In regard to population-based studies of TMD, pain disorders occur in 5–13% of the population and have a negative effect on daily activities (Jagur et al., 2011; Jussila et al., 2017). Disc displacement is characterized by abnormal relationships between the TMJ condyle, the articular disc, and the articular eminence, which can implicate limited mouth opening. It has been estimated that disc displacement occurs in 10% of the general population (Manfredini et al., 2011; Ogura et al., 2012). The degenerative TMJ disease is of low-inflammatory origin but causes osseous changes in the condyle. Prevalence of TMJ

degeneration ranges between 2–34.6% and often increase with age (Tanaka et al., 2008; Manfredini et al., 2011).

Age influences on TMD, and the present peak values of pain disorders and intra-articular joint disorders often occur during the period between adolescence and middle age while degenerative joint disease occurs more frequently in the older age than in the younger age (Velly et al., 2002; Ogura et al., 2012; Lövgren et al., 2016; Gillborg et al., 2017). The increased risk of TMD is related to female gender. Females are 2.3–4.7 times more likely prone to suffer from myofascial pain compared to males; the effect of oestrogen on pain susceptibility has been considered a factor contributing to TMD (Huang et al., 2002; Kang et al., 2007; Ferreira et al., 2016).

Occlusion as a causative factor in TMD is controversial due to lack of evidence. Occlusal support is a maintain posterior occluding pairs. The absence of posterior occlusal support may disturb masticatory ability and performance of the temporomandibular joints. Numerous studies have demonstrated that the decline of occlusal support has an adverse impact on TMD. However, TMD is considered to be a multifactorial etiology, longitudinal studies are therefore necessary for verifying the influence of occlusal support on TMD (Pullinger et al., 1993; Gesch et al., 2004; Mohlin et al., 2007; Türp & Schindler, 2012).

Psychological factors have been regarded as having a role in aggravating progression of TMD. Dworkin and LeResche (1992) developed psychological instruments for diagnostic criteria of TMD. Depression or stress significantly relate with pain sensitivity and increase 2–3 times the risk of TMD. Females suffering from myofascial pain often exhibit more depression than those having TMJ pain. Approximately 16% of chronic TMD patients have psychological disorders co-morbidities of anxiety, depression, and somatization. It has been suggested that psychological stressors cause changes in the neuroendocrine function that increase TMD signs and symptoms (Gameiro et al., 2006; Slade et al., 2007; Giannakopoulos et al., 2010; Reiter et al., 2015).

Other factors associated with TMD have been demonstrated in the literature. Trauma, functional overload, or increased joint friction, all of which can break the cartilage of TMJ and then stimulate pro-inflammation cytokines that lead to degenerative joint disease (Yun & Kim, 2005; Tanaka et al., 2008). Parafunctional habits such as clenching or bruxism can affect TMJ. Prevalence of bruxism is reported to be 58–88% among the TMD patients, and bruxism is more related to myofascial pain than other TMJ disorders (Huang et al., 2002; Manfredini et al., 2003). Regarding the immune-inflammatory perspective, insufficient systemic endogenous control of the pro-inflammatory cytokine tumour necrosis factor-alpha (TNF-alpha) can contribute to TMJ pain and tissue destruction (Alstergren & Kopp, 2006; Ahmed et al., 2015). Genetic variations can contribute to TMD, and several genetic risk factors for clinical, psychological, and sensory phenotypes associated with TMD were observed (Oakley & Vieira, 2008; Slade et al., 2008; Smith et al., 2013; Quinelato et al., 2018).

2.2.4. Radiographic findings of temporomandibular structures

Osseous changes of TMJ are manifestations of inflammatory arthritic disorders and may be part of generalized osteoarthritis (Abrahamsson et al., 2017). Low-inflammatory arthritic disorders of TMJ are related to degenerative joint disease or post-traumatic arthritis, and high-inflammatory arthritic disorders result from infectious arthritis, rheumatoid arthritic conditions, or metabolic arthritic conditions (Tanaka et al., 2008; Leibur et al., 2015). TMJ osseous changes are often measured and analysed using magnetic resonance imaging, cone-beam computed tomography, ultrasonography, or orthopantomography (OPTG).

The pathological process of degenerative joint disease is characterized by deterioration and abrasion of articular cartilage and local thickening and remodeling of the underlying bone (Zarb & Carlsson, 1999; Tanaka et al., 2008). The TMJ structural changes can be observed on OPTG such as flattening, erosion, osteophytes, sclerosis, or resorption. The distribution of TMD-related radiographic findings varies in the literature; however, the severity of condylar osseous changes are increased with age; about 17–77% of the general elderly population have TMJ osseous changes (Hiltunen et al., 2002; Takayama et al., 2008; Alexiou et al., 2009; Pontual et al., 2012).

Prevalence of radiographic signs of TMJ degeneration varies in population-based studies. TMJ erosion is a status of decreased density of the cortical and subcortical layers of the condylar bone, and its prevalence ranges between 5.6–45.6%. TMJ flattening is described as a flat bony contour deviating from the convex shape of the condylar head, and about 21.2–80% of non-TMD patients had TMJ flattening. Osteophytes occurring in 2.9–50% of population are marginal bony outgrowths on the condyle because of excessive loading forces. Sclerosis is an increased density of the cortical bone surface associated with the last stage degeneration. Prevalence of sclerosis ranges between 8.5–23.8% in the general population (Hiltunen et al., 2002; Takayama et al., 2008; Jagur et al., 2011; Mathew et al., 2011; Al-Juhani et al., 2015).

2.3. Changes in the facial skeletal structure of the elderly

The changes in the facial skeletal structure result from the natural ageing process. The longitudinal studies found that the amount osseous resorption occurring in the upper face where the maxillary angle of the elderly decreases for 10 degrees compared to young individuals (Friedman, 2005; Mendelson & Wong, 2012; Rosa et al., 2015). The mandible has been shown clarification changes across the age progression. The mandibular ramus heights tend to decrease with increasing age, whereas the changes in the mandibular length because of ageing have been a matter of debate in previous studies (Merrot et al., 2005; Pecora et al., 2008; Shaw et al., 2010). Loss of occlusal support is more prevalent in the elderly and has an impact on occlusal vertical dimension. The edentulous elderly often have a reduced occlusal vertical dimension and a prognathic mandible

(Ciftçi et al., 2005). However, there is controversial evidence whether alteration in the occlusal vertical dimension causes TMD.

The cephalometric findings enable us to analyse the impact of facial changes on TMD. Numerous authors have suggested cephalometry as an auxiliary diagnostic tool for identifying patients with TMJ internal derangement (Ahn et al., 2004; Emshoff et al., 2011; Matsuo et al., 2016; Xie et al., 2016). The measurements of ramus height and mandibular length show different values in TMD and non-TMD persons. The findings related to facial skeletal Class II profiles and the hyper-divergent growth pattern are significantly correlated with the frequency of TMJ intra-articular disorders (Bertram et al., 2012; Moreno-Hay & Okeson, 2015; Manfredini et al., 2016). There is a decrease of condylar, ramus and posterior facial heights in TMD individuals having TMJ sounds (Almăşan et al., 2013; Chen et al., 2015; Matsuo et al., 2016). The analyses of craniofacial structures related to the TMD signs are necessary for the management of TMD and prosthesis for the elderly.

2.4. Summary of the literature

The implications of oral diseases are connected with the systemic diseases. The most common oral diseases are dental caries and periodontal diseases that have historically been considered the important global oral health burdens (Petersen et al., 2010). In addition, temporomandibular disorders are a group of disorders affecting the temporomandibular joint, masticatory muscles, and adjacent structures, and TMD complications affect daily activities of the elderly population. To the best of our knowledge, no study has been reported on the dental and temporomandibular status of the general elderly Vietnamese population who lived under challenging conditions during the Vietnam War (1945–1975). Therefore, the current research is implemented to clarify the prevalence of dental diseases and TMD in the Vietnamese elderly. Furthermore, declining occlusal support can be prevalent among elderly populations, but it as a causative factor in TMD and facial skeletal structure changes is controversial due to lack of evidence. Determination of the role of occlusal support may provide valuable information about management of TMD and oral function of the elderly.

3. AIMS OF THE STUDY

The general aim of the dissertation was to study oral health status, temporomandibular disorders, and the role of occlusal support in relation to TMD and the craniofacial structure in the Vietnamese elderly.

The specific aims were as follows:

1. to describe oral health behaviour and to determine the prevalence of dental caries and periodontal diseases (Paper I and II);
2. to determine the prevalence of symptoms, clinical signs of TMD and osseous changes in the TMJ condylar head and to ascertain whether there are any associations of TMD with psychological disorders and oral function (Paper III and VI);
3. to investigate the impact of occlusal support on TMD and the craniofacial structures (Paper IV, V and VII);
4. to identify the association between TMD and the craniofacial structural changes in the Vietnamese elderly (Paper V).

4. MATERIALS AND METHODS

4.1. Sample size of the study

This cross-sectional study involved examining the oral health status and temporomandibular structures of elderly people aged 65–74 years living in Danang City, Vietnam. The sample size (300 participants) was calculated to a 90% confidence level, assuming a 50% prevalence of any oral diseases among the elderly Vietnamese population, 5% of acceptable error margin, and 10% of compensation for withdrawn participants.

The participants were selected using a multistage stratified random sampling method based on demographic characteristics. Danang consists of two rural and six urban districts. In the present study, we randomly selected one rural district (Hoa Vang) and three urban districts (Hai Chau, Thanh Khe, and Cam Le). Next, lists of elderly residents were obtained from the Community Unions for Older Adults, which includes all the citizens aged 65–74 years. Finally, participants from each of the selected urban district (50 participants) and rural (150 participants) were randomly sampled and stratified according to gender and age groups (male to female ratio = 1:1, age group 65–69 to 70–74 ratio = 1:1).

Of the 300 agreed participants, forty-two were absent on the days of clinical oral examination. A total of 258 Vietnamese elderly (130 males and 128 females, 46.9% were rural residents) participated in the present study. Of 258 participants, one person refused to take a dental impression, 13 persons were absent on the day of taking radiographs, and 36 refused to answer the questions related to psychological symptoms. The study samples are shown in Figure 1.

Written informed consent that explained detailed study procedures including clinical examination of oral and temporomandibular status and radiographic examination was obtained from all participants. This study was approved by the Human Research Ethics Committee of Danang University of Medical Technology and Pharmacy (No. 523/CN-DHKTYDDN 2014), and performed in accordance with the World Medical Association's Helsinki Declaration.

4.2. Determination of oral health behaviour and dental status

(Paper I and II)

The oral health questionnaire for adults of WHO (2013) was used for studies in Paper I and II (Appendix 1). The elderly self-reported oral hygiene, oral behaviour, time and reason of their latest visit to a dentist, the frequency of consumption of various sugary food and drinks, and the frequency of experiencing oral health problems during the past 12 months.

The assessment of dental status was based on the DMFT index following the WHO Oral Health Survey guidelines (2013). The DMFT score of ranging between 0–32 is the sum of decayed teeth (teeth had primary or secondary caries), missing teeth (tooth loss due to any reason), and filled teeth (teeth had restoration and without caries).

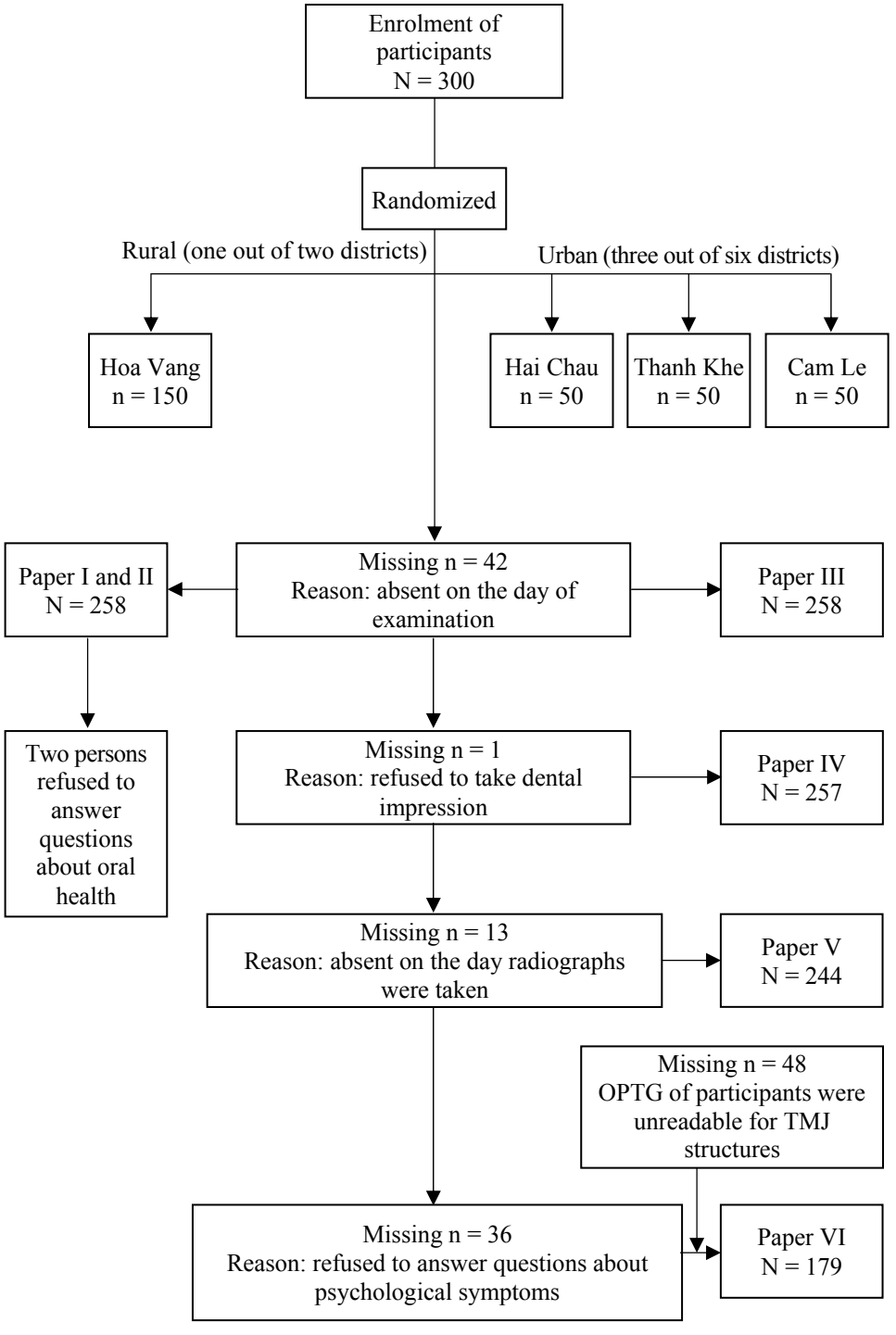

Figure 1. The study samples of the Vietnamese elderly aged 65–74 years

Periodontal status was evaluated using the modified Community Periodontal Index (CPI) including two indicators of periodontal status: gingival bleeding and periodontal pockets. All the teeth present were probed (six sites per tooth) to record any presence of bleeding on probing and periodontal pocket depth (PPD). PPD was scored as follows: score 0 (a PPD of 0–3 mm, no pocket), score 1 (a PPD of 4–5 mm, a shallow pocket), and score 2 (a PPD of ≥ 6 mm, a deep pocket).

Clinical attachment loss (CAL) was recorded at the index teeth of the sextants, to estimate accumulated lifetime destruction of the periodontal attachment. CAL was measured from the cementoenamel junction to the gingival sulcus or pocket at six sites per index tooth. The CAL severity of the sextant was recorded based on the highest CAL score of the index tooth as follows: score 0 (CAL 0–3 mm), score 1 (CAL 4–5 mm), score 2 (CAL ≥ 6 mm). The sextant was excluded if there were less than two teeth present.

4.3. Clinical examination of temporomandibular disorders

(Paper III)

The procedure of TMD clinical examination followed the DC/TMD guidelines (Ohrbach et al., 2014). The participant self-reported TMD symptoms including the history of pain located in the orofacial area, headaches, jaw joint noises, and any locking of the jaw while opening or closing their mouth. Clinical examination signs of TMD consisted of determining the location of orofacial pain and headache; measuring the incisal overjet, incisal overlap, and midline deviation; evaluating the symmetry of the mouth opening pattern; measuring the range of motion and determining the location of pain during mandibular movements; identifying TMJ clicking and crepitus as mandibular movements; confirming the joint locking status; and defining muscle and TMJ tenderness.

Classification of TMD included pain-related TMD, disc displacement, and degenerative joint disease. Pain-related TMD consists of myalgia and arthralgia. The diagnosis of myalgia was based on the confirmation of pain in the masticatory muscle area such as pain from mouth opening or during palpation of the masticatory muscles. Arthralgia was confirmed by TMJ pain from the mandibular movements or from TMJ palpation (Ohrbach et al., 2014; Schiffman et al., 2014).

The diagnosis of disc displacement was as follows: the subject self-reported jaw joint noises and the examiner defined opening and closing TMJ clicking or a vertical mandibular movement click combined with an anterior-posterior mandibular movement click. Disc displacement was also determined in case subject had prior mandibular locking in the closed position and interference in mastication. The degenerative joint disease was clinically diagnosed in case the subject confirmed TMJ noises and the examiner detected TMJ crepitus during mandibular movements (Ohrbach et al., 2014; Schiffman et al., 2014).

4.4. Psychological disorders and oral function evaluation

(Paper VI)

Measurements of psychological disorders and oral function were based on Axis II of DC/TMD protocol (Ohrbach and Knibble, 2014) including questionnaires of: depression (9-item Patient Health Questionnaire PHQ-9, Appendix 2), anxiety (7-item Generalized Anxiety Disorder Scale GAD-7, Appendix 3), somatization/physical symptoms (15-item Patient Health Questionnaire PHQ-15, Appendix 4), limitation of mandibular function (20-item Jaw Functional Limitation Scale JFLS-20, Appendix 5), and frequency of oral parafunctional behaviour (21-item Oral Behaviour Checklist OBC-21, Appendix 6). All the English questionnaire versions were translated into Vietnamese and then back-translated by English language professionals.

The response to each item in PHQ-9 and GAD-7 consisted of assigning a score from zero (not at all) to three points (nearly every day). The total score of PHQ-9 and GAD-7 ranged between 0–27 and 0–21 points, respectively. The symptom level of depression and anxiety were classified into no/mild (0–9 points), moderate (10–14 points), and severe level (≥ 15 points). The response scale for PHQ-15 scored from zero (not bothered at all) to two (bothered a lot). The total score of PHQ-15 was 30 and was grouped into no/low (score 0–9), medium (score 10–14), and the high level (score ≥ 15).

JFLS-20 surveys the limitation of mastication (6 items), mandibular mobility (4 items), verbal and emotional expression communication items (8 items), swallow, and yawn (Table 4 of Paper VI). Each item was scored ranging between 0–10 points (10 points = the most limited mandibular function). OBC-21 was used to determine the frequency of oral parafunctional behaviour. Each item of OBC-21 was given a score from zero to four. The total score of OBC-21 was 84, and it was divided into low parafunction (score 1–24) and high parafunction (score 25–84).

4.5. Assessment of temporomandibular joint osseous changes

(Paper VI)

Orthopantomography was taken using digital orthopantomogram (CRANEX D Digital X-ray unit set at 73kV, 10mA, and 17.6 seconds and CC-detector sensor manufactured by Soredex of Tuusula, Finland). Osseous changes in the TMJ condylar head were analysed on OPTG and included erosion, flattening, osteophytes, and sclerosis. Erosion was a decreased density of the cortical and subcortical layers of the condylar bone. Flattening was loss of smooth and divergence from the convex shape of the condyle. Osteophytes were marginal bone outgrowths on the condyle. Sclerosis was an increased density of the cortical bone extending into bone marrow (Figure 2) (Helenius et al., 2006; Wiese et al., 2008b; Talaat et al., 2016).

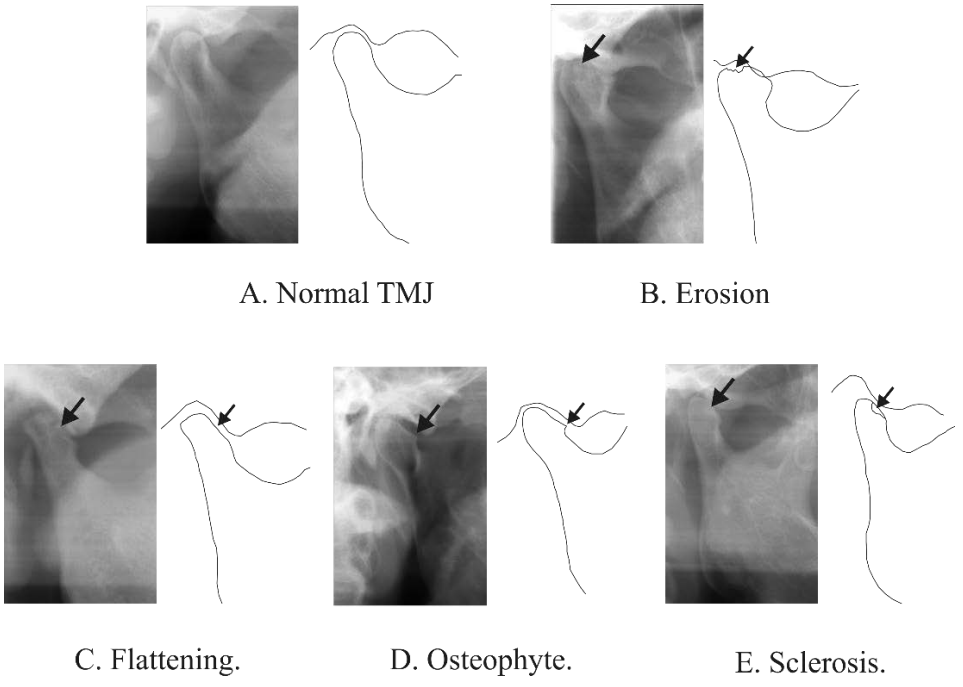

Figure 2. Osseous changes in the TMJ condylar head

4.6. Occlusal support evaluation

(Paper IV, V and VII)

Occlusion was registered using alginate impressions to fabricate dental cast study during the clinical examination. Occlusal features were analysed using Ortho Analyzer™ software (3Shape A/S, Denmark) after the dental cast had been scanned. A functional tooth unit (FTU) is defined as the cusp of a tooth coupling with the fossa of its antagonist. Anterior occluding pairs or premolar occluding pairs is equivalent with one FTU, and a molar occluding pairs is two FTUs. When FTU is used in the posterior region, it is also called a posterior occlusal unit (OU) in the literature (Witter et al., 1999; Ueno et al., 2010). The fixed crowns or bridge prosthesis were calculated as remaining teeth; however, a removable partial prosthesis was not recorded as a tooth.

The dentition was divided into four occlusal support zones based on the position of the occluding pairs of posterior teeth according to Eichner's classification (Eichner, 1990). Class A equates to contact in all four support zones. Class B lacks at least one support zone (B1–B3), or loss of all four supporting zones but contact in the anterior region (B4). Class C has no contact in any support zone (Figure 3).

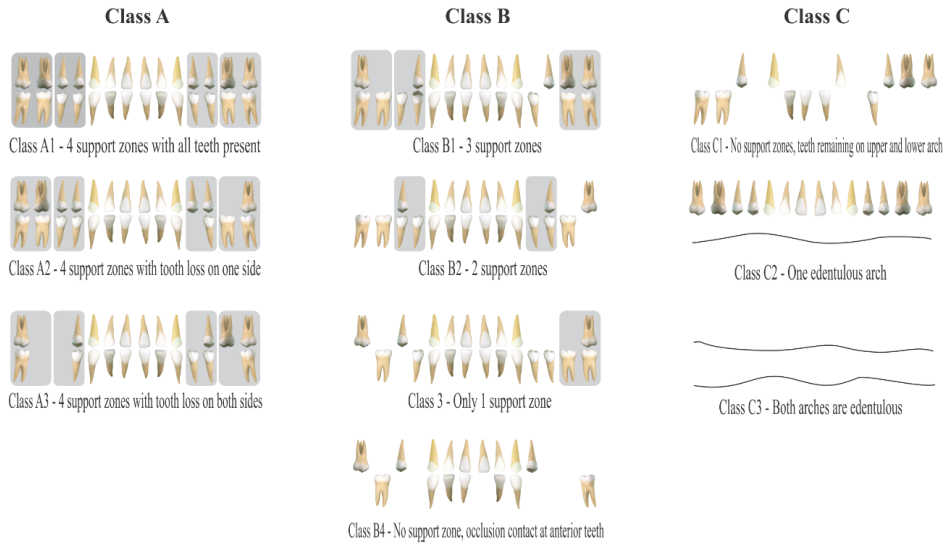

Figure 3. Eichner's classification and subdivision (Eichner, 1990)

4.7. Measurement of facial skeletal structures

(Paper V)

The cephalometric images were taken with a digital CRANEX D Digital X-ray unit (73kV, 10mA, 17.6s, CC-detector sensor; Soredex, Tuusula, Finland) and were tracked by using the NemoCeph 2D software (Nemotec, Madrid, Spain). Hard tissue points used as landmarks during cephalometric analysis, with the reference planes consisting of the Frankfort, mandibular, and cranial base planes. All landmarks points and reference planes are listed in Figure 4 (A-B) and in Table 3.

4.8. Statistical analysis

Version 17.0 of the Statistical Package for Social Sciences software (SPSS Inc., Chicago, Illinois, USA) was used to analyse the data of this dissertation. The significant differences of oral health behaviour, dental caries experience, periodontal status, and TMD in association with gender and residence were tested with Chi-square test, Student's t-test, and Mann-Whitney U test (Paper I–III). Binary logistic regression was used to analyse the influence of risk factors on missing teeth (Paper II) and occlusal support on TMD (Paper IV). The comparison of cephalometric parameters of craniofacial structural changes among occlusal support types according to Eichner's classification were performed with Bonferroni test (Paper V). The association of TMJ osseous changes with psychological disorders and limitation of mandibular function

were done with Student's t-test, Mann-Whitney's U test, and Kruskal-Wallis test (Paper VI). A confidence level of 95% and a two-sided p-value (P) of < .05 were used to reveal significant differences.

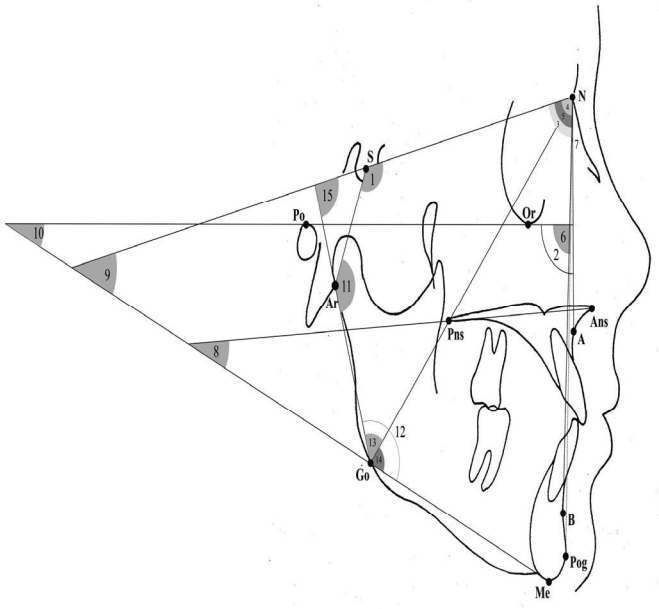

Figure 4A. Angular parameters used in the cephalometric analysis:
(1) N-S-Ar
(2) N-A to the Frankfort plane
(3) SNA
(4) SNB
(5) S-N-Pog
(6) N-Pog to FH
(7) ANB
(8) Ans-Pns to the mandibular plane
(9) Mandibular plane to S-N
(10) Mandibular plane to the Frankfort plane
(11) S-Ar-Go
(12) Ar-Go-Me
(13) N-Go-Me
(14) N-Go-Me
(15) Ar-Go to N-S

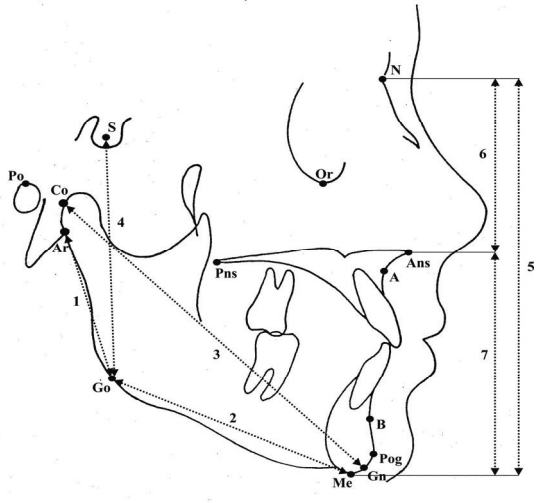

Figure 4B. Linear parameters used in the cephalometric analysis:
(1) Ar-Go
(2) Go-Me
(3) Co-Gn
(4) S-Go
(5) N-Me
(6) N-Ans
(7) Ans-Me

Table 3. Cephalometric landmarks: reference planes, angular and linear parameters

Landmarks	
A	Subspinale: the most concave point of the anterior maxilla
Ans	Anterior nasal spine
Ar	Articulare: the junction between the inferior surface of the cranial base and the posterior border of the ascending rami of the mandible
B	Supramentale
Co	Condylion: the most posterior and superior points on the mandibular condyle
Gn	Gnathion: the point located perpendicularly on the mandibular symphysis, midway between the Pogonion and Menton points
Go	Gonion: the most posterior inferior point on the angle of the mandible
Me	Menton: the most inferior point on the chin
N	Nasion: the middle point of the junction of the frontal and two nasal bones
Or	Orbitale: the lowest point in the lower margin of the bony orbit
Pns	Posterior nasal spine: the posterior limit of the bony palate of the maxilla
Pog	Pogonion: the most anterior point of the mandibular symphysis
Po	Porion: the central point on the upper margin of the external auditory meatus
S	Sella: the midpoint of the Sella turcica
Reference planes	
Frankfort horizontal plane (FH)	Po-Or line projected to form a plane
Mandibular plane	Go-Me line projected to form a plane
True vertical line	The line was drawn vertically through the Nasion point
Cranial base plane	S-N line projected to form a plane
Angles (Figure 4A)	
N-S-Ar (Saddle angle)	N-S and S-Ar lines
N-A to FH	N-A line and Po-Or line
SNA	S-N and N-A lines
SNB	S-N and N-B lines
S-N-Pog	S-N and N-Pog lines
N-Pog to FH	N-A line and Po-Or line
ANB	A-N and N-B lines
MP to Palatal plane	Go-Me and Ans-Pns lines
MP to S-N	Go-Me and S-N line
MP to FH	Go-Me line and Po-Or line
S-Ar-Go (Articular angle)	S-Ar and Ar-Go lines
Ar-Go-Me (Gonial angle)	Ar-Go and Go-Me lines
Ar-Go-N (Upper gonial angle)	Ar-Go and Go-N lines
N-Go-Me (Lower gonial angle)	N-Go and Go-Me lines
Ar-Go to N-S (Ramus inclination)	Ar-Go and N-S lines
Linear parameters (mm, Figure 4B)	
Ar-Go	Ramus height
Go-Me	Mandibular body length
Co-Gn	Effective mandibular length
S-Go	Posterior facial height
N-Me	Anterior facial height
N-Ans	Upper anterior facial height
Ans-Me	Lower anterior facial height
S-Go/N-Me (%)	Facial height ratio
Ans-Me/N-Me (%)	Lower anterior facial ratio

5. RESULTS

5.1. Oral health behaviour and oral health status of the Vietnamese elderly

(Paper I and II)

Regarding self-perception of oral health, 14.3% were wearing removable partial dentures, 3.5% complete upper dentures and 2.3% complete lower dentures. Nearly 50% of the elderly brushed their teeth twice a day, over 90% used a toothbrush and toothpaste for oral hygiene. About one-third of the elderly have never visited a dentist, and only 41.4% visited a dentist for dental treatment because of dental pain. Approximately 60% of participants had been educated more than 5 years (Table 4).

Table 4. Self-reported oral health behaviour of the elderly (N = 258)

Variables		Number	Percent %
Using removable dentures			
	Partial dentures	37	14.3
	Complete upper dentures	9	3.5
	Complete lower dentures	6	2.3
Frequency of tooth brushing			
	Never	6	2.3
	2–6 times per week	7	2.7
	Once a day	119	46.5
	Twice or more times per day	124	48.4
Use of oral hygiene aid			
	Toothbrush	242	94.5
	Wooden toothpicks	219	85.5
	Dental floss and/or mouth rinses	4	1.6
	Toothpaste	237	92.6
	Toothpaste containing Fluoride	171	66.8
Last visit to a dentist			
	< 2 years	106	41.4
	≥ 2 years	63	24.6
	Never	87	34.0
Main reason for the last visit to a dentist			
	Advice	11.8	3.3
	Pain/trouble	45.9	51.6
	Treatment	24.7	34.1
	Routine check-up	4.7	1.1
	Do not remember	12.9	9.9
Duration of education			
	≤ 5 years	105	40.7
	> 5 years	153	59.3

Table 5 shows dental caries experience among the Vietnamese elderly. The mean score of DT, MT, and FT was 6.4 ± 5.5, 7.7 ± 7.1, 0.2 ± 0.9, respectively. The prevalence of the FT component in the sample was only 8.5%, which was lower compared to 88.8% of DT and 90.7% of MT. Approximately 98% participants had experienced dental caries, and the mean of DMFT score of the sample was 14.3 ± 8.7. The rural residents had significantly more missing teeth than the urban residents did (P < .001), and no rural elderly person had a restorative tooth compared to 0.4 ± 1.3 of FT of urban residence.

Table 5. Percentage and mean of dental caries experience in the elderly (N = 258)

Dental caries experience	Total	Gender		P	Residence		P
		Female	Male		Rural	Urban	
Decayed Teeth (DT)							
Percent %	88.8	88.3	89.2	.809	90.1	87.6	.527
Mean ± SD	6.4 ± 5.5	5.9 ± 4.8	7.0 ± 6.1	.101	6.6 ± 5.3	6.2 ± 5.7	.613
Missing Teeth (MT)							
Percent %	90.7	89.1	92.3	.370	93.4	88.3	.162
Mean ± SD	7.7 ± 7.1	8.4 ± 7.0	7.1 ± 7.1	.168	8.8 ± 7.6	6.7 ± 6.5	.014[b*]
Filled Teeth (FT)							
Percent %	8.5	8.6	8.5	.970	0	16.1	< .001[a*]
Mean ± SD	0.2 ± 0.9	0.2 ± 0.7	0.3 ± 1.2	.398	0	0.4 ± 1.3	< .001[b*]
Caries experience (DMFT)							
Percent %	97.7	96.9	98.5	.398	99.2	96.4	.133
Mean ± SD	14.3 ± 8.7	14.3 ± 8.6	14.3 ± 8.7	.986	15.4 ± 8.6	13.4 ± 8.5	.052

[a] Chi-square test, [b] Student's t-test, [*] statistically significant.

Gingival bleeding occurred in 97.2% of the elderly, 62.3% had at least one tooth with PPD 4–5 mm and 21.0% had at least one tooth with PPD ≥ 6 mm. Loss of clinical attachment CAL 4–5 mm was found in 42.9%, CAL ≥ 6 mm was found in 49.8%. The rural residents had significantly more severe periodontal diseases than urban residents (Table 6).

Table 6. Percentage of periodontal diseases in the Vietnamese elderly (N = 258)

Periodontal status	Total	Gender		P	Residence		P
		Female	Male		Rural	Urban	
Gingival status							
Healthy	2.8	3.2	2.4	.686	0	5.2	.016[a*]
Bleeding	97.2	96.8	97.6		100	94.8	

Table 6. Continuation

Periodontal status	Total	Gender		P	Residence		P
		Female	Male		Rural	Urban	
Periodontal pocket depth (PPD)							
PPD 0–3 mm	16.7	22.4	11.0	.020*	8.6	23.7	< .001b*
PPD 4–5 mm	62.3	60.0	64.6		63.2	61.5	
PPD ≥ 6 mm	21.0	17.6	24.4		28.2	14.8	
Loss of clinical attachment (CAL)							
CAL 0–3 mm	7.3	11.5	3.2	.565	2.7	11.1	< .001b*
CAL 4–5 mm	42.9	38.5	47.2		33.9	50.4	
CAL ≥ 6 mm	49.8	50.0	49.6		63.4	38.5	

[a] Chi-square test, [b] Mann-Whitney U test, * statistically significant.

5.2. Clinical findings of temporomandibular disorders

(Paper III)

Approximately one-half of the participants (49.6%) self-reported having had a headache, and 25.2% had had pains in the orofacial area during the previous 30 days. Headaches were significantly associated with females (P = .009) and rural residence (P < .001). Jaw joint noises were detected by 28% of the participants and more frequently in the rural than urban areas (P = .014). Only 3.1% self-reported having locking of the jaw (Table 7).

Table 7. Prevalence of self-reported symptoms of TMD in the Vietnamese elderly (N = 258)

TMD symptom	Total	Gender		P	Residence		P
		Female	Male		Rural	Urban	
Orofacial pain	25.2	60.0	40.0	.053	47.7	52.3	.882
Headache	49.6	57.8	42.2	.009*	59.4	40.6	< .001*
TMJ noises	28.0	54.9	45.1	.256	59.2	40.8	.014*
Locking jaw	3.1	62.5	37.5	.497	62.5	37.5	.481

Chi-square test, * statistically significant.
TMD: Temporomandibular disorders.

Deviated open mouth was observed in 37.6% of the sample and significantly widespread in rural residents (P < .001). About 10% of the elderly had open mouth < 40 mm. Concerning the range of mandibular motion, the mean of maximum opening was 46.1 ± 5.7, maximum laterotrusion on the right side was 8.9 ± 2.3, maximum laterotrusion on the left side was 9.2 ± 2.3, and 8.2 ± 2.4 of protrusion. Males had a larger maximum opening than females (P = .009). Rural residents had significantly limited laterotrusion on the right side compared to urban residents (Table 8).

Table 8. Range of mandibular motion in the Vietnamese elderly (N = 258)

Variables	Total	Gender		P	Residence		P
		Female	Male		Rural	Urban	
Deviated open mouth (%)	37.6	54.1	45.9	.316	67.0	33.0	< .001*
Open mouth < 40 mm (%)	9.7	60.0	40.0	.256	48.0	52.0	.938
Range movement (Mean ± SD, mm)							
Maximum opening	46.1 ± 5.7	45.1 ± 5.1	47.0 ± 6.1	.009*	46.5 ± 5.7	45.7 ± 5.7	.221
Maximum opening with assistance	46.6 ± 5.8	45.8 ± 4.8	47.4 ± 6.6	.032*	47.2 ± 5.3	46.1 ± 6.2	.123
Maximum laterotrusion on the right side	8.9 ± 2.3	8.7 ± 2.6	9.1 ± 2.0	.219	9.2 ± 2.2	8.5 ± 2.3	.020*
Maximum laterotrusion on the left side	9.2 ± 2.3	9.0 ± 2.4	9.5 ± 2.2	.115	9.1 ± 2.4	9.3 ± 2.3	.418
Maximum protrusion	8.4 ± 2.4	8.5 ± 2.4	8.3 ± 2.4	.267	8.4 ± 2.5	8.4 ± 2.3	.911

Chi-square test, * statistically significant, SD: Standard deviation.

Clinical examination of TMJ showed that 48.1% of the participants had a clicking sound. Crepitus occurred in 50.4% of the participants and was found significantly related to rural residents (P = .024). In total, 25.6% of the participants had muscle tenderness which was significantly associated with the rural elderly (P = .006). Females had more prevalent TMJ tenderness than males (Table 9).

Table 10 shows the most common TMD among the Vietnamese elderly was disc displacement (37.6%) followed by degenerative joint disease (34.9%), myalgia (3.5%), and arthralgia (1.2%). In total, 56.6% of the participants suffered from TMD, but there were no significant differences of TMD in gender (P = .696) and in residence (P = .061).

Table 9. Prevalence of temporomandibular joint signs in the Vietnamese elderly (N = 258)

Variables	Total	Gender		P	Residence		P
		Female	Male		Rural	Urban	
TMJ clicking during movement	48.1	48.4	51.6	.705	48.4	51.6	.645
TMJ crepitus during movement	50.4	50.8	49.2	.708	53.8	46.2	.024*
Muscle tenderness	25.6	58.5	41.5	.099	61.5	38.5	.006*
TMJ tenderness	16.3	71.4	28.6	.002*	59.5	40.5	.073

Chi-square test, * statistically significant, TMJ: Temporomandibular joint.

Table 10. Percentage of the elderly diagnosed with the temporomandibular disorders according to DC/TMD axis I (N = 258)

Diagnostic criteria	Total	Gender		P[a]	Residence		P[a]
		Female	Male		Rural	Urban	
Myalgia	3.5	77.8	22.2	.101[b]	77.8	22.2	.088[b]
Arthralgia	1.2	66.7	33.3	.621[b]	33.3	66.7	1.000[b]
Disc displacement	37.6	45.4	54.6	.289	49.5	50.5	.518
Degenerative joint disease	34.9	52.2	47.8	.725	54.5	45.5	.077
At least one TMD diagnosis	56.6	51.4	48.6	.696	51.4	48.6	.061

[a] Chi-square test, [b] Fisher's exact test, DC/TMD: Diagnostic Criteria of Temporomandibular Disorders, TMD: Temporomandibular disorders.

5.3. Findings of temporomandibular disorders related to psychological aspects and oral function

(Paper VI)

Among the total elderly sample, 9.5% had a moderate depression and 2.8% had a severe depression; only 1.7% had moderate anxiety, but 43.6% revealed somatization. None of the significant associations were found between depression, anxiety, and somatization and temporomandibular disorders among the Vietnamese elderly (Table 11).

Table 11. Prevalence of depression, anxiety, and somatization in association with temporomandibular disorders in the Vietnamese elderly (N = 179)

Variable	Total	TMD		P
		No	Yes	
Depression PHQ-9				
No/mild	87.7	85.5	89.6	.687
Moderate	9.5	10.8	8.3	
Severe	2.8	3.6	2.1	
Anxiety GAD-7				
No/mild	98.3	97.6	99.0	.597
Moderate	1.7	2.4	1.0	
Severe	0	0	0	
Somatization PHQ-15				
No/low	56.4	57.8	55.2	.875
Medium	30.2	30.1	30.2	
High	13.4	12.0	14.6	

Chi-square test.
TMD: Temporomandibular disorders.

The mean score of masticatory limitation among the TMD elderly was 2.6 ± 1.9, and among the non-TMD elderly, it was 2.3 ± 2.1. No significant findings in the subscales of JFLS-20 (mastication, mobility, and communication) were associated with TMD ($P > .05$). Concerning oral parafunctional behaviour, 89.9% of the elderly revealed a low parafunction level, and no association was found between TMD and oral parafunctional behaviour among the Vietnamese elderly (Table 12).

Table 12. Score of limitation of mandibular function and prevalence of oral parafunctional behaviour in the Vietnamese elderly (N = 179)

Variable	Total	TMD		P
		No	Yes	
Limitation of mandibular function JFLS-20 (Mean ± SD)[a]				
Mastication	2.4 ± 2.0	2.3 ± 2.1	2.6 ± 1.9	.292
Mobility	0.5 ± 1.1	0.4 ± 0.9	0.5 ± 1.2	.600
Communication	0.2 ± 0.5	0.2 ± 0.4	0.2 ± 0.6	.891
Global	1.0 ± 1.0	1.0 ± 1.0	1.1 ± 1.0	.362
Oral parafunctional behaviour OBC-21 (%)[b]				
No	8.4	8.4	8.3	
Low	89.9	91.6	88.5	.267
High	1.7	0	3.1	

[a] Student's t-test, [b] Chi-square test, TMD: Temporomandibular disorders.

5.4. Osseous changes in the condylar head of the temporomandibular joint

(Paper VI)

Of 196 OPTG images of the elderly, 107 images belonged to TMD participants and 89 to non-TMD participants. Among the TMD participants, 45 cases had flattening, and 35 erosion, 17 had sclerosis, and 10 osteophytes. Regarding the number of osseous signs, combined signs were present in more TMD participants than in non-TMD participants. No associations were found between osseous changes and TMD among the Vietnamese elderly (Figure 5).

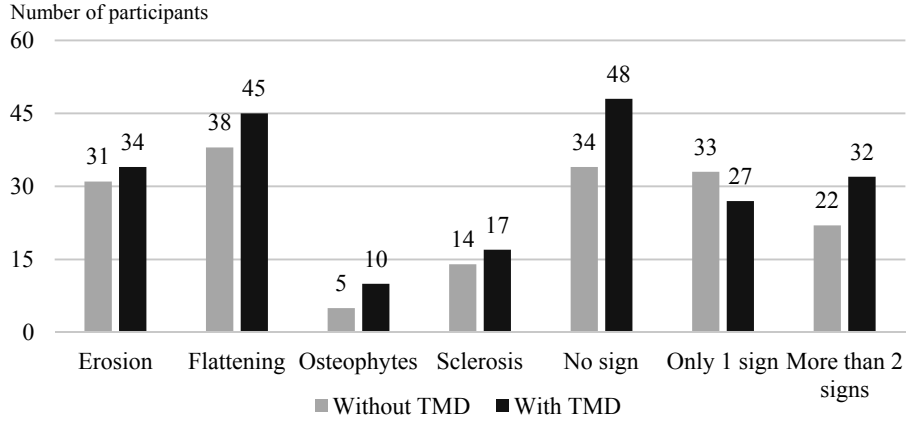

Figure 5. Osseous changes in the TMJ condylar head in the Vietnamese elderly with TMD and without TMD (N = 196)

Of 392 TMJ condyles were accounted for recording osseous changes. Flattening was observed in 28.6% of the total of TMJ condyles, followed by erosion (18.6%), sclerosis (10.5%), and osteophytes (4.3%). Flattening, osteophytes, and sclerosis presented significantly more on the left side than on the right side (Table 13).

Table 13. Percentage of osseous changes in the temporomandibular joint condylar head

Osseous change	Total of condyles (N = 392)	Right side (n = 196)	Left side (n = 196)	P
No change	59.4	61.7	57.1	.355
Erosion	18.6	18.4	18.9	.570
Flattening	28.6	25.0	32.1	< .001*
Osteophytes	4.3	2.0	6.6	.023*
Sclerosis	10.5	7.7	13.3	< .001*

Chi-square test, * statistically significant.

5.5. Associations among temporomandibular disorders, occlusal support and facial skeletal structures

(Paper IV, V and VII)

According to Eichner's classification, 44.7% of the elderly had Class A occlusion, 39.3% had Class B, and 16.0% Class C. The prevalence of Class C was more frequent in rural residents than in urban residents (P < .001). No significant difference was found between females and males related to the distribution of Eichner's classification (Table 14).

Table 14. Percentage of distribution of occlusal support according to Eichner's classification of the elderly (N = 257)

Eichner's classification	Total	Gender		P	Residence		P
		Female	Male		Rural	Urban	
Class A	44.7	38.3	51.2		37.2	51.5	
Class B	39.3	43.0	35.7	.105	38.0	40.4	< .001*
Class C	16.0	18.7	13.1		24.8	8.1	

Chi-square test, * statistically significant.

The binary logistic regression indicated significant associations between loss of occlusal support and TMD. The elderly with total loss of unilateral occlusal support, the odds of developing TMD was 3.36 (95% CI = 1.21–9.36, P = .020), and for those having total loss of bilateral occlusal support, the odds of having TMD was 2.71 (95% CI = 1.12–6.56, P = .027). Eichner's Class C tends to

increase the risk for developing TMD compared to Class A (OR = 2.04, 95% CI = 0.96–4.34, P = .063) (Table 15).

Table 15. The associations between occlusal support and temporomandibular disorders in the Vietnamese elderly (N = 257)

Occlusal support	Odds ratio	95% CI		P
		Lower	Upper	
Eichner's classification				
Class A	1			
Class B	1.28	0.75	2.19	.368
Class C	2.04	0.96	4.34	.063
Occlusal unit status				
Unilateral distal extension loss				
No	1			
Yes	1.67	0.67	4.18	.273
Bilateral distal extension loss				
No	1			
Yes	1.29	0.52	3.19	.587
Total unilateral loss				
No	1			
Yes	3.36	1.21	9.36	.020*
Total bilateral loss				
No	1			
Yes	2.71	1.12	6.56	.027*

Binary logistic regression test, * statistically significant, CI: confidence interval.

Multiple comparisons using Bonferroni test indicated that in Class C SNB angle, S-N-Pog angle, and the angle formed by N-Pog to the Frankfort plane were statistically larger compared to those of Class A and Class B (P < .001). The lower gonial angle (N-Go-Me), articular angle (S-Ar-Go), mandibular plane to S-N, and mandibular plane to the Frankfort plane of both Class A and Class B were statistically larger than those of Class C (P < .001). Of the linear parameters, anterior facial height (N-Me) and lower anterior facial height (Ans-Me) were statistically different among the three classes (P < .001). Posterior facial height (S-Go) of Class C was significantly shorter than in Class A or Class B (P < .001). Facial height ratio (S-Go/N-Me) and lower anterior facial height ratio (Ans-Me/N-Me) were statistically different among the three classes (P = .014 and P < .001, respectively) (Table 16).

Table 16. Effect of occlusal support on facial-skeletal structures based on cephalometric analysis (N = 244)

Cephalometric measurements	Total	Eichner's classification			P	Bonferroni test
		Class A	Class B	Class C		
Angular parameters (^{0})						
Cranial base relationships						
Saddle angle (N-S-Ar)	126.3	126.6	126.1	125.6	.681	
NA to FH	92.0	92.4	92.0	90.6	.049*	C < B, B = A
SNA	84.4	84.4	85.0	83.3	.096	
SNB	79.2	78.2	79.5	81.1	< .001*	A = B, B < C
S-N-Pog	79.9	78.6	80.1	83.0	< .001*	A < B < C
N-Pog to FH	87.4	86.5	87.2	90.4	< .001*	A = B, B < C
Relationship of maxilla to mandible						
ANB	5.3	6.2	5.5	2.2	< .001*	C < B, B = A
Mandibular plane to palatal plane	21.1	22.2	21.2	17.4	< .001*	C < B, B = A
Mandibular relationships						
Mandibular plane to S-N	34.0	35.6	33.9	29.4	< .001*	C < B, B = A
Mandibular plane to FH	26.4	27.7	26.7	22.1	< .001*	C < B, B = A
Articular angle (S-Ar-Go)	146.7	148.8	146.4	141.6	< .001*	C < B, B = A
Gonial angle (Ar-Go-Me)	119.7	118.9	119.9	121.2	.225	
Upper gonial angle (Ar-Go-N)	46.6	44.8	46.7	51.4	< .001*	A < B < C
Lower gonial angle (N-Go-Me)	73.1	74.2	73.1	69.9	< .001*	C < B, B = A
Ramus inclination (Ar-Go to N-S)	93.2	95.6	92.8	87.4	< .001*	C < B < A
Linear parameters (mm)						
Ramus height (Ar-Go)	49.3	49.9	49.3	47.9	.139	
Mandibular body length (Go-Me)	68.7	69.1	68.5	68.2	.525	
Effective mandibular length (Co-Gn)	107.6	108.3	107.4	105.9	.109	
Posterior facial height (S-Go)	75.4	76.8	75.2	72.0	< .001*	C < B, B = A
Anterior facial height (N-Me)	113.0	116.3	112.5	104.8	< .001*	C < B < A
Upper anterior facial height (N-Ans)	50.2	50.5	49.8	50.0	.339	
Lower anterior facial height (Ans-Me)	62.8	65.7	62.7	54.8	< .001*	C < B < A
Facial height ratio % (S-Go/N-Me)	66.9	66.1	67.0	68.9	.014*	A = B, B < C
Lower anterior facial ratio % (Ans-Me/N-Me)	55.5	56.5	55.6	52.1	< .001*	C < B, B = A

* Statistically significant.

Table 17 shows significant values of TMD signs associated to cephalometric parameters. Limited mouth opening was significantly associated with a small angle formed by N-Pog to the Frankfort plane (P = .020), and a large ANB angle (P = .035). Crepitus was significantly associated with the larger angles of S-N-Pog (P = .039), ANB (P = .001), the angle formed by N-Pog to the Frankfort plane (P = .036), and the upper gonial angle (Ar-Go-N, P = .023). TMJ tenderness was related to a short effective mandibular length (Co-Gn, P = .014), a short anterior facial height (N-Me, P = .003), small angles between the mandibular plane and the palatal plane (P = .009), the mandibular plane and S-N (P = .048), and the mandibular plane and the Frankfort plane (P = .017). Muscle tenderness was related to the large upper gonial angle (Ar-Go-N, P = .024) but a small lower gonial angle (N-Go-Me, P = .025). The lower anterior facial ratio (Ans-Me/N-Me) was significantly associated with a limited mouth opening (P = .042), TMJ crepitus (P = .027), and TMJ tenderness (P = .002).

Table 17. Associations of cephalometric parameters with TMD signs in the elderly (N = 244)

Parameter	TMD sign				P*
	Yes		No		
	Mean	SD	Mean	SD	
Limited mouth opening (< 40 mm)					
N-Pog to FH (^{0})	85.5	4.8	87.7	4.2	.020
ANB (^{0})	6.5	2.3	5.1	3.1	.035
Ans-Me/N-Me (%)	56.7	2.3	55.3	3.3	.042
Muscle tenderness					
Ar-Go-Me (^{0})	117.8	6.9	120.3	7.2	.024
N-Go-Me (^{0})	71.7	4.9	73.5	5.6	.025
Temporomandibular joint crepitus					
S-N-Pog (^{0})	80.5	4.6	79.3	4.1	.039
N-Pog to FH (^{0})	87.9	4.7	86.8	3.9	.036
ANB (^{0})	4.6	3.4	5.9	2.4	.001
Ar-Go-N (^{0})	47.3	5.1	45.9	4.4	.023
Ans-Me/N-Me (%)	54.9	3.3	55.9	3.1	.027
Temporomandibular joint tenderness					
Mandibular plane to palatal (^{0})	18.7	5.6	21.5	6.2	.009
Mandibular plane to S-N (^{0})	32.1	6.2	34.3	6.5	.048
Mandibular plane to FH (^{0})	24.5	5.0	26.8	6.5	.017
N-Go-Me (^{0})	70.9	5.3	73.5	5.4	.006
Co-Gn (mm)	105.4	5.6	108.0	6.2	.014
N-Me (mm)	109.3	6.7	113.7	8.5	.003
Ans-Me (mm)	59.2	7.8	63.5	7.2	.001
Ans-Me/N-Me (%)	53.9	3.8	55.7	3.1	.002

*Student's t-test, statistically significant, TMD: Temporomandibular disorders.

6. DISCUSSION

6.1. Oral health status of the Vietnamese elderly

(Paper I and II)

The majority of the Vietnamese elderly had severe dental caries. The observed prevalence of the elderly having dental caries was in line with 96% of those living in Southern Vietnam and was higher compared to 85% of the adult population in the national oral health report (Nguyen et al., 2010; Roberts-Thomson & Spencer, 2010). Dental caries experience among the Vietnamese elderly remained at the high level of DMFT > 14 and was at the same level with the Chinese elderly (Liu et al., 2013) but lower compared to the results conducted in other studies (Wyatt, 2002; Rihs et al., 2009; Doğan & Gökalp, 2012). The various DMFT levels at 65–74 years of age suggest that risk factors for dental caries can be different in different countries.

The cumulative risks of developing dental diseases in the current study might result from behaviour and perceived oral health among the elderly. Most of the Vietnamese elderly thought that dental diseases inducing tooth loss, was due to the naturally ageing process; therefore, it seemed that the attitudes towards oral health care were ignored. Poor oral hygiene might be a factor in our sample where more than half of the elderly did not brush their teeth at least twice a day. Most elderly people thought that brushing their teeth after the morning wake-up was enough for their oral hygiene. Paper II reported that the low educational level was a risk of tooth loss; therefore, lack of perception about oral health was likely to contribute to oral problems among the Vietnamese elderly. Our findings were supported by Siukosaari et al. (2012) demonstrating that level of education had a clear effect on the periodontal health status in the elderly. The present study was also in accordance with other studies, indicating that the low educational level and lack of oral health perception were the major risks for poor oral health in the elderly (Paulander et al., 2003; Hugo et al., 2007; Lundegren et al., 2012).

More than one-third of the elderly have never visited a dentist and others visited a dentist due to dental pains. Oral problems concern not only the elderly themselves but also the oral health care system. The density of dentists in Vietnam has been estimated to be no more than one per 10,000 inhabitants (Nguyen et al., 2010). This is likely to lead to lack of oral hygiene instruction and limits oral care service for the elderly community. The evidence was that a few decayed teeth were filled whereas approximately 30% of number of teeth were extracted in a dentition. This showed that the treatment option of dental pain for the elderly was painkiller medicine and then extraction. Evidently, when the decayed tooth was not saved, its consequence was tooth loss and eventually edentulousness, which is a failure of the dental care system (Gil-Montoya et al., 2015).

Approximately 6% of the participants were edentulous, and this result was somewhat lower than in other countries (Petersen et al., 2010). However, one

could predict that the prevalence of edentulousness will increase in the coming years because of periodontal diseases. We examined the remaining teeth of the elderly and found that nearly 40% of teeth had periodontal pockets deeper than 4 mm. The periodontal diseases and poor oral hygiene could result in aggressive tooth loss and have an impact on the quality of life, especially in rural residents. Other studies conducted in developed and developing countries have also indicated that oral state of rural residents is often worse than that of urban residents (Gökalp et al., 2010; Petersen et al., 2010; Jiang et al., 2013; Liu et al., 2013).

There were no reports of the impact of periodontal diseases on the Vietnamese elderly. Mortality from infectious cardiovascular diseases is a burden in Vietnam (Minh et al., 2003). Inflammation may be a possible pathway to link periodontal diseases with cardiovascular diseases. In addition, periodontal diseases constitute a risk of other systemic diseases such as diabetes mellitus, osteoporosis, respiratory diseases, rheumatoid arthritis, osteoporosis, and Alzheimer's disease because of bacterial pathogen transmission (Esfahanian et al., 2012; Bansal et al., 2013; Bracci, 2017; Silvestre et al., 2017; Cardoso, Reis, Manzanares-Céspedes, 2018). Therefore, the improvement of oral health-related knowledge and early treatment interventions of dental caries and periodontal diseases are priority for community-based oral health programmes in Vietnam to make efforts to reduce the risk of systemic diseases in the elderly.

6.2. Temporomandibular disorders of the Vietnamese elderly

(Paper III and VI)

Temporomandibular disorders were widespread among the Vietnamese elderly alongside dental diseases. Nearly half of the participants self-reported TMD symptoms; it is likely that such symptoms could be caused by age-related physiological changes. Among TMD symptoms detected in the present study, headaches were significantly associated with the female gender. It is true that the elderly Vietnamese women could have a low threshold of pain response due to the decline in general health; moreover, the bulk of routine housework and meagre income distressed the female elderly, which may be the cause of more frequent headaches.

The most frequent TMD sign in the Vietnamese elderly was TMJ sounds. The prevalence of TMJ sounds in the present study ranges between 36–71% of the subjects having TMJ sounds among the general elderly population of previous reports (Schmitter et al., 2005; Unell et al., 2012; Camacho et al., 2014). TMJ clicking was the most common sign of the intra-articular joint disorders and crepitation implied degeneration of the TMJ structure (Amaral et al., 2013; Schiffman et al., 2014). There was coexistence of clicking and crepitation in the Vietnamese elderly. Ageing is a risk factor of joint degeneration, loss of fibrocartilage and inflammation of TMJ appear to be major pathobiological processes that might influence disc position in joint pathology

(Stegenga, 2001). A low prevalence of muscle tenderness was found in the Vietnamese elderly. This can be due to the reduction of sensory stimulation in the elderly. Others studies reported that the prevalence of muscle tenderness tends to decrease with age (Mundt et al., 2005; Schmitter et al., 2005; Gillborg et al., 2017).

In the present study more than half of the participants suffered from TMD, and the high prevalence of TMD among the elderly in Vietnam was in line with other studies conducted in older adult populations (Dallanora et al., 2012; Camacho et al., 2014; Murrieta et al., 2016). Our study found that 34.8% of the elderly had TMJ degeneration. As regards osteoarthritis, the prevalence of TMJ degeneration of our participants ranged between 36–41% in the elderly Vietnamese population having osteoarthritis (Hoa et al., 2003). In addition, the incidence of TMJ osteoarthritis could increase after the period of middle age. The fact that chondrocyte senescence could develop the risk of cartilage degeneration; in turn, these changes might negatively influence the outcome of an attempt to remodel articular cartilage (Martin & Buckwalter, 2002).

The prevalence of disc displacement was also in line with the degeneration joint disease. The co-morbidity between the two conditions among the Vietnamese elderly could be explained by different reasons. Firstly, disc displacement often occurs in the adult group and can elongate with age if an individual does not have TMD intervention. In fact, no elderly participant in our study received treatment for TMJ disc displacement. Secondly, disc displacement is a type of internal derangement and there was an association between internal derangement and osteoarthritis, a type of degenerative disease (Bertram et al., 2001). Finally, the TMJ osseous changes due to degeneration might influence the position relationship to the disc in the glenoid fossa, and that could cause disc displacement.

Many TMD patients seek treatment because of pain. TMD pain and depression often co-exist; however, a poor correlation was found between TMD and depression, anxiety, and somatization among the Vietnamese participants. TMD can be an asymptomatic or involve chronic pain that would cause psychological problems such as anxiety and depression. Otherwise, psychological factors were linked to pain sensitivity and predicted 2–3 times increased risk of TMD (Slade et al., 2007; Jivnani et al., 2017). In fact, our participants represented a healthy population that could be less affected by psychological disoders, and TMD pain such as myalgia and arthralgia accounted only 3% of the sample. This could explain why psychological factors and TMD had a weak association among the elderly. However, as TMD can be asymptomatic but it influences activities of daily living and is related to general health, the oral health care system should be taken into account for early diagnosis of TMD. The prevention of TMD would be valuable for the Vietnamese population to increase the quality of life.

The present study found that nearly half of the participants reported having somatization, a manifestation of psychological distress with the presence of bodily symptoms. This is because other factors such as increasing age, sleep disorders, and economic hardship have more impact on somatization than TMD.

Moreover, lack of emotional support between the elderly and their children, due to the urbanization process, might have a significant effect on the health-related quality of life for the elderly in Vietnam. In future, the Vietnamese social services should offer more activities for elderly people.

The Vietnamese elderly often exhibited a limitation related to mastication ability rather than mandibular mobility, and verbal and emotional expression. This is because a poor dental status and missing teeth influenced mastication. However, subscales JFLS-20 scores of 65–74-year-olds in this study were much higher compared to those of 18–44-year-olds in the study by Ohrbach et al. (2013). This study suggested that ageing affects oral functional limitation. The predictive TMD model indicated an increase in TMD incidence along with an increasing JFLS-20 score in the general population.

In the present study, TMD was non-significantly associated with the oral parafunction and limitation of mandibular function among the Vietnamese elderly. Our finding is in accordance with the study by Meulen et al. (2006) that found no relationships between the self-reported oral parafunctions and TMD pain complaints but contrasts with other studies which demonstrated such parafunction as clenching, bruxism, and the habit of talking a long time on the phone provoking TMD (Kino et al., 2005; Michelotti et al., 2010).

The present study found that more than half of the participants had TMJ osseous changes. This is in accordance with other population-based studies with a prevalence range of 11.6– 50% of TMJ osseous changes and stability around 45% in the older age groups (Takayama et al., 2008; Jagur et al., 2011; Bäck et al., 2017). The study revealed specific individuals 65–74 years of age; a low condylar bone quality in this age group could be significantly correlated with the development of TMJ osteoarthritis (Shi et al., 2017).

Among all the radiographic signs of TMJ osseous changes, flattening was the most frequent and occurred in more than a quarter of the elderly participants. Alexiou et al. (2009) found that TMJ flattening was more common among the persons over 55 years of age. In addition, flattening could result from a reduction of joint space and increased friction between the condylar head. In many cases where the elderly lost many posterior teeth, the TMJ condyle rotates and moves forwards to adapt mastication of the anterior teeth; therefore, it would increase the risk of flattening in the elderly. Erosion is the decreased density of the cortical and subcortical bones, and it often occurs in the early stage of degeneration. The present study found 18.6% of TMJ erosion, which is in accordance with Takayama's study (2008) that found 14.7% of the general population had TMJ erosion. Erosion in TMJ increases between 1.6–27.4 times the risk of osteoarthritis and 1.5–7.5 times the risk of limited mouth opening (Wiese et al., 2008a).

The signs of sclerosis found in this study were relatively modest. Sclerosis attempts to remodel TMJ degeneration by increasing density of the subcortical bone; therefore, it often occurs later than flattening and erosion. Moreover, sclerosis was significantly associated with increased ageing (Krisjane et al., 2012; Pontual et al., 2012; Shetty et al., 2014). The present study found that a few

elderly participants had osteophytes. The presence of osteophytes was an indication that the TMJ condyle had adapted to degenerative changes in the past. The mean age of osteophytes occurrence is 47 years, and its severity increased gradually from 56 years. Moreover, only large osteophytes in the TMJ can be identified with orthopantomograph imaging (Hussain et al., 2008; Alexiou et al., 2009). This could explain why a low prevalence of osteophytes was present in our elderly.

Prevalence of TMJ osseous changes in the non-TMD elderly is on the same level with the TMD elderly in the current study, and no significant associations were found between TMJ osseous changes and TMD in the elderly. This was consistent with the finding by Takanayma et al. (2008); the latter indicated that TMJ osseous changes were similar in the dentate-patient and the TMD-patient populations. Moreover, the report by Hiltunen et al. (2003) that was based on a 5-year follow-up study found a weak correlation between radiographic findings and TMD signs. Numerous studies have indicated that TMJ osseous changes could occur in asymptomatic individuals, and there were poor correlations between radiographic findings and clinical symptom pain as well as the oral function (Tanaka et al., 2008; Wiese et al., 2008a; Bäck et al., 2017). This can be explained by several different reasons. Firstly, the activity of TMD cannot be definitively determined using the diagnostic images; it needs the help from medical history, clinical findings, and symptoms to determine disease occurrence. Secondly, a person having TMJ osseous changes is unlikely to have TMD internal derangement because it depends on the confirmation of TMJ sounds. The findings by Kiliç et al. (2015) indicated a weak correlation between TMJ sounds and TMJ erosion, flattening, osteophytes, and sclerosis. Lastly, similarly to other joints in the human body, TMJ osseous changes could be influenced by different systemic factors such as gender, ageing, and arthritis, not only from TMD itself (Martin & Buckwalter, 2002; Alstergren & Kopp, 2006; Bäck et al., 2017).

The present study conducted analyses of TMD in 65–74 years of age. The high prevalence of disc displacement and degenerative joint disease presented in this age group, whereas TMD pains were at a low level. Social demographical (i.e. gender and residence) and psychological domains were nonetheless not significantly associated with TMD. This tends to suggest that TMD could be regarded as asymptomatic and there would be an impact of stronger factors on TMD among the Vietnamese elderly.

6.3. The impact of occlusal support on temporomandibular disorders and facial structural changes

(Paper IV, V, and VII)

Occlusal unit is used to describe the number of posterior occluding pairs of teeth and is significant in determining masticatory efficiency and chewing ability (Witter et al., 2001; Ueno et al., 2010; Naka et al., 2014). Our participants had only about 50% of total OUs. This is in accordance with the most frequently missing teeth in the Vietnamese elderly were molar teeth followed by premolars and anterior teeth. The mean number of OUs in our study was in line with those in the elderly living in Southern Vietnam and the Japanese elderly (Ueno et al., 2010; Nguyen et al., 2011). Witter et al. (2001) demonstrated that the maintenance of 3–5 OUs could provide sufficient oral function; 42.8% of our elderly did not reach this number of OU for their dentition.

In the current study, nearly 16% of the participants had no posterior occlusal supports. The distribution of Eichner's classification in the present study is in line with that of the German population but differs from the Japanese elderly (Kindler et al., 2012; Okamoto et al., 2012). It was found that the TMD participants had significantly more missing posterior teeth than the non-TMD participants. This finding is in accordance with Pullinger et al. (1993) and Gillborg et al. (2017) who found that missing 5–6 posterior teeth can contribute to the risk of TMJ pain and osteoarthritis. Loss of more than 30% of posterior teeth could cause a decline of mastication, influenced by biased occlusion, which can possibly affect the TMJ structures.

The Vietnamese elderly who had lost a total of posterior occluding pairs on one side had a 2.7 times higher risk of developing TMD. Chewing food on one side implies improper dynamics of TMJ, and increases the friction of the intra-articular structure. It could break the TMJ cartilage layers and initiate inflammation of TMJ (Santana-Mora et al., 2013). In the same way, loss of all the posterior occlusal support increased twice the risk of TMD in the Vietnamese elderly. Bilateral occlusal supports maintain balanced occlusion and vertical dimension of occlusion. The absence of bilateral occlusal supports would change adaptations in the neuromuscular function and induce muscle tenderness and TMJ pain (Ikebe et al., 2005; Türp & Schindler, 2012).

Numerous studies indicated that absence of the occlusal support reduces oral function activities, muscle tenderness and increased pain as well as TMJ sounds (Ciancaglini et al., 1999; Mundt et al., 2005; Ikebe et al., 2010). Another aspect explaining the impact of lost occlusal support on TMD is related to the biomechanism. An unstable TMJ due to functional overload from occlusion changes the adaptive capacity of TMJ. This links to hypoxia and increases the level of pro-inflammatory cytokines, induces the activity of osteoclasts and causes the breakdown of TMJ cartilage (Tanaka et al., 2008). The findings of the present study contribute to the findings of the previous studies, indicating that a shortened dental arch could prevent the development of TMD (Witter et al., 2001; Sarita

et al., 2003). Moreover, we reviewed the impacts of occlusal support on TMD based on data collected from 1,411 citations published over the period 1992–2017 (Paper VII). We found that loss of occlusal units has more impact on TMD than loss of posterior teeth, and total loss of unilateral occlusal support seems to be an etiological factor for TMD.

The decline of the number of occlusal support zones has a significant impact on the mandibular structure among the Vietnamese elderly. The mandible tends to protrude in the elderly having less occlusal support. This is evidenced by the alteration of the anterior cranial base angles and the decreased ramus inclination. It implies adaptation to a new functional position for masticatory performance in the anterior region. These findings are consistent with the findings of other cephalometric studies in elderly populations (Brzoza et al., 2005; Huumonen et al., 2010). Moreover, a larger upper gonial was also found in such participants; it could be explained by resorption of the mandibular bone as the mandibular posterior teeth had been extracted. Our finding is in accordance with the study by Okşayan et al. (2014) which demonstrated rapid bone resorption after extracted posterior teeth.

The comparison of cephalometric linear measures in the current study showed that the elderly without occlusal support had shorter anterior facial height. This can be explained by the fact that no occlusal support reduced not only vertical dimension of occlusion but also symphysis height of mandible (Merrot et al., 2005). Several studies also indicated that being edentulous also results in significantly shorter mandibular length and ramus height (Merrot et al., 2005; Rosa et al., 2015). As of result of no occlusal support, the mandible tended toward anti-clockwise rotation, and an anterior Class III relation occurs to replace an anterior Class I relation (Ozturk et al., 2013; Wiens & Priebe, 2014). In turn, facial height does not change significantly if an elderly person has enough occluding pairs of teeth (Shimizu et al., 2006).

6.4. The associations between temporomandibular disorders and facial structural changes

(Paper V)

The cephalometric parameter has been suggested as an auxiliary method for the discrimination of TMD (Almăşan et al., 2013). Significant associations were found between cephalometric parameters and signs of TMD among the elderly in the present study. The retrusive position of the Pogonion point was significantly associated with TMJ crepitus. Crepitation is one of the main signs of the degenerative joint disease, and osseous degeneration might affect the condylar size and change the position of the condyle in the glenoid fossa that might change the Pogonion position.

Decreased height of the lower third face was also related to crepitation. It could well be that loss of occlusal supports contributed to both the decline of

facial height and crepitation. A person without occlusal support tends to find the temporary occlusal contact of the anterior teeth, which affects the variation of the condyle-fossa relationship; even though in the case edentulousness the condyle was situated upwards and forwards within the glenoid fossa (Tanaka et al., 2008; Uma et al., 2015). The evidence of our cephalometric findings was that alteration of the articular point was significantly associated with loss of occlusal supports and crepitus; therefore, such variations created compression on the articular disc and initiated inflammation of articular surfaces that likely led to crepitation of the degenerative joint.

The present study found that anticlockwise changes in the mandible were related to muscular tenderness. The angles of elderly having muscle tenderness, which were created by the mandibular plane and cranial base, were significantly smaller compared to that of non-sufferers. This might be so because those TMD elderly had a shorter ramus and ramus inclination. A study indicated that a shorter ramus was significantly associated with TMD (Hwang et al., 2006). Moreover, mandibular direction changes could affect the position and dynamic movement of the articular disc; in the case of disc displacement, TMD pains might occur due to the compression on the lateral pterygoid muscle and the stress of retrodiscal tissue of TMJ.

Cephalometric studies indicated significant findings related to discrimination in TMD. Patients with osteoarthritis have shorter ramus height than those without osteoarthritis (Emshoff et al., 2011). Among persons with the Class II relationship, those having crepitus would have a smaller condylar ratio compared to those without crepitus (Matsuo et al., 2016). The decrease in posterior facial height (S–Go), ramus height (Ar–Go), and backward rotation of the mandible were more severe in female with disc displacement without reduction than those with disc displacement with reduction (Ahn et al., 2004).

In summary, poor dental status, temporomandibular disorders, and loss of occlusal support are major concerns for the elderly Vietnamese population. All these issues influence not only the general health and quality of life but also increase cost of healthcare for the elderly. The current study indicated the associations among TMD, occlusal support, and craniofacial structures. However, does TMD precede craniofacial structure changes? Alternatively, do craniofacial structure changes cause TMD? There are debates regarding the initiating event between TMD and craniofacial structure changes in the elderly of our study. This issue should be clarified in the future studies.

7. CONCLUSIONS

The conclusions of the present study are as follows:

1. Dental caries was at a high level in the Vietnamese elderly, and most elderly people had clinical signs of periodontitis and periodontal diseases. The insufficient perception of oral hygiene and lack of dental visits might contribute to poor oral health status in the Vietnamese elderly.
2. Temporomandibular disorders affected more than half of the participants. The main signs of TMJ osseous changes in the elderly were flattening and erosion. There were no associations of TMD with psychological disorders and limitation of mandibular function in the Vietnamese elderly.
3. Total loss of unilateral occlusal support and absence of occlusal support were risk factors for TMD. The higher was the number of lost occlusal support zones, the more significant were the changes in the craniofacial structures. The elderly without occlusal support tended to have mandibular prognathism to adapt their mastication.
4. The changes in the craniofacial structures were significantly associated with clinical signs of TMD in the Vietnamese elderly. TMJ crepitus and TMJ tenderness were related to anti-clockwise rotation and protrusion of the mandible and reduction of the lower facial height ratio.

The obtained information could be valuable for the planning of preventive and active treatment of oral healthcare in Vietnam with special emphasis on the elderly. Changing attitudes and increased knowledge and perception of oral health are of primary importance for the elderly population. The primary oral healthcare system should be improved in the rural areas. TMD, often related to chronic orofacial pain, and having an adverse impact on daily activities, should be treated by specialists; thus, there is a need for a strategic plan for training TMD experts in Vietnam and more effective policies from the Vietnamese health authorities to support the edentulous elderly approaching prosthodontic treatment to restore the harmony of the oral function.

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APPENDICES

Appendix 1. Oral Health Questionnaire for Adults (WHO, 2013)

1. How many natural teeth do you have?

No natural teeth	□ 0	10–19 teeth	□ 2
1–9 teeth	□ 1	20 teeth or more	□ 3

2. During the past 12 months, did your teeth or mouth cause any pain or discomfort?

Yes	□ 1	No	□ 2
Don't know	□ 9	No answer	□ 0

4. Do you have any removable dentures?

	Yes	No
	1	2
A partial denture?	□	□
A full upper denture?	□	□
A full lower denture?	□	□

5. How would you describe the state of your teeth and gums? Is it "excellent", "very good", "good", "average", "poor", or "very poor"?

	Teeth	Gums		Teeth	Gums
Excellent	□ 1	□ 1	Average	□ 4	□ 4
Very good	□ 2	□ 2	Poor	□ 5	□ 5
Good	□ 3	□ 3	Very poor	□ 6	□ 6
Don't know	□ 9	□ 9			

6. How often do you clean your teeth?

Never	□1	2–6 times a week	□ 5
Once a month	□2	Once a day	□ 6
2–3 times a month	□3	Twice or more a day	□ 7
Once a week	□4		

7. Do you use any of the following to clean your teeth or gums? (Read each item)

	Yes	No		Yes	No
	1	2		1	2
Toothbrush	□	□	Dental floss	□	□
Wooden toothpicks	□	□	Charcoal	□	□
Plastic toothpicks	□	□	Other:.....		

8. Please tick on the box below

	Yes	No
a) Do you use toothpaste to clean your teeth?	□ 1	□ 2
b) Do you use toothpaste that contains fluoride?	□ 1	□ 2
Don't know	□ 9	

9. How long is it since you last saw a dentist?

Less than 6 months	□ 1
6–12 months	□ 2
More than 1 year but less than 2 years	□ 3
2 years or more but less than 5 years	□ 4
5 years or more	□ 5
Never received dental care	□ 6

10. What was the reason of your last visit to the dentist?

Consultation/advise	□1	Routine check-up/treatment	□ 4
Pain or trouble with teeth, gums or mouth	□ 2	Don't know/don't remember	□ 5
Treatment/ follow-up treatment	□ 3		

11. Because of the state of your teeth or mouth, how often have you experienced any of the following problems during the past 12 months?

	Very often 4	Fairly often 3	Some-times 2	No 1	Don't know 0
(a) Difficulty in biting foods	□	□	□	□	□
(b) Difficulty chewing foods	□	□	□	□	□
(c) Difficulty with speech/trouble pronouncing words	□	□	□	□	□
(d) Dry mouth	□	□	□	□	□
(e) Felt embarrassed due to appearance of teeth	□	□	□	□	□
(f) Felt tense because problems with teeth	□	□	□	□	□
(g) Have avoided smiling because of teeth	□	□	□	□	□
(h) Had sleep that is often interrupted	□	□	□	□	□
(i) Have taken days off work	□	□	□	□	□
(j) Difficulty doing usual activities	□	□	□	□	□
(k) Felt less tolerant of spouse or people are close to you	□	□	□	□	□
(l) Have reduced participation in social activities	□	□	□	□	□

12. How often do you eat or drink any of the following foods, even in small quantities? (Read each item)

	Several time a day 6	Every day 5	Several times a week 4	Once a week 3	Several times a month 2	Never 1
Fresh fruit	□	□	□	□	□	□
Biscuits, cakes, cream cakes...	□	□	□	□	□	□
Lemonade, Coca Cola...	□	□	□	□	□	□
Jam/honey	□	□	□	□	□	□
Chewing gum	□	□	□	□	□	□
Sweets/candy	□	□	□	□	□	□
Milk with sugar	□	□	□	□	□	□
Tea with sugar	□	□	□	□	□	□
Coffee with sugar	□	□	□	□	□	□

13. Do you smoke?

□ 1 Yes □ 2 No

If yes, then how many sigarettes per day…….……?

14. Do you drink alcohol?

□ 1 Yes □ 2 No

If yes, how many drinks did you usually drink per day……?

15. What level of education have you completed?

No formal schooling	□ 1	High school completed	□ 5
Less than primary school	□ 2	College/university completed	□ 6
Primary school completed	□ 3	Postgraduate degree	□ 7
Secondary school completed	□ 4		

Appendix 2. Nine items of the Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001)

Over the last 2 weeks, how often have you been bothered by the following problems? Please place a check mark in the box to indicate your answer.				
	Not at all	Several days	More than half the days	Nearly every day
Little interest or pleasure in doing things	□	□	□	□
Falling down, depressed, or hopeless	□	□	□	□
Trouble falling or staying asleep, or sleep to much	□	□	□	□
Feeling tired or having little energy	□	□	□	□
Poor appetite or overeating	□	□	□	□
Feeling bad about yourself–or that you are a failure or have let yourself or your family down	□	□	□	□
Trouble concentrating on things, such as reading the newspaper or watching television	□	□	□	□
Moving or speaking so slowly that other people could have noticed? Or the opposite–being so fidgety or restless that you have been moving around a lot more than usual	□	□	□	□
Thinking that you would be better off dead or of hurting yourself in some way	□	□	□	□

Appendix 3. Seven items of the Generalized Anxiety Disorder (GAD-7) (Spitzer et al., 2006)

Over the last 2 weeks, how often have you been bothered by the following problems? Please place a check mark in the box to indicate your answer.				
	Not at all	Several days	More than half the days	Nearly every day
Feeling nervous, anxious or on edge	□	□	□	□
Not being able to stop or control worrying	□	□	□	□
Worrying too much about different things	□	□	□	□
Trouble relaxing	□	□	□	□
Being so restless that it is hard to sit still	□	□	□	□
Becoming easily annoyed or irritable	□	□	□	□
Feeling afraid as if something awful might happen	□	□	□	□

Appendix 4. Fifteen items of the Patient Health Questionnaire (PHQ-15) (Kroenke et al., 2002)

During the past 4 weeks, how much have you been bothered by any of the following problems?			
Not bothered at all		Bothered a little	Bothered a lot
Stomach pain	□	□	□
Back pain	□	□	□
Pain in your arms, legs, or joints (knees, hips, etc.)	□	□	□
Menstrual cramps or other problems with your periods*	□	□	□
Headaches	□	□	□
Chest pain	□	□	□
Dizziness	□	□	□
Fainting spells	□	□	□
Feeling your heart pound or race	□	□	□
Shortness of breath	□	□	□
Pain or problems during sexual intercourse	□	□	□
Constipation, loose bowels, or diarrhea	□	□	□
Nausea, gas, or indigestion	□	□	□
Feeling tired or having low energy	□	□	□
Trouble sleeping	□	□	□

* for women.

Appendix 5. Twenty items of the Jaw Functional Limitation Scale (JFLS-20) (Ohrbach et al., 2008)

For each of items below, please indicate the level of limitation during the last month. If the activity has been completely avoided because it is too difficult, then circle '10'.
If you avoid an activity for reasons other than pain or difficulty, leave the item blank.

	No limitation										Severe limitation
Chew tough food	0	1	2	3	4	5	6	7	8	9	10
Chew hard bread	0	1	2	3	4	5	6	7	8	9	10
Chew chicken (i.e., prepared in oven)	0	1	2	3	4	5	6	7	8	9	10
Chew crackers	0	1	2	3	4	5	6	7	8	9	10
Chew soft food (i.e., macaroni, cooked vegetables, fish)	0	1	2	3	4	5	6	7	8	9	10
Eat soft food requiring no chewing	0	1	2	3	4	5	6	7	8	9	10
Open wide enough to bite from a whole apple	0	1	2	3	4	5	6	7	8	9	10
Open wide enough to bite into a sandwich	0	1	2	3	4	5	6	7	8	9	10
Open wide enough to talk	0	1	2	3	4	5	6	7	8	9	10
Open wide enough to drink from a cup	0	1	2	3	4	5	6	7	8	9	10
Swallow	0	1	2	3	4	5	6	7	8	9	10
Yawn	0	1	2	3	4	5	6	7	8	9	10
Talk	0	1	2	3	4	5	6	7	8	9	10
Sing	0	1	2	3	4	5	6	7	8	9	10
Putting on a happy face	0	1	2	3	4	5	6	7	8	9	10
Putting on an angry face	0	1	2	3	4	5	6	7	8	9	10
Frown	0	1	2	3	4	5	6	7	8	9	10
Kiss	0	1	2	3	4	5	6	7	8	9	10
Smile	0	1	2	3	4	5	6	7	8	9	10
Laugh	0	1	2	3	4	5	6	7	8	9	10

Appendix 6. Twenty-one items of the Oral Behaviour Checklist (OBC-21) (Markiewicz et al., 2006)

How often do you do each of the following activities, based on the last month?
If the frequency of the activity varies, choose the higher option.

Activities During Sleep	0 None of the time	1 < 1 night/ month	2 1–3 nights/ month	3 1–3 nights/ week	4 4 – 7 nights/ week
Clench or grind teeth when asleep, based on any information you may have	□	□	□	□	□
Sleep in a position that puts pressure on the jaw (for example, on stomach, on the side)	□	□	□	□	□
Activities During Waking Hours	None of the time	A little of the time	Some of the time	Most of the time	All of the time
Grind teeth together during waking hours	□	□	□	□	□
Clench teeth together during waking hours	□	□	□	□	□
Press, touch, or hold teeth together other than while eating (that is, contact between upper and lower teeth)	□	□	□	□	□
Hold, tighten, or tense muscles without clenching or bringing teeth together	□	□	□	□	□
Hold or jut jaw forward or to the side	□	□	□	□	□
Press tongue forcibly against teeth	□	□	□	□	□
Place tongue between teeth	□	□	□	□	□
Bite, chew, or play with your tongue, cheeks or lips	□	□	□	□	□
Hold jaw in rigid or tense position, such as to brace or protect the jaw	□	□	□	□	□
Hold between the teeth or bite objects such as hair, pipe, pencil, pens, fingers, fingernails, etc.	□	□	□	□	□
Use chewing gum	□	□	□	□	□
Play musical instrument that involves use of mouth or jaw (for example, woodwind, brass, string instruments)	□	□	□	□	□
Lean with your hand on the jaw, such as cupping or resting the chin in the hand	□	□	□	□	□
Chew food on one side only	□	□	□	□	□
Eating between meals (that is, food that requires chewing)	□	□	□	□	□
Sustained talking (for example, teaching, sales, customer service)	□	□	□	□	□
Singing	□	□	□	□	□
Yawning	□	□	□	□	□
Hold telephone between your head and shoulders	□	□	□	□	□

SUMMARY IN ESTONIAN

65–74 aastaste vietnamlaste suutervis ja alaõualiigese haiguslikud seisundid

Sissejuhatus

Tervest suust räägitakse siis, kui näo ja lõualuude piirkonnas ei ole valu, hambakaariest, põletikulisi protsesse, kasvajaid, teisi haigusi ega normist kõrvalekaldeid, mis halvendaksid mälumis- ja kõnefunktsiooni ning psühhosotsiaalset heaolu.

Vietnami eakad on üle elanud Vietnami sõja (1945–1975), nende tervist ja elukvaliteeti on mõjutanud erinevad majandusmudelid ja globaalsed muutused. Suus on näha paljude üldhaiguste ilminguid. Viimane suu tervise uuring Vietnamis (1999) tuvastas mõõduka suu- ja hambahaiguste levimuse täiskasvanud vietnamlaste hulgas, kuid see uurimus ei kaasanud eakate rühma. Vananeva ja nõrgestatud inimese suu tervist võivad mõjutada mitmed riskitegurid.

Maailma Terviseorganisatsiooni (WHO) järgi on oluline säilitada kõrge vanuseni vähemalt 20 hammast. Samas on eelnevate uuringute põhjal 90%-l 65–74-aastastest parodondihaigusi ja 30%-l täielik hambutus, mistõttu on häiritud toidu peenestamine, toitainete omastamine, suhtlemine, psüühika ja üldtervis.

Mälumisfunktsiooni ei mõjuta üksnes hammaste tervis ja hambumus, vaid ka alalõualiigeste seisund. Alaõualiigese anatoomiliste ja funktsionaalsete haiguslike seisundite ühisnimetajaks on temporomandibulaarliigese e. alalõualiigese (TMJ) haiguslikud seisundid (TMD). TMD sümptomeid on 60%-l inimestest. Komplitseerunud TMD korral esineb kroonilist valu ja häiritud mälumisfunktsiooni, mis omakorda mõjutab elukvaliteeti. Teadaolevalt puudub seni informatsioon eakate vietnamlaste TMD sageduse ja riskitegurite kohta.

Hambahaiguste ja TMD ravi on suureks koormuseks tervishoiusüsteemile ja ühiskonnale. Andmed suu tervise kohta on vajalikud tervishoiusüsteemi tööjõuvajaduse arvestamiseks ja ennetusprogrammide efektiivsuse hindamiseks. Käesolevas uurimuses keskendusimegi suutervise, sealhulgas hambahaiguste, hambumuse ja alalõualiigese haiguslike seisundite kui eakate inimeste üldtervise riskifaktorite uurimisele.

Arvestades, et tegu on esimese Vietnamis läbiviidud eakate suutervise uuringuga, lähtusime vanuserühma valikul Maailma Terviseorganisatsiooni soovitustest. Uuring korraldati Vietnami suuruselt kolmandas linnas Danangis, kus elab üle miljoni inimese ning mis jaguneb kuueks linna- ja kaheks maapiirkonnaks. Eakad inimesed moodustavad 3% sealsest elanikkonnast.

Uurimistöö eesmärgid

Töö põhiliseks eesmärgiks oli uurida eakate vietnamlaste suutervise ja alaõualiigese seisundit seoses oklusaalsete kontaktide ja alalõualiigese morfoloogiliste muutustega.

Uuringu eesmärgid:

1. Kirjeldada vanemaealiste vietnamlaste hambakaariese ning parodondihaiguste esinemissagedust ning suutervise käitumist.
2. Analüüsida TMD sümptoome, kliinilisi tunnuseid ja TMJ luulisi muutusi ning teha kindlaks, kas esineb seoseid TMD, psühholoogiliste riskitegurite ja alalõualiigese funktsiooni vahel.
3. Analüüsida oklusioonikontaktide mõju näokolju struktuuridele ja TMD arengule.
4. Uurida TMD ja näokolju morfoloogilste muutuste vahelisi seoseid.

Uuringu metoodika

Uuringusse kaasati mitmeastmelise juhusliku kihtvaliku meetodit rakendades Danangi piirkonnast 258 vietnamlast vanuses 65–74 aastat. Uuritutest 130 olid mehed ja 128 naised, kellest 46,9% elasid maal. Suu tervislikku seisundit hinnati WHO 2013. aastal avaldatud suutervise uuringu juhendist lähtudes. Hammaste seisund registreeriti, kasutades kaarieseindeksit (*Decyed Missing Filled Teeth* (DMFT)), milles on summeeritud karioossed (D), eemaldatud (M) ja täidisega ravitud (F) hambad (T). Parodondi seisundit hinnati parodontaalindeksi (*Community Periodontal Index* (CPI)), igemete veritsuse indeksi, igemetasku sügavuse (*Periodontal Pocket Depth* (PPD)) ja kliinilise kinnituse kao (*Clinical Attachment Loss* (CAL)) põhjal. Suutervise käitumist hinnati kasutades WHO suutervise küsimustikku (*Oral Health Questionnaire for Adults* (WHO, 2013)).

Alalõualiigese haigusi diagnoositi, kasutades temporomandibulaarliigese haiguste diagnostika kriteeriume (*Diagnostic Criteria for Temporomandibular Disorder* (DC/TMD)). Erilise tähelepanu all oli DC/TMD I telg, mis on seotud TMD sümptoomide, kliiniliste nähtude ja klassifikatsiooniga, ning II telg, mis hindab psühholoogilisi faktoreid ja mandibulaarliigese funktsiooni piiratust. TMJ kondülaarosas esinevaid erosioone, osteofüüte, lamendumist ja skleroosi nähte hinnati ortopantomograafia (*CRANEX D Digital X-ray unit*; 73 kV, 10 mA, 17,6 s, CC-*detector sensor*; *Soredex*, Tuusula, Soome) abil.

Hambumust hinnati seoses TMD ja kraniofatsiaalsete muutustega. Hambumuse kirjeldamiseks võeti alginaatmassiga jäljendid, mille abil tehti mudelid, mida eelnevalt skanneerituna hinnati omakorda *Ortho Analyzer*™ (3*Shape A/S*, Taani) tarkvara toel. Hambumust hinnati Eichneri klassifikatsiooni järgi, milles hambakaar on jagatud oklusioonikontaktide põhjal neljaks tsooniks (Eichner, 1990). A-klassi puhul olid kontaktis kõik tsoonid, B-klassi puhul puudus kontakt ühes tsoonis (B1–B3) või kõigis neljas toetavas tsoonis, aga samas esines frontaalhammaste kontakt (B4). C-klassi puhul ei kontakteerunud hambad üheski tsoonis.

Tsefalomeetrilisi uuringuid kasutati digitaalset *CRANEX D Digital X-ray unit'*it (73 kV, 10 mA, 17,6 s, *CC-detector sensor*; Soredex, Tuusula, Soome) aparaati ja hinnati NemoCeph 2D tarkvara (Nemotec, Madrid, Hispaania) abil. Tsefalomeetriliste analüüside tegemisel olid orientiirideks mineraliseerunud kudede kindlad punktid ja tasapinnad, nagu Frankforti, mandibulaar- ja koljupõhimiku tasapinnad.

Kogutud andmed töödeldi statistiliselt kasutades sotsiaalteaduste tarkvara SPSS versiooni 17.0 (SPSS Inc., Chicago, Illinois, USA). Suutervise käitumise, hambakaariese, TMD ja liigespindade morfoloogiliste muutuste ja parodondihaiguste soolisi erinevusi ja seoseid hariduse ja elukohaga analüüsiti kasutades Hii-ruut testi, Student t-testi ja Mann-Whitney U testi. Binaarset logistilist regressioonanalüüsi kasutati puuduvate hammaste ja oklusaalsete kontaktide TMD riski hindamiseks. Bonferrroni testi rakendati tsefalomeetriliste parameetrite ja näokolju strukturaalsete muutuste seoste hindamisel. Statistiliselt peeti oluliseks $P < 0,05$. Psühholoogiliste tegurite, lõualuu funktsiooni ja luuliste muutuste vahelisi seoseid uuriti Student t-testi, Mann-Whitney U testi, and Kruskal-Wallis testi kasutades.

Tulemused

98%-l uuringus osalenutest olid hambad kaariesest kahjustatud. DMFT-indeksi keskmine väärtus oli 14,3 ± 8,7, millest DT moodustas 6,4 ± 5,5, MT 7,7 ± 7,1 ja FT 0,2 ± 0,9. Maaelanikel oli hambaid eemaldatud oluliselt rohkem kui linnaelanikel ($P < 0,001$). Igemete veritsust tuvastati 97,2%-l uuritutest, 62,3%-l oli PPD vähemalt ühel hambal 4–5 mm ja 21%-l ≥ 6 mm. CAL 4–5 mm oli 42,9%-l ja CAL ≥ 6 mm 49,8%-l uuritutest. Maaelanikel oli parodondihaigusi sagedamini kui linnaelanikel ($P < 0,001$).

Kokku oli 56,6% uuritutest alalõualiigese haigusi, nende hulgas sagedamini esines alalõualiigese diski asendi häiret (37,6%), millele järgnesid degeneratiivsed liigesehaigused (34,9%), müalgia (3,5%) ja artralgia (1,2%): Soolisi ja ealisi erinevusi ei leitud. Kliinilise uuringu käigus leiti 48,1%-l uuritavatest diski plõksumist ja 50,4%-l krepitatsiooni. Ligikaudu 25%-l uuritutest esines lihasvalulikkust ($P = 0,002$).

12,3%-l uuritutest diagnoositi depressiooni ja 43,6%-l somatisatsiooni. Alalõualiigese struktuursete muutuste ja psühholoogiliste faktorite vahel seoseid ei leitud. Ligikaudu 90%-l uuritutest diagnoositi erineva tasemega parafunktsioone. Küsimustiku *Jaw Functional Limitation* JFLS-20 põhjal oli keskmine TMD skoor koos mälumislihaste haaratusega 2,6 ± 1,9 ja ilma mälumislihaste haaratuseta 2,3 ± 2,1 ($P > 0,05$). Alalõualiigese radioloogiliste muutuste nähud mõlemal kondüülil summeerituna olid lamendumine 28,6%, erosioonid (18,6%), skleroos (10,5%) ja osteofüüdid (4,3%).

Kui ühepoolselt olid oklusioonikontaktid kadunud, siis TMD väljaarenemiseks suurenes risk 3,36 korda (95% CI = 1,21–9,36, $P = 0,020$). Nendel vanemaealistel, kellel oklusioonikontaktid puudusid, suurenes bilateraalse TMD risk 2,71 korda (95% CI = 1,12–6,56, $P = 0,027$). Eichneri klassifikatsiooni klass C suurendas TMD kujunemise riski, võrreldes A-klassiga (OR = 2,04, 95% CI = 0,96–4,34, $P = 0,063$).

Duncani testi kasutamine näitas, et vanemaealised, kellel oli Eichneri klassifikatsiooni C-klassi oklusioon, olid SNB nurk, S-N-Pog nurk ja N-Pog nurk Frankforti horisontaali suhtes statistiliselt oluliselt suuremad, võrreldes A- ja B-klassi oklusiooniga ($P < 0,001$). Goniaalnurk (N-Go-Me), artikulaarnurk (S-Ar-Go), mandibulaartasandi suhe S-N-tasandisse ja mandibulaartasandi suhe Frankfordi

tasandisse olid A- ja B-klassi oklusiooniga uuritavatel statistiliselt oluliselt suuremad, võrreldes C- klassi oklusiooniga ($P < 0,001$). Lineaarsetest mõõtudest olid näo eesmine kõrgus (N-Me) ja näo alumine kõrgus (Ans-Me) kõigis kolmes oklusioonigrupis ($P < 0,001$) statistiliselt oluliselt erinevad. Näo tagumise osa kõrgus (S-Go) oli C-klassi oklusiooniga patsientidel tunduvalt lühem kui A- või B-klassi oklusioonitüübi puhul ($P < 0,001$). Näo kõrguse suhe (S-Go/N-Me) ja alumise näokõrguse suhe (Ans-Me/N-Me) oli kõigis kolmes oklusiooniklassis erinev ($P = 0,014$ ja $P < 0,001$).

Piiratud suu avamine oli tugevalt seotud väikese nurgaga N-Pog Frankforti tasapinnas ($P = 0,020$) ja suure ANB-nurgaga ($P = 0,035$). Krepitatsiooni sai seostada S-N-Pog-i ($P = 0,039$), ANB ($P = 0,001$), N-Pog-i Frankforti tasapinna ($P = 0,036$) ja ülemise goniaalnurga (Ar-Go-N, $P = 0,023$) suurenenud väärtustega. TMJ-i tundlikkus suhestus lühikese alalõualuuga (Co-Gn, $P = 0,014$), lühikese näo eesmise osaga (N-Me, $P = 0,003$), väikeste nurgaväärtustega mandibulaar- ja palatinaaltasapinna ($P = 0,009$), mandibulaartasapinna ja S-N vahel ($P = 0,048$) ning mandibulaartasapinna suhtes Frankforti tasapinda ($P = 0,017$). Lihaste tundlikkus suhestus suure eesmise goniaalnurga väärtustega (Ar-Go-N, $P = 0,024$), kuid väikese alumise goniaalnurga väärtustega (N-Go-Me, $P = 0,025$). Näo alumise osa suhe (Ans-Me/N-Me) seostus piiratud suuavamisega ($P = 0,042$), krepitatsiooni ($P = 0,027$) ja TMJ-i tundlikkusega ($P = 0,002$).

Järeldused

1. Hambakaariese esinemissagedus on eakatel vietnamlastel kõrge, enamusel uuritutest esines parodondi haiguste sümptoome. Ebapiisav suuhügieen ja ravi kättesaadavus on eakate vietnamlaste halva suutervise põhjusteks.
2. Temporomandibulaarliigese haigusseisundid mõjutavad rohkem kui pooli vanemaealistest. Põhilised TMJ luulised muutused olid liigese lamenemine ja erosioon. Statistiliselt olulisi seoseid ei leitud psühholoogiliste tegurite ja halvenenud mälumisfunktsiooniga.
3. Täielik ühe- või kahepoolne oklusioonikontaktide kaotus on TMD riskifaktoriks. Mida suurem on kaotatud oklusioonikontaktide arv, seda tõenäosemad on morfoloogilised muutused luulistes struktuurides. Toidu peenestamiseks tekib adaptatiivse kohanemisena alaõua eesmine asend.
4. Kraniofatsiaalsete struktuuride muutused eakatel vietnamlastel on tavaliselt tingitud alalõualiigese haiguslikest seisunditest. Liigese krepitatsioon ja valulikkus on seotud alalõua vastupäeva rotatsiooni ja protrusiooniga, samuti näo alumise kolmandiku kõrguse vähenemisega.

Saadud informatsioon omab väärtust Vietnami tervishoiusüsteemis suutervise alase ennetustegevuse ja aktiivse ravi planeerimisel. Suutervise teadlikkuse tõstmine on primaarse tähtsusega. Väga oluline on parandada ravi kättesaadavust maapiirkondades. TMD on haigus, millega sageli kaasneb valu näo-lõualuude piirkonnas, mis halvab igapäevaseid tegevusi ja peaks olema ravitud spetsialistide poolt. Vastavate spetsialistide väljaõppe tagamine on riigi strateegiline vajadus. Hammaste proteesimiseks vajaliku riikliku toetuse sisseviimine on oluline tasakaalustatud mälumisfunktsiooni kindlustamiseks.

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PUBLICATIONS

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My research interest is related to community dental health, dental occlusion, orofacial pain, and temporomandibular disorders. More than ten articles were published in international peer-reviewed journals, four manuscripts have been submitted for publication, and fourteen abstracts were presented at international conferences, all of which are my scientific achievements during the period of the Doctoral curriculum (2014–2018).

Publications:

1. Minh Son Nguyen, Ülle Voog-Oras, Triin Jagomägi, Toai Nguyen, Mare Saag. Oral Health Behaviour and Oral Health Status of Elderly Vietnamese. Oral Health and Preventive Dentistry. 2018. Accepted for publication.

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Teadustöö

Teadustöö on olnud seotud rahva suutervise, hambumuse, näo piirkonna valude ja temporomandibulaarliigese häirete temaatikaga. Enam kui kümme artiklit on avaldatud rahvusvahelistes eelretsenseeritavates ajakirjades ja neli artiklit on esitatud avaldamiseks. Doktorantuuri perioodil (2014-2018) on tutvustatud neljateistkümnel korral oma uuringute tulemusi rahvusvahelistel konverentsidel koos teeside avaldamisega.

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