Revue d'Épidémiologie et de Santé Publique 68 (2020) 83–90

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

Original article

Important oral care needs of older French people: A cross-sectional study☆

Importants besoins en soins bucco-dentaires des personnes très âgées en France : étude transversale

R.W. Rosa [a], J. Samot [b,c], C. Helmer [d], G. Pourtau [b], V. Dupuis [b,c], J.-C. Fricain [b,c,e], A. Georget [f], J.-F. Dartigues [a,d,f], E. Arrivé [b,c,d,*]

[a] *Université de Bordeaux, ISPED, centre Inserm U1219–épidémiologie-biostatistique, Bordeaux, France*
[b] *Université de Bordeaux, UFR d'odontologie, Bordeaux, France*
[c] *Centre hospitalier universitaire de Bordeaux, pôle de médecine et chirurgie bucco-dentaire, Bordeaux, France*
[d] *Inserm U1219, centre Inserm épidémiologie et biostatistique, université de Bordeaux, Bordeaux, France*
[e] *Inserm U1026, centre Inserm bioingénierie tissulaire, université de Bordeaux, Bordeaux, France*
[f] *Centre hospitalier universitaire de Bordeaux, pôle de santé publique, unité de soutien méthodologique à la recherche clinique et épidémiologique (USMR), Bordeaux, France*

ARTICLE INFO

Article history:
Received 2 May 2019
Accepted 10 January 2020
Available online 25 February 2020

Keywords:
Oral health
Quality-of-life
Elders
Cross-sectional study
France

ABSTRACT

Background. – Older persons comprise a growing proportion of the European population and may have a distinct epidemiological oral profile requiring specific preventive and curative care poorly documented. The objectives of this study were to assess the oral health status of people ≥ 90 years of age in France, to compare their perceived and observed oral care needs and to investigate the oral problems associated with a low oral health-related quality-of-life (OHRQoL).

Methods. – An oral cross-sectional study was performed during the 25th follow-up of a cohort of older persons being followed up prospectively for screening of dementia over a 15-year period in Gironde and Dordogne, France. Clinical oral indices were determined by oral examinations conducted at the participants' place of living. Cohen's Kappa coefficient was used to assess the agreement between perceived and observed oral care needs. Oral problems associated with a low OHRQoL, measured with the Geriatric Oral Health Assessment Index (GOHAI < 50) were investigated with logistic regression. Odds ratios (OR) were estimated with their 95% confidence intervals (CI).

Results. – Data from 90 persons were analysed (76% female; median age = 93 years; 20% living in an institution). Plaque and calculus were present in 93% and 58% respectively, of the 74 dentate participants. The mean number of decayed, missing, and filled teeth was 26.5 (± 5.3); 66% of the participants had at least one untreated decayed tooth. Among the 85 participants with tooth loss not replaced by a fixed denture, two thirds had a removable dental prosthesis; 84% of these prostheses were considered to be maladapted. Among the 39 participants who felt unable to consult a dentist (43%), lack of transportation was the most frequently cited reason. Although 88% of the participants needed oral care, only 26% perceived that they had such a need (Kappa = 0.06). Oral problems associated with a GOHAI < 50 were the absence of posterior occluding teeth (OR = 7.15; 95%CI = 1.53–33.35; $P = 0.012$), feeling of dry mouth (OR = 11.94; 95%CI = 3.21–44.39; $P = 0.0002$) and oral pain (OR = 9.06; 95%CI = 1.91–69.00; $P = 0.033$).

Conclusions. – Persons ≥ 90 years of age have considerable preventive and curative dental care needs that impact their quality-of-life but they are rarely aware and lack transportation. NCT04065828.

☆ The work was conducted within the Bordeaux Teaching Hospital.

* Corresponding author at: UFR des sciences odontologiques, 146, rue Léo-Saignat, 33000 Bordeaux, France.

https://doi.org/10.1016/j.respe.2020.01.135

RÉSUMÉ

Position du problème. – Les personnes âgées constituent une proportion croissante de la population européenne mais leur profil épidémiologique bucco-dentaire est mal documenté. Les objectifs de cette étude étaient d'évaluer l'état bucco-dentaire des personnes âgées de 90 ans et plus en France, de comparer leurs besoins en soins bucco-dentaires perçus et observés, et d'identifier les problèmes bucco-dentaires associés à une faible qualité de vie liée à la santé bucco-dentaire (QdVSBD).

Méthodes. – Une étude transversale bucco-dentaire a été réalisée lors du 25e suivi d'une cohorte de personnes âgées en Gironde et en Dordogne. Les indices bucco-dentaires ont été recueillis lors d'examens cliniques effectués au domicile des participants. L'accord entre les besoins perçus et observés a été évalué avec le coefficient de Kappa de Cohen. Les problèmes bucco-dentaires associés à une faible QdVSBD ont été identifiés par régression logistique.

Résultats. – Les données de 90 personnes ont été analysées (76% de femmes ; âge médian = 93 ans ; 20% vivant en institution). La plaque et le tartre étaient présents chez respectivement 93% et 58% des 74 participants dentés. Le nombre moyen de dents cariées, manquantes et obturées était de 26,5 (± 5,3) ; 66% des participants avaient au moins une dent cariée non traitée. Parmi les 85 participants avec édentement non compensé par prothèse fixée, deux tiers avaient une prothèse amovible ; 84% de ces prothèses étaient considérées comme inadaptées. Consulter un dentiste présentait des obstacles pour 43% des participants, citant le plus souvent le manque de moyens de transport. Bien que 88% des participants aient eu besoin de soins bucco-dentaires, seuls 26% le percevaient (Kappa = 0,06). L'absence d'occlusion postérieure (odds ratio [OR] = 7,15 ; intervalle de confiance [IC] à 95% = 1,53–33,35 ; p = 0,012), la sensation de bouche sèche (OR = 11,94 ; IC 95% = 3,21–44,39 ; p = 0,0002) et une douleur orale (OR = 9,06 ; IC 95% = 1,91–69,00 ; p = 0,033) étaient associées à une faible QdVSBD.

Conclusion. – Les personnes de 90 ans et plus ont d'importants besoins bucco-dentaires préventifs et curatifs qui ont un impact sur leur qualité de vie, mais elles sont rarement au courant et manquent de moyens de transport. NCT04065828.

1. Introduction

In 2017, people aged ≥ 90 years accounted for about 3% of the French total population [1]. This proportion will increase sharply due to the increased life expectancy of the baby-boom generation [2]. Indeed, the proportion of people aged ≥ 85 years has increased fourfold since the 1950s and is expected to reach 7.5% of the total population by 2050 [3]. These trends are not specific to France but are observed around the world [4].

Persons aged ≥ 90 years have a high incidence of comorbidities and co-medications, and are frequently in a state of dependency, which hampers oral care. Indeed, nearly 75% of people aged ≥ 85 years reported having very limited activity [5]. Ocular, joint, cardiovascular and endocrine or metabolic pathologies were most frequently reported and respondents had a mean of six concomitant pathologies. One in two persons aged ≥ 85 years is dependent [6], with the major reason for this being dementia (> 50% of cases) [7]. Malnutrition is associated with dependency [8] and alteration of the oral condition is a risk factor for malnutrition and frailty [9]. Comorbidities and their treatment, as well as dependency, can create or exacerbate oral pathologies or complicate their management [10]. Indeed, very old persons are more likely than younger ones to have dental and root caries, xerostomia and oral mucosal lesions [11]. These oral conditions may not be detected or treated because of difficulties in seeking care [12] but can also impact quality of life, social relations and feeding, and are risk or aggravating factors for malnutrition and cardiovascular, endocrine, autoimmune and neurodegenerative conditions [13–16]. This is therefore important to screen them as early as possible to provide appropriate care. However, compared to other European countries, persons aged ≥ 50 years in France show a low frequency of dental consultations and that of curative (rather than preventive) care is higher [17], resulting in fine invasive care such as tooth avulsion and then, in a low masticatory capacity and low proportion of denture users [18]. There are few epidemiological studies on the oral health of older persons in France [13,19,20], and most of them are for hospitalised and institutionalised people or people aged no more than the seventies; therefore, the extent of the need for specific preventive and curative care in very old people living in the community is unclear. The main objective of our study was thus to assess the oral health status and oral health-related quality-of-life (OHRQoL) of people ≥ 90 years of age in France. Secondary objectives were to explore the concordance between oral care needs perceived by the participants with the needs identified through oral clinical examination and to investigate what oral problems were associated with a low OHRQoL.

2. Methods

2.1. Design and study sample

We designed a cross-sectional study involving the cohort of the *Personnes agées QUID* (PAQUID) study, an ongoing prospective, community-based cohort study of the epidemiology of dementia and Alzheimer disease in the elderly population of France that began in 1988 [21]. The study enrolled 3777 persons aged ≥ 65 years, randomly selected from the electoral rolls of Gironde and Dordogne in southwestern France.

In 2013–2014, PAQUID participants underwent the first 25-year follow-up and were visited at their place of living by a psychologist. During this visit, they were asked to participate in an oral substudy. If they agreed, they were contacted to set up an appointment with a dentist. Persons unable to provide informed consent, and whose legal caregiver could not be reached or who refused to participate, were not enrolled.

2.2. Ethics

The study was approved by the Consultative Committee for the Protection of Persons participating in Biomedical Research of the

Bordeaux Teaching Hospital and conducted in full accordance with the World Medical Association Declaration of Helsinki. Informed verbal consent was obtained from all the participants according to a procedure approved by the Consultative Committee for the Protection of Persons participating in Biomedical Research of the Bordeaux Teaching Hospital.

2.3. Outcomes of interest

The main outcomes of interest were as follows: number of decayed, missing and filled teeth (DMFT) among a total of 32 teeth [22], number of posterior occluding pairs (POPs) in natural teeth or fixed prosthetics except for wisdom teeth [23], oral pain (presence and degree measured by numeric scale) [24], oral lesions (presence and nature according to the World Health Organisation [WHO] International Classification of Diseases adapted for oral health) [25], Xerostomia Inventory (XI) [26] and OHRQoL (Geriatric Oral Health Assessment Index [GOHAI]) [27].

As per the WHO recommendations, the D (decayed) component of the DMFT included teeth with cavity carious lesions or temporary fillings on crowns and/or roots (code 1 or 2) and the F (filled) component included teeth with at least one permanent restauration (including crowns), without caries on crowns and/or roots (code 3) [22].

OHRQoL was assessed using the French version of the GOHAI, a 12-item questionnaire [28]. Subjects were asked if they always, often, sometimes, seldom or never experienced oral problems (in the previous 3 months). Responses were scored on a scale ranging from 1 to 5, with higher scores indicating better oral health. A global score was calculated by summing the responses, where total scores ranged from 12 to 60. A GOHAI score of < 50 was considered indicative of compromised OHRQoL [29].

The following variables were also considered: tooth loss (not including those replaced by a fixed prosthetic [bridge or implant]) replaced (or not) by a removable dental prosthesis, nature, year of conception and adaptation of the prosthesis, observed oral care needs, perceived oral care needs, regularly seeing a dentist, date and reason for the last visit to the dentist, barriers to seeing a dentist and oral hygiene habits.

Lack of adaptation of the prosthesis was defined as the presence of one or more of the following: reline/tissue conditioner, excessive wear of the posterior teeth, lack of integrity and stability or retention problems [30].

2.4. Data collection

Clinical oral indices were derived from assessments by a clinical oral examination conducted at the participant's place of living by two dentists according to the WHO recommendations for oral health epidemiological surveys [22]. They performed a standardised examination of the oral soft tissue and teeth using a mouth mirror, gauze and overhead light, with the participant seated on an armchair or bed in the most comfortable way for him/her. The findings were recorded on a standardised form by an assistant (dental student). No explorer was used, as per local ethics recommendations, to avoid performance of invasive examinations in observational studies. No X-rays were used as per WHO recommendations [22].

A calibration was conducted to standardise the data collection; this involved examination of nine patients by the two dentists. The intra-class correlation coefficient for the number of DMFT was 0.99 (95% CI = 0.98–1.00), corresponding to excellent reliability [22,31].

Data on oral health habits and OHRQoL were collected during face-to-face interviews with the participant or accompanying person using a standardised questionnaire.

The following variables were also extracted from the PAQUID database: socio-demographic characteristics (sex, date of birth, educational level and living and familial conditions), current or past tobacco consumption, comorbidities (presence of at least one of the following: diabetes, Parkinson disease and history of myocardial infarction or stroke), drugs (number of drugs taken daily, psychotropic agent intake), dementia (defined as a Mini Mental State Examination [MMSE] score of < 20 [32]) and dependency according to the cumulative disability scale (CDS) [33]. The CDS is a four-stage index that combines the Activity Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) scales and mobility (assessed by the Rosow and Breslau scale). The CDS classifies dependency as follows: no dependency: 0; dependency only on the Rosow scale: 1; dependency on the Rosow and IADL scales but not on the ADL scale: 2; and dependency on all three scales: 3.

2.5. Statistical analysis

Categorical variables were shown as frequencies and percentages. Continuous variables were presented as numbers, means, standard errors (SE), medians, minima, maxima and quartiles (interquartile interval [IQI]). Cohen's Kappa coefficient was used to assess the agreement between perceived and observed oral care needs. Oral problems associated with low OHRQoL (GOHAI score of < 50) were investigated with univariate and multivariate logistic regression. The threshold for significance was fixed at $P = 0.05$.

The analyses were conducted using SAS software (ver. 9.3; SAS Institute, Inc., Cary, NC, USA).

3. Results

3.1. Description of the population

Out of 231 persons who underwent the 25-year PAQUID follow-up in 2013, 197 were asked to participate in the sub-study and 90 were enrolled (75.6% female) (Fig. 1). The refusal rate was 54.3%. Compared to non-participants, the oral sub-study participants were less likely to live in an institution and to have a low educational level (Table 1). Their median age was 93 years (IQI = 92–95 years; min = 91 years, max = 106 years). In total, most of them were widowed. Half of the participants (N = 45) lived alone. Furthermore, 15% had dementia according to the MMSE score and 36.7% had grade-3 dependency (Table 2). Comorbidities were common (71%). One participant reported current tobacco consumption and 25 reported past tobacco consumption.

3.2. Oral health habits

Sixty percent of the participants regularly visited a dentist ($n = 54$). The median time from the last visit to the dentist was 15 months (IQI = 5–60 months; min = 1 month, max > 99 months). The most frequent reason for the last visit to a dentist was emergency care (44%, $n = 38$), followed by treatment continuation (29%, $n = 25$) and a check-up (8%, $n = 7$).

Thirty-nine participants (43.3%) felt unable to consult a dentist; among them, lack of access to transportation was cited by 90% ($n = 35$).

Ninety-six percent (71/74) of the dentate participants reported brushing their teeth at least once a day. The majority ($n = 71$) had a manual toothbrush. Among 62 visible toothbrushes, 35% were in bad condition ($n = 22$) and needed to be changed. Seventy-five percent of the participants used fluoride toothpaste ($n = 55$). All participants reported having no difficulty with brushing their teeth, but one reported needing help to clean his/her teeth and six to clean his/her removable prosthesis.

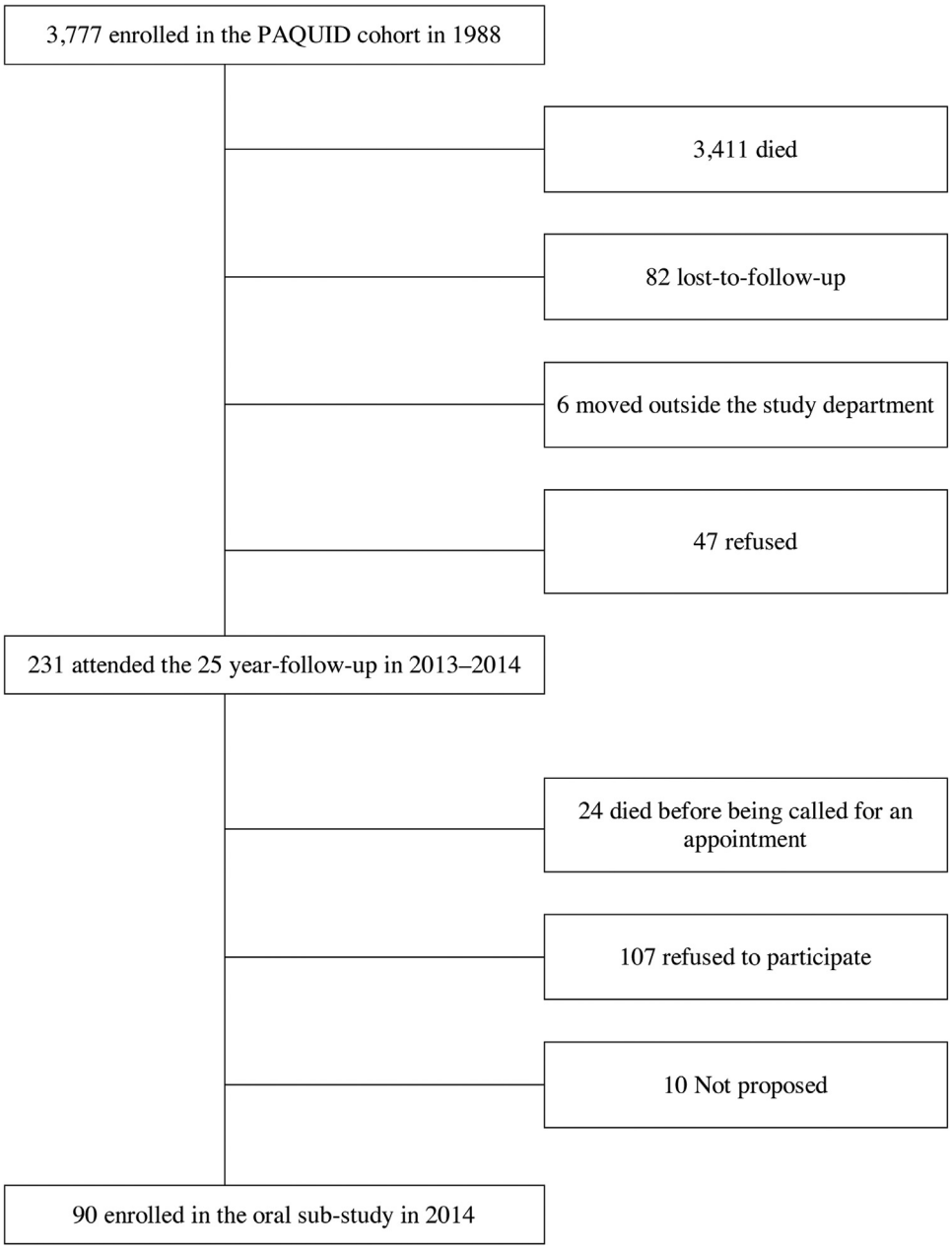

Fig. 1. Flow chart of the participants in the PAQUID oral sub-study, France, 2014.

Table 1
Socio-demographic characteristics of participants and non-participants in the PAQUID oral sub-study, France, 2014.

	Non-participants (N = 117)		Participants (N = 90)		*P*
	N/Mean	%/SD	N/Mean	%/SD	
Age (years, at the PAQUID 25-year follow-up)	93.9	2.7	93.5	3.0	0.390
Women (vs. men)	86	73.5	68	75.6	0.737
Institutionalised (vs. not)	41	35.0	20	22.2	0.045
French primary school certificate (vs. not)	77	65.8	76	84.4	0.002

PAQUID: Personnes agées QUID.

3.3. Oral status

Oral pain was reported by 6.7% of the participants ($n = 5$; median intensity of 3; IQI = 2–3; min = 1, max = 4).

Among 74 dentate participants, plaque was present in 93% and calculus in 58%. Thirty-three oral lesions were detected in 29% of participants ($n = 26$). Lesions were located on the buccal mucosa (21%), gingiva (21% sulcus, free or attached gingiva), palate (18%) or lips (15%); of the lesions, 18% were erythema, 15% keratosis, 15% macula, and 15% pigmentation.

The median XI index was 16 (IQI = 12–21; min = 11, max = 40); 24% ($n = 21$) of the participants declared always or frequently

Table 2
Medical characteristics of the participants in the PAQUID oral sub-study (N = 90), France, 2014.

	N	%
Current or past tobacco consumption	26	28.9
Presence of other comorbidities[a] (vs. no)	64	71.1
Number of medication used per day (n = 88), mean (SD)	6.8	3.0
Psychotropic intake (vs. no)	35	38.9
Dementia (MMSE > 20, vs. no) (n = 85)	13	15.3
Cumulative disability scale		
Grade 0 or 1	21	23.3
Grade 2	36	40.0
Grade 3	33	36.7

PAQUID: Personnes agées QUID; MMSE: Mini-Mental State Examination.
[a] Diabetes or Parkinson disease; and history of myocardial infarction or stroke.

Table 3
Number of DMFT in ≥ 90-year-old adults in the PAQUID oral sub-study (N = 90), France, 2014.

	Mean	Standard deviation	Minimum	Maximum
DMFT	26.5	5.3	11	32
Decayed teeth				
Number	3.7	4.8	0	24
%DMFT	14.8	18.8	0	76
Missing teeth				
Number	18.1	9.2	2	32
%DMFT	65.6	26.2	0	100
Filled teeth				
Number	4.8	5.3	0	23
%DMFT	19.6	21.4	0	74

PAQUID: Personnes agées QUID; DMFT: decayed, missing and filled teeth.

having a feeling of dry mouth. The mean number of DMFT was 26.5 (SD = 5.3) (Table 3). The mean number of missing teeth was 18.1 (SD 9.2); these included 39 teeth replaced by a bridge in 18 patients and 8 teeth replaced by implants in 2 patients.

Five participants (6%) had no tooth loss or tooth loss with a fixed replacement. The median number of POPs was 0 (IQI = 0; 2; min = 0, max = 8); 48 (53.9%) of the participants had no POP. Overall, 18% of the participants were totally edentulous on both maxillae (n = 16). Among them, 13 had bi-maxillary prostheses; 1 a single prosthesis and 2 no prosthesis. Thirteen participants had all teeth missing on one maxilla (85% with denture) with partial or no tooth loss on the other. Forty-one participants (45.5%) had bi-maxillary partial tooth loss; of them, a bi-maxillary prosthesis was present in 16 participants (39%), a single prosthesis in 8 (20%) and no prosthesis in 17 (41%). Fifteen participants (17%) had partial tooth loss on one maxilla only; less than half (n = 6) of them had prosthesis. Of 85 participants with tooth loss not replaced by a fixed denture, two-thirds (66%; n = 56) had a removable dental prosthesis, 91.1% (n = 51) had a maxillary prosthesis and 76.8% (n = 43) had a mandibular prosthesis. About 50% of prostheses were made prior to 2000. Also, 84.3% of maxillary prostheses and 83.7% of mandibular prostheses were considered to not be adapted. However, very few of the participants (n = 5) did not use their prosthesis during meals. Sixty-five percent (65.6%) of the participants had at least one untreated decayed tooth. The mean number of decayed teeth was 2.9 (SD = 4.2) (Table 3).

3.4. Perceived and observed oral care needs

Twenty-six percent of the participants (n = 24) perceived that they needed oral care. Among them, 71% felt they needed prosthesis, 50% conservative dental care, 25% avulsion and 8% dental scaling. A need for oral care was observed in 88% of the participants (n = 79) (Fig. 2). The Kappa value for agreement between perceived and observed oral care needs was 0.06 and 56 participants were unaware of their need for oral care. In addition, 77% (n = 69) of the participants had dental plaque requiring treatment.

3.5. Oral health-related quality of life

Among the 89 participants with available data, the mean GOHAI score was 54 (SD = 6.5; min = 29, max = 60); 19 participants (21.3%) had a GOHAI score of < 50. Participants with a GOHAI score of < 50 were more likely to have perceived oral care needs than those with a GOHAI score of ≥ 50 (57.9% vs. 18.6%, P = 0.001). However, they had similar observed oral care needs (89.5% vs. 87.1%, P = 1.000).

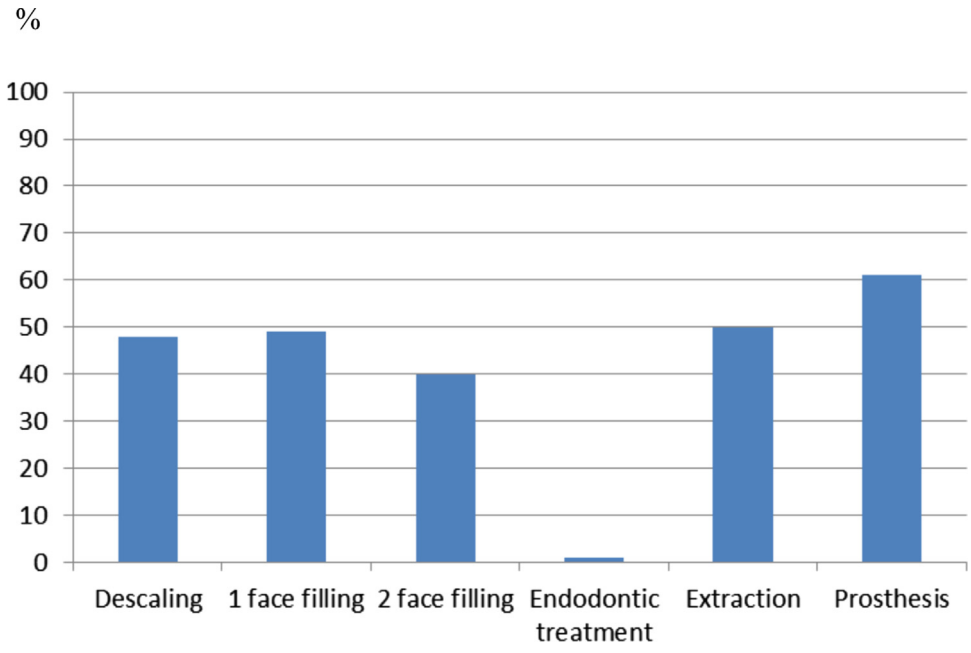

Fig. 2. Observed treatment needs of ≥ 90-year-old adults in the PAQUID oral sub-study (N = 90), France, 2014-PAQUID, Personnes Agées QUID.

Table 4
Oral problems associated with low oral health related quality of life defined by a GOHAI score < 50, in ≥ 90-year-old adults in the PAQUID Oral Sub-study (N = 87), France, 2014.

	GOHAI < 50 N = 18		GOHAI ≥ 50 N = 68		Univariate analysis[a]			Multivariate analysis[a]		
Variables	N	%	N	%	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Dental caries	12	66.7	53	76.8	0.64	0.19–1.87	0.381			
Absence of posterior occluding pairs	14	77.8	33	47.8	3.82	1.14–12.77	0.030	7.15	1.53–33.35	0.012
Oral pain	3	16.7	3	4.3	4.4	0.81–23.98	0.087	9.06	1.91–69.00	0.033
Feeling of dry mouth	11	61.1	10	14.5	9.27	2.90–29.59	0.0002	11.94	3.21–44.39	0.0002
Oral lesion	4	22.2	20	29.4	0.69	0.20–2.34	0.547			
Absence of prosthetic rehabilitation	9	50.0	30	43.5	1.3	0.46–3.68	0.621			

PAQUID: Personnes agées QUID; GOHAI: Geriatric Oral Health Assessment Index; OR: odds ratio; CI: confidence interval.
[a] Logistic regression.

Oral problems associated with a GOHAI score of < 50 were the absence of POP (OR = 7.15; 95%CI = 1.53–33.35; *P* = 0.012), feeling of dry mouth (OR = 11.94; 95%CI = 3.21–44.39; *P* = 0.0002) and oral pain (OR = 9.06; 95%CI = 1.91–69.00; *P* = 0.033) (Table 4).

4. Discussion

To our knowledge, this is one of the rare comprehensive reports worldwide of the oral status of people ≥ 90 years of age living either at home or in an institution. Most previous studies worldwide focused on younger or solely on institutionalised/hospitalised persons or on only one oral problem [19,20,29,34,35].

The mean number of decayed teeth was 2.9 and two thirds of the participants had at least one untreated decayed tooth. This finding corroborates those of previous cohort studies showing that dental caries are active among older people, with a mean increment of about one surface per year [36,37].

However, our number is well above those of national studies conducted in United States and Germany as described in a recent review, with untreated caries representing a small part of the DMFT (DT ≤ 0,5) even in people > 75 years old [38]. Dental caries disease seems therefore more acute in very old people than "younger" ones. This is despite the fact that preventive interventions exist, such as use of fluoride either in toothpaste or varnish or in restorative materials or artificial replacement saliva in case of dry mouth [39] but they are not systematically proposed to older people in France. Also, plaque was present in about 90% of dentate participants and calculus in 60%. These data suggest that tooth brushing was not performed optimally, even though the majority of participants declared themselves capable of brushing their teeth without difficulty. In addition, 25% of dentate participants did not use fluoride toothpaste, which was shown to prevent dental caries at 1000 ppm fluoride [40]. Moreover, two thirds of the 85 participants with tooth loss not replaced by a fixed denture had a removable dental prosthesis. Patients with removable dental prostheses are at increased risk of dental caries [41] as prostheses can retain biofilm, particularly if they are not well adapted. Among the 94 prostheses in 56 participants, 50% were made prior to 2000 and about 85% were considered not adapted; these data are comparable to previous reports [29]. Edentulism can reduce bone density and induce continuous loss of bone volume [42]. Therefore, prostheses may become maladapted over time and require replacement.

About 90% of the participants needed oral care for a prosthesis, conservative dental care, avulsion, and/or dental scaling. However, only 26% of participants perceived that they needed oral care. A similar result was observed in another study in Brazil [43]. The idea of tooth loss as a natural part of aging, along with the primary focus being on systemic diseases, could result in underestimation of the need for oral care. However, when perceived, oral care needs were associated with a low OHRQoL. In this study, the OHRQoL scores were higher than those from other studies involving nursing home residents and non-institutionalised elders (41% GOHAI < 50 [29]; 40% GOHAI < 30 [43]). This may be because educational and emotional aspects influence the perception of oral health [43] and comparisons should be made carefully. Cognitive function may also influence OHRQoL. In our study, 15% of the participants suffered of dementia as defined by MMSE evaluation. A previous study, conducted in 226 community-living participants with age 70 years or older, resident of West Virginia, USA, demonstrated that GOHAI could be used in a reliable way even in those with cognitive impairment and that OHRQoL was lower in these people [44]. Absence of POP was associated with low OHRQoL. An explanation may be that edentulism, particularly in the posterior area, reduces masticatory performance and may result in food selection or food with a mushy consistency [45]. This emphasises the importance of prevention and early care in the younger ages to preserve dental organs. Oral pain was reported by few patients (about 7%), but when present, was associated with OHRQoL, highlighting the importance of investigating and caring the origin of the pain. Oral lesions were observed in only 30% of the participants. This prevalence was lower than expected: for instance, a study conducted in Denmark reported the presence of lesions in about 75% community-dwelling individuals aged 65–95 years which was associated with smoking and xerostomia [46]. Dental caries, despite their frequency, were not associated with OHRQoL. However, they have also been described to be related to xerostomia as well [47].

Feeling of dry mouth, reported by 25% of the participants, was found to be associated with low OHRQoL, as shown by a previous study conducted in younger patients in Germany (mean age of 68 years) [48]. Age-related thinning of the oral mucosa, denture-related conditions, polymedication and hyposalivation render older people more susceptible to xerostomia [49], which in most cases, are easily treatable with artificial replacement saliva [39,50]. Elder people and their caregiver, as well as health professionals, should be better informed about this problem, its consequences on oral health status and related quality-of-life and its treatment.

The majority of participants (60%) regularly visited a dentist and the most frequent (29%) reason for the last visit was treatment continuation. The Departments of Gironde and Dordogne have a high density of dental surgeons (67–89 per 100,000 habitants) [51]. Lack of access to transportation was the most frequent barrier to visiting a dentist, possibly due to difficulty in physical ambulation as 77% of the participants had dependency according to the IADL.

The main limitations of this descriptive study were a lack of representativeness and the small sample size. Despite the fact that our sample was issued from a representative sample at the initiation of the PAQUID cohort in 1988, the present sample was mainly selected and restricted by survival in link with their very old age and their acceptance to participate. The refusal rate was

high, which is common in studies in old people, as seen even in younger populations [52] and may have resulted in a bias in enrolment towards people in better health (and, as a result, a higher GOHAI score). This may explain the low frequency of participants living in an institution. Also, participants living in their own homes or with family might be more likely to welcome interviewers, as they enjoy greater privacy compared to institutional residents. In addition, participants had a higher educational level than non-participants, possibly because the former had a greater understanding of the importance of the study. Therefore, the non-participants may have a worse oral health status than the participants.

Finally, our results raised the question on how to improve the elderly's oral health. A meta-analysis showed that caregivers' education on oral health significantly improved oral hygiene and oral mucosa [53], even in people with cognitive impairment [54]. The use of battery-powered devices may be a useful help for tooth brushing [55] but this generation of people might not be aware. Oral health programs on xerostomia in community-dwelling elderly were also shown to be effective in increasing oral salivary secretion rates and OHRQoL [56]. Access to dental professional help should be facilitated. In a context where providing appropriate transportation for the patient to the dental practice is complex to organise; teledentistry is a promising tool with an excellent accuracy for diagnosing dental pathology in older adults living in nursing homes [57]. When care is needed, moving the dental professional to the patient's place of living would be sometimes more efficient but, to our knowledge, this has not yet been evaluated. This would allow the dentist to conduct not only clinical examination and oral health education, but also preventive care such as silver diamine fluoride application that has been shown to be effective in preventing dental caries in older people [58]. A more global approach has been recently described towards minimally invasive intervention based on caries risk assessment, including not only reinforcement of oral hygiene and the use of fluoride toothpaste and varnish, but also atraumatic restorative treatment and shortened dental arch with limitation of dental prosthesis and extraction [59].

5. Conclusion

Older people have considerable dental preventive and curative care needs. However, they are rarely aware and may not seek care by themselves. Assistance with oral hygiene should be provided to such people who also require regular consultations with a dentist to prevent dental caries and promote adaptation to removable prostheses or alternative minimal rehabilitations and treatment. Our findings suggest that the oral health of older people could be improved by:

- increasing awareness of the importance of oral health among professional and non-professional caregivers (i.e.: regarding help with brushing teeth, mucous membranes and prostheses, use of fluoride toothpaste and an adapted toothbrush (powered), awareness of signs of oral problems, such as pain, dry mouth or missing tooth, regular visits to the dentist, ...);
- enhancing the accessibility of dentists by implementing transportation or teledentistry of home-based interventions;
- promoting preventive and minimally invasive measures from dentists to decrease the prevalence of oral problems and improve OHRQoL.

Disclosure of interest

The authors declare that they have no competing interest.

Funding

This study was funded by the Bordeaux Teaching Hospital.

Acknowledgements

We thank all the participants in this study. We also thank Sebastien Marchi for his support of our research; Pr Véronique Dupuis for her approval to conduct the research; the PAQUID psychologists for presenting our study to the participants; Rodolphe Thiébaut and Karen Leffondré for their methodological support; Marie-Hélène Sage for making appointments with the participants; Severine Martiren, Belinda Bastol and Catherine Maldonado for managing the data and Aurélie Ablonet for her professional English editing of the manuscript.

We acknowledge Colgate Palmolive for kindly providing each participant with Meridol toothpaste (20 mL) and a Meridol toothbrush.

References

[1] Institut national de la statistique et des études économiques. Population totale par sexe et âge au 1er janvier 2018. https://www.insee.fr/fr/statistiques/1892088?sommaire=1912926 Accessed 20 April 2019.
[2] Institut national de la statistique et des études économiques. Projections de population à l'horizon 2060; 2012 [Accessed 20 April 2019]http://www.insee.fr/fr/themes/document.asp?ref_id=ip1320.
[3] Institut national de la statistique et des études économiques. Les personnes âgées; 2005 [Accessed 20 April 2019]https://www.insee.fr/fr/statistiques/1371789.
[4] World Health Organisation, 2018. Ageing and health https://www.who.int/news-room/fact-sheets/detail/ageing-and-health Accessed 20 April 2019
[5] Direction de la recherche des études de l'évaluation et des statistiques. État de santé de la population en France; 2017 [Accessed 20 April 2019]https://drees.solidarites-sante.gouv.fr/IMG/pdf/esp2017.pdf.
[6] Direction de la recherche des études de l'évaluation et des statistiques. Handicaps-Incapacités-Dépendance; 2001 [Accessed 20 April 2019]http://www.vie-publique.fr/documents-vp/serieetud16.pdf.
[7] Pérès K, Matharan F, Carrière I, Berr C, Dartigues JF. Rapport sur la dépendance: 4 cohortes épidémiologiques; 2011 [Accessed 20 April 2019]https://www.cnsa.fr/documentation/_projet_dependance_4_cohortes_cnsa_version_finale_nov2011_.pdf.
[8] Haute Autorité de santé. Recommandations professionnelles, stratégies de prise en charge en cas de dénutrition protéino-énergétique chez la personne âgée. Argumentaire; 2007 [Accessed 20 April 2019]http://www.has-sante.fr/portail/upload/docs/application/pdf/denutrition_personne_agee_2007_-_argumentaire.pdf.
[9] De Marchi RJ, Hugo FN, Hilgert JB, Padilha DMP. Association between oral health status and nutritional status in south Brazilian independent-living older people. Nutrition 2008;24:546–53.
[10] Ghezzi EM, Ship JA. Systemic diseases and their treatments in the elderly: impact on oral health. J Public Health Dent 2000;60:289–96.
[11] Guiglia R, Musciotto A, Compilato D, Procaccini M, Lo Russo L, Ciavarella D, et al. Aging and oral health: effects in hard and soft tissues. Curr Pharm Des 2010;16:619–30.
[12] Vilstrup VL, Holm-Pedersen P, Mortensen EL, Avlund K. Dental status and dental caries in 85-year-old Danes. Gerodontology 2007;24:3–13.
[13] Arrivé E, Letenneur L, Matharan F, Laporte C, Helmer C, Barberger-Gateau P, et al. Oral health condition of French elderly and risk of dementia: a longitudinal cohort study. Community Dent Oral Epidemiol 2012;40:230–8.
[14] Kim JM, Stewart R, Prince M, Kim SW, Yang SJ, Shin IS, et al. Dental health, nutritional status and recent-onset dementia in a Korean community population. Int J Geriatr Psychiatry 2007;22:850–5.
[15] Azarpazhooh A, Leake JL. Systematic review of the association between respiratory diseases and oral health. J Periodontol 2006;77:1465–82.
[16] Scannapieco FA, Cantos A. Oral inflammation and infection, and chronic medical diseases: implications for the elderly. Periodontol 2000 2016;72:153–75.
[17] Listl S, Moran V, Maurer J, Faggion Jr CM. Dental service utilisation by Europeans aged 50 plus. Community Dent Oral Epidemiol 2012;40:164–74.
[18] Listl S. Denture-wearing by individuals among the older segment of European populations. Int J Prosthodont 2012;25:15–20.
[19] Desoutter A, Soudain-Pineau M, Munsch F, Mauprivez C, Dufour T, Coeuriot JL. Xerostomia and medication: a cross-sectional study in long-term geriatric wards. J Nutr Health Aging 2012;16:575–9.
[20] Tramini P, Montal S, Valcarcel J. Tooth loss and associated factors in long-term institutionalised elderly patients. Gerodontology 2007;24:196–203.
[21] Dartigues JF, Gagnon M, Barberger-Gateau P, Letenneur L, Commenges D, Sauvel C, et al. The Paquid epidemiological program on brain ageing. Neuroepidemiology 1992;11(Suppl 1):14–8.

[22] World Health Organisation. Oral Health Surveys – Basic Methods, 5th edition, WHO; 2013 [Accessed 20 September 2018]http://www.who.int/oral_health/publications/9789241548649/en/.
[23] Tsakos G, Marcenes W, Sheiham A. The relationship between clinical dental status and oral impacts in an elderly population. Oral Health Prev Dent 2004;2:211–20.
[24] dos Santos Calderon P, Peixoto RF, Gomes VM, da Mota Corrêa AS, de Alencar EN, Rossetti LMN, et al. Concordance among different pain scales in patients with dental pain. J Orofac Pain 2012;26:126–31.
[25] World Health Organisation. Application of the International Classification of Diseases to Dentistry and Stomatology; 1995 [Accessed 20 September 2018]http://apps.who.int/iris/handle/10665/40919.
[26] Thomson WM, Chalmers JM, Spencer AJ, Williams SM. The Xerostomia Inventory: a multi-item approach to measuring dry mouth. Community Dent Health 1999;16:12–7.
[27] Atchison KA, Dolan TA. Development of the Geriatric Oral Health Assessment Index. J Dent Educ 1990;54:680–7.
[28] Tubert-Jeannin S, Riordan PJ, Morel-Papernot A, Porcheray S, Saby-Collet S. Validation of an oral health quality of life index (GOHAI) in France. Community Dent Oral Epidemiol 2003;31:275–84.
[29] Klotz A-L, Hassel AJ, Schröder J, Rammelsberg P, Zenthöfer A. Oral health-related quality of life and prosthetic status of nursing home residents with or without dementia. Clin Interv Aging 2017;12:659–65.
[30] Hummel SK, Wilson MA, Marker VA, Nunn ME. Quality of removable partial dentures worn by the adult U.S. population. J Prosthet Dent 2002;88:37–43.
[31] Iranzo-Cortés JE, Montiel-Company JM, Almerich-Silla JM. Caries diagnosis: agreement between WHO and ICDAS II criteria in epidemiological surveys. Community Dent Health 2013;30:108–11.
[32] Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–98.
[33] Barberger-Gateau P, Rainville C, Letenneur L, Dartigues JF. A hierarchical model of domains of disablement in the elderly: a longitudinal approach. Disabil Rehabil 2000;22:308–17.
[34] Gil-Montoya JA, de Mello AL, Barrios R, et al. Oral health in the elderly patient and its impact on general well-being: a non-systematic review. Clin Interv Aging 2015;10:461–7.
[35] Murray Thomson W. Epidemiology of oral health conditions in older people. Gerodontology 2014;31(Suppl 1):9–16.
[36] Griffin SO, Griffin PM, Swann JL, et al. Estimating rates of new root caries in older adults. J Dent Res 2004;83:634–8.
[37] Thomson WM. Dental caries experience in older people over time: what can the large cohort studies tell us? Brit Dent J 2004;196:89–92.
[38] López R, Smith PC, Göstemeyer G, et al. Ageing, dental caries and periodontal diseases. J Clin Periodontol 2017;44(Suppl 18):S145–52.
[39] Walls AW, Meurman JH. Approaches to caries prevention and therapy in the elderly. Adv Dent Res 2012;24(2):36–40.
[40] Wong MCM, Clarkson J, Glenny A-M, Lo ECM, Marinho VCC, Tsang BWK, et al. Cochrane reviews on the benefits/risks of fluoride toothpastes. J Dent Res 2011;90:573–9.
[41] Tanaka J, Tanaka M, Kawazoe T. Longitudinal research on the oral environment of elderly wearing fixed or removable prostheses. J Prosthodont Res 2009;53:83–8.
[42] Misch CE. Contemporary implant dentistry, ed 3rd, Mosby Elsevier; 2008.
[43] Esmeriz CEC, Meneghim MC, Ambrosano GMB. Self-perception of oral health in non-institutionalised elderly of Piracicaba city, Brazil. Gerodontology 2012;29:e281–9.
[44] Lee KH, Wu B, Plassman BL. Cognitive function and oral health-related quality of life in older adults. J Am Geriatr Soc 2013;61(9):1602–7.
[45] Klotz AL, Hassel AJ, Schröder J, Rammelsberg P, Zenthöfer A. Oral health-related quality of life and prosthetic status of nursing home residents with or without dementia. Clin Interv Aging 2017;12:659–65.
[46] Lynge Pedersen AM, Nauntofte B, Smidt D, Torpet LA. Oral mucosal lesions in older people: relation to salivary secretion, systemic diseases and medications. Oral Dis 2015;21(6):721–9.
[47] Anil S, Vellappally S, Hashem M, Preethanath RS, Patil S, Samaranayake LP. Xerostomia in geriatric patients: a burgeoning global concern. J Investig Clin Dent 2016;7(1):5–12.
[48] Hahnel S, Schwarz S, Zeman F, Schäfer L, Behr M. Prevalence of xerostomia and hyposalivation and their association with quality of life in elderly patients in dependence on dental status and prosthetic rehabilitation: a pilot study. J Dent 2014;42(6):664–70.
[49] Gueiros LA, Soares MSM, Leão JC. Impact of ageing and drug consumption on oral health. Gerodontology 2009;26:297–301.
[50] Gil-Montoya JA, Silvestre FJ, Barrios R, Silvestre-Rangil J. Treatment of xerostomia and hyposalivation in the elderly: a systematic review. Med Oral Patol Oral Cir Bucal 2016;21(3):e355–66.
[51] Observatoire national de la démographie des professions de santé. État des lieux de la démographie des chirurgiens-dentistes; 2013 [Accessed 20 April 2019]https://solidarites-sante.gouv.fr/IMG/pdf/Etat_des_lieux_de_la_demographie_des_chirurgiens_dentistes_decembre_2013.pdf.
[52] Heegaard KM, Holm-Pedersen P, Bardow A, Hvidtfeldt UA, Grønbaek M, Avlund K. The Copenhagen Oral Health Senior Cohort: design, population and dental health. Gerodontology 2011;28(3):165–76.
[53] Wang TF, Huang CM, Chou C, Yu S. Effect of oral health education programs for caregivers on oral hygiene of the elderly: a systemic review and meta-analysis. Int J Nurs Stud 2015;52(6):1090–6.
[54] Rozas NS, Sadowsky JM, Jeter CB. Strategies to improve dental health in elderly patients with cognitive impairment: a systematic review. J Am Dent Assoc 2017;148(4):236–45.
[55] Yaacob M, Worthington HV, Deacon SA, Deery C, Walmsley AD, Robinson PG, et al. Powered versus manual tooth-brushing for oral health. Cochrane Database Syst Rev 2014;6:CD002281.
[56] Seo K, Kim HN. Effects of oral health programmes on xerostomia in community-dwelling elderly: a systematic review and meta-analysis. Int J Dent Hyg 2019. http://dx.doi.org/10.1111/idh.12418 [Epub ahead of print].
[57] Queyroux A, Saricassapian B, Herzog D, Müller K, Herafa I, Ducoux D, et al. Accuracy of teledentistry for diagnosing dental pathology using direct examination as a gold standard: results of the Tel-e-dent study of older adults living in nursing homes. J Am Med Dir Assoc 2017;18(6):528–32.
[58] Hendre AD, Taylor GW, Chávez EM, Hyde S. A systematic review of silver diamine fluoride: effectiveness and application in older adults. Gerodontology 2017;34(4):411–9.
[59] Allen PF, Da Mata C, Hayes M. Minimal intervention dentistry for partially dentate older adults. Gerodontology 2019;36(2):92–8.