Title: Chewing function, general health and the dentition of older Australian men: The Concord Health and Ageing in Men Project.

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ABSTRACT

Objectives: To describe the relationship between chewing function, oral health and general health characteristics in a population of community-dwelling older Australian men.

Methods: Analysis of data obtained from the 4th wave of the Concord Health and Ageing in Men Project assessed the bivariate and multivariate association of 614 participants, aged 79

years and over and their chewing capacity using three main indicators: capacity to chew eleven food-items ranging from boiled eggs through to fresh carrots and nuts; discomfort when eating; and interruption of meals. Associations with chewing were assessed for dentate vs edentate participants, numbers of teeth present, active dental disease and key general health conditions such as disabilities, co-morbidities and cognitive status. Logistic regression models were adjusted for age, country of birth, income, education and marital status. Risk ratios and 95% confidence intervals were estimated.

Results: Twenty-one per cent of participants could not eat hard foods, while 23.1% reported discomfort when eating; and 8.8% reported interrupted meals when eating. There was a three-fold difference in the capacity of dentate men to chew firm meat over edentate men (95% CI, 2.0-4.9); a 2.5 times increased likelihood of edentate men reporting discomfort when eating (95% CI 1.5-4.3); and 1.9 times greater likelihood of edentate participants reporting having meals interrupted (95% CI 1.4-2.6). Chewing/eating difficulties were associated with both dental status (number of teeth, active dental caries) and self-rated dental health. General health conditions associated with chewing function included; disability, physical activity, co-morbidities, cognitive status and depression. Older men's self rated oral health and general health perceptions were also associated with aspects of chewing function.

Conclusions: Reducing rates of edentulism may lead to improved chewing and eating function in older men, but additional focus needs to be directed to the association of chewing and eating difficulties with general health and specific dental conditions.

KEY WORDS. Chewing, eating, self-reported health perceptions, geriatric dentistry.

1. INTRODUCTION

The ability to chew a diverse range of foods has been associated with nutrient intake[1-3] and oral health-related quality of life.[4]

The prevalence of chewing problems in older populations depends on how chewing is measured. It also varies in different ethnic, gender and age populations. Reports from the British National Diet and Nutrition Survey[2,5] noted that approximately one in five community-dwelling dentate people had difficulty eating raw carrots, apples, nuts and well done steak. Slade, Spencer and Roberts-Thomson[6] reported that 37.9% of those 60 years or over had difficulty with eating one or more of six foods, with the edentulous sub-group having a significantly higher prevalence of difficulty than those with some natural teeth. Leung et al[7] reported that 15.3% of their community-dwelling population 60 years and older suffered problems in chewing. Poor chewing capacity was associated with a lower instrumental activities of daily living, poor nutritional status, post-stroke and having difficulty brushing teeth or dentures. Moriya et al[8]reported that 31.1% of those aged 65-74

years, and 41.8% of those aged 75-84 years had only "fair" or "poor" self-assessed masticatory ability. Chewing difficulties in this population were associated with posterior occluding pairs of teeth, periodontal treatment needs and denture-related factors. Avlund et al[9]reported a prevalence of 45% of men and 54% of women 70 years and older had chewing difficulties. Reduced chewing capacity was associated with having few or no teeth. They noted also that there were strong inter-relationships between status of the dentition, chewing problems and general functional limitations such as mobility. A study of 1,720 Brazilian adults reported that chewing impairment ranged between 13.0% in men and 18.0% in women.[10] A higher prevalence of chewing problems were associated with increasing age, lower education and income, and having no, or fewer natural teeth. A nationally representative Swedish study of people aged 77 years and older[11]reported a prevalence of chewing difficulty of 20.8%.

Gilbert et al[5] cited 12 clinical and self-reported conditions which related to chewing problems in dentate participants in the Florida Dental Care Study. Socio-demographic factors such as age, gender, education level and ability to pay for dental care did not appear to impact on chewing satisfaction or capacity.

Many studies have reported that chewing/eating problems are common in old age, but the association with general health and the dentition is less clear. The Concord Health and Ageing in Men Project (CHAMP) provides opportunity to explore these relationships in greater depth. CHAMP collected general health and oral health information on a population-representative sample of older community dwelling men from inner western Sydney suburbs in the 8th year of the project.[13] This paper reports on the prevalence of chewing/eating difficulties and the relationships between these, the status of the dentition and general health conditions of CHAMP participants.

2. METHODS

There were 1,705 community dwelling men aged 70 years and older recruited into a prospective population-representative study of health and ageing in 2005-2006.[14] Since then, three follow-up waves have been conducted. The most recent of these, at the 8th year of the project, included an intra-oral examination of dental status Of the 614 participants: 524 were dentate (had one or more natural teeth present); 90 were edentate (and wore dentures); and 296 participants met the criteria for a complete periodontal assessment.[13] Further information was collected on: the ability to chew common foods; eating/chewing difficulties[15]; and presence of pain and discomfort related to chewing. Details of the questionnaires and assessment processes have been reported elsewhere.[13,14,16]

Self-rated perception of oral health status was collected in response to the question: "How would you rate your dental health at the current moment". Response options were: "excellent; very good; good; fair; poor; and don't know". Response options were later collapsed into two categories: excellent/very good/good; and fair/poor/don't know. Self-rated general heath status was derived from responses to the SF-12 questionnaire.[14] The four response options were collapsed for later analyses into two categories: excellent/good and

fair/poor/very poor. The oral health assessments were completed within 6-weeks of the information collected in the Self-Completed Questionnaire (SCQ). The SCQ also collected information on the participants' use of dental services.

The Chewing Index used was based on Leake[17] and modified for the demographics of the local population. Participants were asked at the nutrition interview, "Are you currently able to chew the following foods?" Eleven food items, ranging from soft to hard foods were presented, and participants were asked to respond YES/NO to each item. Items that a participant did not eat for reasons other than hardness (taste, allergy etc) were recorded as Not Applicable. The food items were: boiled egg; boiled vegetables; pasta, fresh lettuce salad; hamburger; dried apricots; pizza; firm meat; fresh apple; fresh carrot and nuts. The food items were later grouped for analyses into two categories: soft and hard food groups. Hard foods included firm meat, fresh apples, fresh carrots and nuts.

The OHIP-14[15]comprises 14 questions, two of the items relate to chewing and eating: "In the last 12-months have you ever found it uncomfortable to eat food because of problems with your teeth, mouth or dentures?" and "In the last 12-months have you interrupted meals because of problems with your teeth, mouth or dentures?" Participants responses were reported on a five-item scale: never; hardly ever; occasionally; fairly often; and very often. The last three responses to each of these questions were later combined. Consequently the three chewing function (dependant variables) in the analyses were: capacity to eat/chew hard foods (derived from the 11-item chewing index); discomfort when eating (derived from OHIP-14 question 4); and meal interruption (derived from OHIP-14 question 8).

Dry mouth was estimated at the clinical dental assessment.[20]

Oral health characteristics were dichotomized at these cut-points: number of natural teeth present, ≤ 20; active coronal decay and active root surface decay, 0 tooth surfaces affected; posterior Functional Tooth Units, > 7 FTUs; Periodontal Pocket Depth (PPD), < 3 sites with ≥ 3mm depth; Clinical Attachment Loss (CAL), <5 sites with ≥ 5mm loss; mouth dryness, saliva evident before 60secs; self-rated oral health, excellent/very good; favourable pattern of dental visits, last visit ≤ 2yrs; recent pain/discomfort when eating, no recent pain/discomfort. The main general health parameters, and cut-points for dichotomization, were: disability (Activities of Daily Living (ADL), no disabilities); physical activity (the Physical Activity Scale for the Elderly (PASE), ≥ 80), cognitive status (Mini-Mental State Examination (MMSE), ≥ 26), depression (Geriatric Depression Scale(GDS), < 5); and Self Rated General Health (excellent/good). Total number of co-morbidities (cut-point ≤ 1) and smoking history were also recorded..

Statistical analyses were performed using the SAS software program. A P-value of 0.05 was considered to define statistical significance of associations. Adjusted logistic regression models were developed, controlling for age, country of birth, income, education and marital status. . Risk ratios (RR) are presented rather than odds ratios (OR).[19]

3. RESULTS

General characteristics of eating and chewing difficulties

The ranking of difficulty with chewing foods followed the soft to hard food groupings as listed in the SCQ. Overall 20.8% of men (n=128) had difficulty eating *hard* foods. There was no participant who reported difficulty in chewing boiled eggs and vegetables; but 13.8% (n=85) had difficulties chewing fresh carrots, 10.7% (n=66) with firm meat, and 8.6% (n=53) with difficulty in eating nuts. Only 7.3% (n=45) had difficulty chewing a fresh apple, and less than 3.5% had difficulty with chewing dried apricots, pizza, fresh lettuce salad and hamburger. Table 1 summarises the differences in pattern of chewing difficulty by whether or not the participant had some (dentate) or no natural teeth (edentate). There were no differences between dentate and edentate participants in chewing the softer foods (boiled egg, boiled vegetables and pasta). But statistically significant differences were evident between chewing capacity and dental status for all other foods ($p<0.05$).

TABLE 1 ABOUT HERE

Twenty-three per cent of participants (n=142) found it "uncomfortable to eat any food because of problems" with their teeth, mouth or dentures, with edentate men having 2.5 times (95% CI 1.5-4.3) greater probability of discomfort when eating. Fifty-two participants (8.5%) reported that they occasionally, fairly often or very often had to "interrupt their meal because of problems with their teeth, mouth or dentures". Edentate men had 1.9 times (95% CI 1.4-2.6) greater likelihood of interruption to meals than dentate men.

Four hundred and twenty-nine men rated their dental health as either "excellent" "very good" or "good" (70.1%). There was no statistical difference between dentate and edentate participants in their responses.

Multivariate modelling of risk factors for eating and chewing difficulties

Tables 2 and 3 summarise the unadjusted and adjusted risk ratios of the dentate participants inability to eat hard foods and discomfort when eating (n=524).

In dentate men, there was a 2.3 times greater likelihood that those with fewer than 21 natural teeth were *not able to eat hard foods* such as steak, fresh apples, carrots and nuts. This relationship remained statistically significant when adjusted for confounding factors of age, country of birth, income, education level and marital status (Table 2). While there was a 70% increased likelihood that those participants with one or more active root surface decay lesions could not eat hard foods in the unadjusted analysis, this association was nullified by the adjusted analysis. CHAMP men who rated their oral health as fair/poor/don't know were twice as likely not to be able to eat hard foods compared with those who self-rated their oral health as excellent/very good/good. Similarly, those men who had recently experienced pain or discomfort when eating were twice as likely, not to be able to eat hard foods, than those who had not experienced recent pain when eating.

TABLE 2 ABOUT HERE

Discomfort when eating, in dentate men, was associated with; number of teeth, active coronal decay, active root surface decay, self-rated oral health, and recent pain or discomfort (Table 3). Men with fewer than 21 natural teeth were more than twice as likely to have had discomfort when eating within the past 12-months. Further, men with active coronal and root surface decay were significantly more likely to have reported discomfort than men without any active decay. Finally, men who rated their oral heath as fair/poor/don't know were almost four-times more likely to have experienced discomfort when eating.

TABLE 3 ABOUT HERE

In only two instances were there statistically significant associations in edentate CHAMP men between chewing difficulties and local dental characteristics. Those with fair/poor/don't know self-rated oral health were more likely to have had discomfort when eating than those who rated their oral health as excellent/very good/good; however the association was only statistically significant in the unadjusted analysis (unadjusted RR = 2.5; CI, 1.5-4.1; adjusted RR = 1.3; CI, 0.9-1.7). Those with fair/poor/don't know self-rated oral health were two-to-three-times more likely to report interruption to their meals in the previous 12-months than those who rated their oral health as excellent/very good/good (unadjusted RR = 3.2; CI 1.3-8.0; adjusted RR = 2.1 CI, 0.9-4.6).

Tables 4 and 5 summarise the relationships between dentate participants and general health characteristics. The ability to eat hard foods was significantly associated with five general health characteristics in both unadjusted and adjusted analyses (Table 4): disability; physical activity; co-morbidities; cognitive status; and depression. Having a disability was associated with a two-fold increase in not being able to eat hard foods; lower physical activity was associated with a two-fold increased risk of not being able to eat hard foods; and having two or more co-morbidities was associated with a 60% increased likelihood of inability to eat hard foods. Men with lower cognitive status were more likely to be unable to consume hard foods than men with higher cognitive status and those with a high depression score were about twice as likely to be unable to chew hard foods.

TABLE 4 ABOUT HERE

The relationship between discomfort when eating; and disability, cognitive status and depression, were statistically significant only in unadjusted analyses (Table 5). Having two or more co-morbidities was associated with discomfort only in the adjusted model.

TABLE 5 ABOUT HERE

The only statistically significant relationship between general health characteristics and reporting that meals were interrupted because of their teeth, mouth or dentures, was for depressive symptoms. CHAMP men with a GDS of five or more were more than twice as likely to report having had their meals interrupted because of eating problems (unadjusted RR = 2.6; CI, 1.6-4.4; adjusted RR = 2.2; CI, 1.3-3.7).

4. DISCUSSION

This study used three estimates of chewing function in older Australian men (ability to eat hard foods, discomfort when eating and meal interruption) to explore the associations between chewing function, dental status and health characteristics. There was a stark difference in chewing function and whether or not older men had some or no natural teeth. For those with some teeth, the number of natural teeth and the presence of active dental decay were the most important independent factors associated with chewing function. Periodontal diseases (PPD and CAL) and dry mouth were not associated with variation in chewing function. Chewing function was associated with older men's self rated dental health in some analyses, but like the association between self-rated general health and chewing function – not a consistent factor across the three estimates. While a number of the general health conditions studied (disability, number of co-morbidities, cognitive status and depression) were associated with inability to chew hard foods, these general health issues were not strongly associated with the two other chewing function estimates.

Twenty-one percent of men in the CHAMP had difficulty in chewing hard foods. This is similar to the prevalence estimates from Sweden[11] and Britain,[2,5] lower than those reported in South Australia, Japan and Denmark,[6, 8,9]and higher than studies from Brazil or Hong Kong.[7,10] There was a strong association between capacity to chew certain foods and dentate status. Substantially fewer edentate men were able to chew the hard food items. The risk ratio between edentate and dentate men ranged from 1.9 (capacity to chew fresh carrots) to 3.1 (capacity to chew firm meats/steak). This relationship between poorer chewing capacity for the edentate, despite the wearing of dentures, is consistent with findings reported elsewhere.[20-22] Those without natural teeth were more likely to report discomfort when eating and having their meals interrupted because of their dentures. Edentate men also had 1.7times the risk of having pain or discomfort in the past month when eating hard foods.

Different studies have reported associations between various risk factors and chewing capacity in different ways. Leake[17] reported edentulism as a "strong" determinant of chewing disability, a finding supported by this study.

The prevalence of poor or low chewing performance in this study was derived from two self-rated questions on problems with eating and meal interruption. Responses to the occurrence of these problems were recorded as occurring "occasionally, fairly often or very often" during the previous 12 months. Twenty-three percent of CHAMP men reported discomfort when eating and nine percent said that they had to interrupt their meals because of chewing problems. Gilbert et al[12]identified a prevalence of "dissatisfaction with chewing" of 16%, using different criteria than CHAMP. A national Australian telephone survey of adults reported that 24% of respondents 65 years and over, avoided eating certain foods due to problems with their teeth, with females reporting a higher prevalence (25.8%) than males (19.7%).[23] Our findings fall within the same spectrum of responses to eating and chewing issues as this national study.

The relationship between active dental disease, chewing function and eating problems is an area of contestability. In our study the presence and severity of periodontal diseases was not associated with variation in chewing or eating problems. Similarly, the number of FTUs

was not associated with any of the three measures of chewing/eating ability. In addition, an association between our estimate of the use of dental services and chewing/eating difficulties was not significant. The presence of active coronal and root surface decay was inconsistently associated with certain variations in responses to the three chewing/eating measures. More detailed recording of specific dental conditions, may be required to elucidate relationships in this area.

Dry mouth (low salivary flow rate) has also been suggested as an important factor associated with chewing function, capacity and satisfaction.[2,3] While there was a statistically significant difference in salivary flow rates between dentate and edentate CHAMP men, associations between mouth dryness and adverse chewing/eating impacts was not statistically significant in either the unadjusted or adjusted models. This is in keeping with the findings of Sheiham et al.[5]

There are conflicting reports on the relationship between the number of teeth and/or posterior FTUs necessary for satisfactory oral function and chewing.[2,24] Naka et al[25] could not identify a specific number of occluding pairs of teeth or FTUs necessary to provide adequate oral function. Our study used the posterior occlusal threshold for inadequacy of oral function a FTU score of ≤ 7. This would equate to four or five occluding molar and/or premolar pairs of teeth. At this threshold level, no statistically significant associations could be found between inadequacy of FTUs and the likelihood of chewing or eating difficulties. However, for each of the three measures of eating/chewing function in our study, we found that the number of teeth present in dentate men was significantly associated with capacity to eat hard foods, reporting of discomfort when eating, and with the likelihood of reporting interruption with eating during meals. Having fewer than 21 natural teeth was a significant factor in reduced chewing function, a finding consistent with other studies.[6,9,10]

A key finding of our study was that each of the three chewing/eating estimates used was associated with self-rated perception of oral health status. Those dentate men who reported fair, poor or uncertainty about the current state of their teeth and mouth had a higher likelihood of not being able to eat hard foods, of reporting discomfort when eating, and of having their meals interrupted because of their chewing/eating difficulties than their peers who rated their dental health good/very good/excellent. Further, the association between chewing/eating difficulties were also present for self-rated general health. That is, chewing and eating function was related not only to oral health related quality of life values, but importantly also, to general health quality of life perceptions.

Few studies on chewing and eating perceptions have tested associations with general health characteristics.[9,11] In our study, the capacity to eat/chew hard foods showed the strongest associations with general health factors. Men who had a disability, two or more co-morbidities, low physical activity, low cognitive status and moderate to high levels of depression had a higher likelihood of chewing/eating difficulty. This supports the work by Avulund et al[9] who showed an association between disability and lower chewing capacity and Lexomboom et al[11] who demonstrated an association between cognitive impairment, loss of teeth and reduced chewing capacity. It highlights the need for health practitioners to

be aware of the relationships that deteriorating physical and mental capacity in older persons may have on their eating capacity and nutritional consequences.

A strength of this study lies in the multi-disciplinary nature of the data collection and consideration of linkages between oral health and general health. However, the study was cross-sectional and so it is not possible to establish the temporal, or causal, nature of observed relationships. Another limitation is the difficulty of comparing across studies because of variations in methodology and culture. Further research and analyses are required in this area. Finally, it may be especially valuable to consider different thresholds levels and grouping for determining both reference and experimental groups in the regression analyses which may impact on outcomes and study findings.

Capacity to chew a variety of different foods is central to both good nutritional intake and quality of life. This study has shown that older Australian men have great variability in their chewing capacity and function which is especially marred by having few or no natural teeth, and by the presence of active tooth decay. As the Australian population ages more older people will present to health practitioners with disability, co-morbidities, poor cognitive function and depression. Maintaining natural teeth, free of active dental decay may contribute to better health outcomes through improved chewing function and self-rated health of older Australians.

ACKNOWLEDGEMENTS.

The CHAMP study is funded by the National Health and Medical Research Council (project grant number 1065647, 2014) the Ageing and Alzheimer's Institute and Sydney Medical School Foundation. We thank all of the staff working on the CHAMP, the participants in the project and their families and dental assistants who recorded that chair-side data. The support of the Department of Geriatric Medicine, Concord Repatriation General Hospital and the Sydney Dental Hospital, Sydney Local Health District is also gratefully acknowledged.

DISCLOSURES

The views expressed are those of the authors, not of the funders. Data analysis and interpretation were carried out by the authors independently of the funding sources. The corresponding author had full access to the survey data and had final responsibility for the decision to submit for publication.

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Table 1. Participants who answered "No" to the Question: "Are you currently able to chew the following foods?" Asked during the Nutrition Interview. Where: RR is the Risk Ratio; CI the 95% Confidence Interval and * P<0.05 level of significance. N = 614.

Type of Food	Dentate N (%)	Edentate N (%)	RR (CI)
Boiled egg	0 (0)	0 (0)	0
Boiled vegetables	0 (0)	0 (0)	0
Pasta	0 (0)	1 (1.1)	0
Fresh lettuce salad	3 (0.6)	4 (4.4)	7.8 (1.8-34.4)*
Hamburger	13 (2.5)	7 (7.8)	3.2 (1.3-7.8)*
Dried apricot	16 (3.1)	9 (10.0)	3.5 (1.6-7.6)*
Pizza	7 (1.3)	4 (4.4)	3.6 (1.1-11.9)*
Firm meat such as steak	43 (8.2)	23 (25.6)	3.1 (2.0-4.9)*
Fresh apple	34 (6.5)	11 (12.2)	2.0 (1.1-3.8)*
Fresh carrot	65 (12.4)	20 (22.2)	1.9 (1.3-3.0)*
Nuts	38 (7.2)	15 (16.7)	2.3 (1.3-3.9)*

Table 2. Characteristics of the *dentate* CHAMP men related to the likelihood of not being able to eat hard foods such as firm steak, fresh apples, fresh carrot and nuts. Where RR is the Risk Ratio; CI is the 95% Confidence Interval; Ref is the Reference Group and * P<0.05. The Adjusted RR controls for age, country of birth, income, highest education level, marital status. N = 524 with periodontal data on a sub-sample N=296.

Characteristic	N (%)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)
Number of teeth Ref: > 20 teeth	70 (13.4)	2.3 (1.5 – 3.4)*	1.9 (1.2 – 2.9)*
Active coronal decay Ref: 0 tooth surfaces	40 (7.6)	1.4 (0.9 – 1.9)	1.23 (0.9 – 1.8)
Active root decay Ref: 0 tooth surfaces	37 (7.1)	1.7 (1.12 – 2.4)*	1.4 (0.9 – 2.0)
Functional Tooth Units Ref: >7posterior FTUs	48 (9.2)	1.0 (0.7 – 1.4)	0.9 (0.6 – 1.3)
Periodontal Pocket Depth Ref: < 3 sites with ≥ 3mm	34 (11.5)	1.03 (0.9 – 1.2)	1.0 (0.9 -1.1)
Clinical Attachment Loss Ref: < 5 sites with ≥ 5mm	37 (12.5)	1.1 (0.9 – 1.3)	1.1 (0.9 – 1.2)
Mouth dryness Ref: Saliva before 60 seconds	8 (1.5)	0.8 (0.4 – 1.5)	0.6 (0.3 – 1.3)
Self rated oral health [a] Ref: Excellent, v good, good	46 (8.8)	2.3 (1.6 – 3.2)*	1.9 (1.3 – 2.7)*
Favourable dental visits Ref: ≤ 2 years since last visit	23 (4.4)	1.2 (0.8 – 1.9)	1.0 (0.7 – 1.6)
Recent pain/discomfort with eating or swallowing? Ref: No pain/discomfort	16 (3.1)	2.0 (1.3 – 3.2)*	1.9 (1.3 – 2.9)*

[a] In this analysis age was adjusted as a categorical variable.

Table 3. Characteristics of the *dentate* CHAMP men related to their responses to their "occasionally, fairly often or very often" *discomfort with eating in the previous 12-months*. RR is the Risk Ratio; CI is the 95% Confidence Interval; Ref is the Reference Group and * P<0.05. The Adjusted RR controls for age, country of birth, income, highest education level, marital status. N = 524 with periodontal data on a sub-sample N=296.

Characteristic	N (%)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)
Number of teeth Ref: > 20 teeth	79 (15.1)	2.3 (1.5 – 3.4)*	2.1 (1.4 – 3.1)*
Active coronal decay Ref: 0 tooth surfaces	49 (9.4)	1.6 (1.1 – 2.2)*	1.5 (1.0 – 2.1)*
Active root decay Ref: 0 tooth surfaces	43 (8.2)	1.7 (1.3 – 2.4)*	1.6 (1.1 – 2.2)*
Functional Tooth Units Ref: >7 posterior FTUs	57 (10.9)	1.1 (0.8 – 1.6)	1.1 (0.8 - 1.6)
Periodontal Pocket Depth Ref: < 3 sites with ≥ 3mm	43 (14.5)	0.9 (0.9 – 1.1)	1.0 (0.9 – 1.1)
Clinical Attachment Loss Ref: < 5 sites with ≥ 5mm	48 (16.2)	0.9 (0.8 – 1.1)	0.9 (0.9 – 1.2)
Mouth dryness Ref: Saliva before 60 seconds	13 (2.5)	1.2 (0.7 – 1.9)	0.9 (0.6 – 1.7)
Self rated oral health [a] Ref: Excellent, v good, good	66 (12.6)	3.8 (2.7 – 5.4)*	3.6 (2.6 – 5.1)*
Favourable dental visits Ref: ≤ 2 years since last visit	22 (4.2)	0.9 (0.7 – 1.5)	0.9 (0.6 – 1.4)
Recent pain/discomfort with eating or swallowing? Ref: No pain/discomfort	20(3.8)	2.2 (1.5 – 3.3)*	2.2 (1.5 – 3.2)*

[a] In this analysis age was adjusted as a categorical variable.

Table 4. General health characteristics of the CHAMP men related to the likelihood of not being able to eat hard food foods such as firm steak, fresh apples, fresh carrot and nuts. Where RR is the Risk Ratio; CI is the 95% Confidence Interval; Ref is the Reference Group and * P<0.05. The Adjusted RR controls for age, country of birth, income, highest education level, marital status and edentulism. N = 612 with 2 Missing values.

Characteristic	N (%)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)
Disability (ADL) Ref: No disabilities	71 (11.6)	2.4 (1.8 – 3.3)*	2.1 (1.5 – 2.9)*
Physical Activity (PASE)[a] Ref: ≥ 80	61 (9.9)	2.0 (1.5 – 2.7)*	1.9 (1.4 – 2.5)*
Number of Co-morbidities Ref: ≤ 1 Co-morbidity	84 (13.7)	1.6 (1.1 – 2.2)*	1.5 (1.1 – 2.1)*
Cognitive status (MMSE) Ref: ≥ 26	37 (6.0)	2.3 (1.6 – 3.3)*	2.1 (1.4 – 3.1)*
Geriatric Depression (GDS) Ref: < 5	42 (6.8)	2.23 (1.7 – 3.1)*	1.78 (1.3 – 2.4)*
Smoking History Ref: Never Smoked	81 (13.2)	1.20 (0.9 – 1.67)	1.02 (0.7 – 1.4)
Self rated general health Ref: Excellent, good	39 (6.4)	1.26 (0.9 – 1.8)	1.06 (0.8 – 1.5)

[a] In this analysis age was adjusted as a categorical variable.

Table 5. General health characteristics of the CHAMP men related to their "occasionally, fairly often or very often" *discomfort with eating in the previous 12-months*. Where RR is the Risk Ratio; CI is the 95% Confidence Interval; Ref is the Reference Group and * P<0.05. The Adjusted RR controls for age, country of birth, income, highest education level, marital status and edentulism. N = 612 with 2 Missing values.

Characteristic	N (%)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)
Disability (ADL) Ref: No disabilities	61 (9.9)	1.5 (1.1 – 1.9)*	1.3 (0.9 – 1.8)
Physical Activity (PASE) Ref: < 80	84 (13.7)	1.3 (0.9 – 1.7)	1.13 (0.8 – 1.5)
Number of Co-morbidities Ref: ≤ 1 Co-morbidity	89 (14.5)	1.3 (0.9 – 1.8)	1.4 (1.0 – 1.9)*
Cognitive status (MMSE) Ref: ≥ 26	31 (5.0)	1.5 (1.1 – 2.2)*	1.4 (0.9 – 1.9)
Geriatric Depression (GDS) Ref: < 5	41 (6.7)	1.9 (1.4 – 2.6)*	1.6 (1.2 – 2.2)
Smoking History Ref: Never Smoked	94 (15.3)	1.3 (0.9 – 1.8)	1.2 (0.8 – 1.6)
Self rated general health Ref: Excellent, good	54 (8.8)	1.7 (1.3 – 2.3)*	1.6 (1.2 – 2.2)*