

## The life course and oral health in old age\*

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### ABSTRACT

Alongside a marked increase in the population of older New Zealanders has been an increase in tooth retention: more and more older adults now have at least some of their own teeth. Understanding their oral health demands consideration of their journey along the life course. The common clinical oral conditions – dental caries ('tooth decay') and periodontitis ('gum disease') – are both chronic and cumulative, and highly socially patterned in their occurrence, being more prevalent and severe in those of lower socio-economic position. Those who have ended up with 'good oral health' in old age are those who have had the wherewithal to adapt successfully to their oral disease burden as it has accumulated over the years. In this paper, I consider the utility of the life course approach for interpreting and understanding data, and I apply its principles to a number of important observations on older people's oral health.

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### Paper proper

The oral health of older people (those aged 65 years or more) has attracted considerable attention in the last three decades. Before then, it had largely been ignored, because the typical older New Zealander had no teeth remaining and wore complete dentures. That situation has changed markedly. In this paper, I reflect on the importance and utility of the life course approach for understanding the oral health of older people. After all, they have not suddenly appeared out of nowhere; older people were once babies, children, adolescents, young adults, and then middle-aged adults before they reached their current stage, and the cumulative nature of the main oral conditions means that interpreting older people's oral health data requires consideration of their life course journey (Ettinger and Marchini 2020).

A number of factors have led to the contemporary increase in interest in older people's oral health. The population has been steadily ageing, with falling fertility and greater longevity causing a steady increase in the proportion and absolute number of New Zealanders aged 65 or more. Alongside that demographic shift has been an increase in tooth retention, with the result that there are more and more older adults with at least some of

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their own teeth (Thomson and Smith 2022). For at least the first half of the twentieth century, the dominant practice in New Zealand – particularly for women – was to have the entire dentition removed and replaced by complete dentures early in adulthood (Sussex et al. 2010). That phenomenon was largely socio-culturally-determined and strongly socially patterned, with dentition removal rates considerably higher among working-class New Zealanders (Sussex 2008). Accordingly, not only were older adults with their own teeth in the minority, they tended also to be among society's socio-economic elite (Thomson 2012a). This social class differential led to the erroneous view that the common oral conditions were not that prevalent or severe among older people, since those who had kept their natural teeth to old age had enjoyed better health and living conditions anyway. The greater and 'more egalitarian' tooth retention seen in recent decades (Ministry of Health 2010) has largely dispelled that notion. Although the transition to edentulism is much less of a feature of the contemporary oral health experience, it is likely to remain an important event for a small proportion of New Zealanders however, given that, for some, removal of the remaining remnants of a broken-down dentition is likely to bring about an end to decades of suffering. It should also be borne in mind that such a transition is tending to occur at a later stage in life, when the required neuromuscular adaptation to complete dentures may be more difficult (and people who are less well-off are unable to opt for implant-supported prostheses).

### ***The common clinical oral conditions***

The common clinical oral conditions – dental caries ('tooth decay') and periodontitis ('gum disease') – are biofilm-mediated, non-communicable diseases (NCDs) which are both chronic and cumulative. Dental caries involves the loss of mineral from the intra-oral dental hard tissues to form caries lesions, or 'cavities' (Machiulskiene et al. 2020). Periodontitis is a chronic inflammatory condition whereby a host-mediated immune response to dysbiosis in the subgingival bacterial biofilm causes progressive destruction of the periodontal tissues (including alveolar bone), resulting in loss of periodontal attachment and the structures which support the teeth (Tonetti et al. 2018).

The end point of both dental caries and periodontitis is tooth loss – itself cumulative but not necessarily inevitable – which can manifest as partial or complete loss of the dentition (Thomson 2012a; Hyland et al. 2022). Although edentulism is now much less common, incremental tooth loss continues, with most New Zealanders in their 50s or older having had teeth removed due to dental caries and/or its sequelae (Ministry of Health 2010).

All three states – dental caries, periodontitis and tooth loss – are highly socially patterned in their occurrence, being more prevalent and severe in people of lower socio-economic position (Thomson 2012a, 2012b; Schwendicke et al. 2015). That inequality is, of course, also apparent with respect to self-rated oral health (Mejia et al. 2018). As people age, social inequalities widen (see below).

An appreciation of the life course journey is crucial to understanding the oral health of older people. Those who have ended up with 'good oral health' in old age are those who have adapted successfully to their oral disease burden as it has accumulated over the years, and they have been able to afford the required dentition maintenance over that period. Their oral state is such that they are able to chew, taste and enjoy their food, and to smile and speak comfortably and without social embarrassment (Locker 1988).

They may have retained most of their natural teeth, they may be denture wearers, or they may have a combination of these. Very few people reach old age without having lost one or more teeth. Recent work has highlighted wide diversity in the residual dentition and associated denture wearing among older New Zealanders, and underlined the rarity of the completely intact dentition in that age group (Hyland et al. 2019; Hyland et al. 2022).

Successful oral ageing into the later years should therefore not (and cannot) be defined solely by the outdated concept of dentition completeness (that is, whether someone is with or without teeth or their replacements). The concept of adequate oral functioning is considerably broader than the biomedical notions of telomeres, the number of remaining teeth, and the like which have largely predominated to date (McGrath et al. 2022). Given the value placed by older people on social engagement, independence, physical health and positive attitudes (Reich et al. 2020), having a mouth and dentition (whether natural or artificial) which enables those is important. Accordingly, a biopsychosocial and functional approach is both pragmatic and more appropriate, given the wide divergence in biological status which is evident in any older population. The biopsychosocial model emphasises the interconnections among biological, psychological and socio-environmental factors in determining health states, and it is consistent with the WHO definition of healthy ageing as ‘developing and maintaining the functional ability that enables well-being in older age’ (World Health Organization 2015).

The common oral conditions are cumulative. That is, they accumulate during the life course, and so interpreting and explaining their occurrence in an ageing population requires an understanding of both (i) the life course approach and (ii) interpersonal differences in the pace of ageing.

### ***Thinking about the life course***

The life course can be defined as the age-graded sequence of socially defined roles and events that occurs over historical time and place (Elder et al. 2002); simply put, it is our journey through life. People spend most of their lives as adults, and mature ones at that, but development continues as a lifelong process as they pass through the developmental epochs of infancy/childhood and adolescence, into adulthood and early middle age, and then through middle and older age (with the latter two comprising just over half of the life course).

The five notions of (i) time and place, (ii) life span development, (iii) timing, (iv) agency and (v) linked lives are useful in life course theory (Black et al. 2009), as are the concepts of trajectories, transitions and turning points. These are described briefly in Table 1, alongside oral health examples. People do not live their lives in isolation; the historical context and events shape those lives in ways that can have longlasting effects. For example, the introduction of fluoride toothpaste in the early 1970s was responsible for a substantial decrease in dental caries experience (O’Mullane et al. 2016) which continues to have marked benefits for dentate people of all ages as they move through the life course.

### ***Ageing and non-communicable diseases (NCDs)***

The NCDs which account for the bulk of health care effort and expenditure in modern society are the chronic, steadily accumulating conditions which are subclinical at first but become steadily more apparent, one by one reaching the point at which they are

**Table 1.** Concepts in life course theory, applied to oral conditions.

Concept/ principle	Description	Oral health example(s)
Time and place	Lives occurring within a historical context and setting	Early 1970s introduction of fluoride toothpaste
Life-span development	Humans continue to develop meaningfully beyond childhood; earlier experiences shape subsequent ones	Biographical disruption arising from tooth loss
Timing	The chronological ordering of events	Severe dental caries in deciduous anterior teeth leading to enamel defects (demarcated opacities) in the permanent successor teeth
Agency	People make decisions that shape their lives	Daily oral self-care practices; usual dietary intake; tobacco use
Linked lives	Lives are lived interdependently, reflecting social links and norms	Intergenerational continuity in oral health
Trajectories	Paths of change in developmental processes	The rate of accumulation of caries lesions in tooth surfaces through life
Duration	The length of time spent in a given state or identity	The period spent in residential aged care
Transitions	A change in status or identity (an entry point into a new state or identity)	The transition from the deciduous dentition to the permanent one (admittedly a protracted one)
Turning point	A substantial change in life direction	Smoking cessation in early adulthood, leading to improved periodontal health

diagnosed and therapeutic intervention is required which is usually pharmacological but may be surgical. The rate of ongoing accumulation of NCDs is likely to reflect inter-individual differences in biological ageing, whereby some people age at considerably higher rates than their age cohort peers. That is, we all age at the same rate *chronologically*, but there is marked variation in how quickly we are ageing *biologically*.

What is the evidence for different rates of ageing? Elliott et al. (2021) recently characterised and described differences in the pace of ageing among participants followed to age 45 years in the Dunedin Study. They used a composite measure assembled from 19 different biomarkers representing the cardiovascular, metabolic, renal, immune function, oral and pulmonary domains. The pace of ageing was found to range from 0.4–2.4 biological years per chronological year. Those ageing faster already had poorer cognitive and sensorimotor function, along with anatomical evidence of higher brain age and central nervous system degeneration (assessed using MRI scans). That these differences were already apparent by age 45 means that people's NCD trajectories are already well established by midlife, being determined by individual differences in genetic endowment, cellular biology, and life experiences and exposures. That ageing has usually involved decades of subclinical decline – in, variously, the cardiovascular, metabolic, renal, immunological, neurological and pulmonary organ systems – prior to NCD clinical manifestation, diagnosis and management later in life. Thus, as the Dunedin Study cohort passes through late middle age and into old age, that ongoing decline will become apparent in a steadily-accumulating number of chronic conditions requiring medical or surgical intervention.

The exception to this pattern is the chronic oral conditions, the cumulative nature (and ready assessment) of which means that their accumulation during the life course manifests at a rather more steady and detectable rate (Thomson 2004; Broadbent et al. 2013). Interestingly, dental caries experience in old age begins to accumulate considerably faster after entry to residential aged care, with the annual increment (the number of new 'cavities') more than doubling from the one newly affected surface per year observed among community-dwelling older people, and then more than doubling

again if the resident has dementia (Chalmers et al. 2005). Periodontal loss of attachment becomes apparent during the early 20s and increases steadily through into middle age, manifesting mainly as increases in the depth and extent of periodontal pockets, particularly among smokers (Zeng et al. 2014). By old age, the majority of new periodontal attachment loss manifests as increases in gingival recession rather than in pocketing (Beck et al. 1997; Thomson 2004). Caries- or periodontitis-associated incremental tooth loss also continues.

### **Capital and oral health**

The dental literature on older people has paid attention largely to the personal behaviours and exposures which have led to those chronic oral conditions, without consideration of the life-course journey. Such a narrow focus has not been helpful, enabling misinterpretation of much of the available evidence. A wider perspective is needed.

It is useful here to consider the three types of capital in respect of the resources used to achieve and maintain health (Frytak et al. 2002). *Financial* capital is an individual's income and wealth; these determine his/her consumption of health-promoting goods. *Human* capital arises from investments in education and training that provide the wherewithal to avoid risky exposures or behaviours. *Social* capital arises from personal relationships and interactions. As a simple example pertaining to dental caries experience, the first might enable the purchase of fluoride toothpaste and a healthier diet along with the ability to invest in ongoing maintenance of the dentition; the second favours the adoption and long-term retention of a health-promoting behaviour such as twice-daily toothbrushing; and the third manifests as the social norm of having clean white teeth, and having none visibly missing.

Taken together – and being operative day after day, week after week, year after year, over a number of decades – those three different forms of capital favour lower dental caries rates and greater tooth retention than among people who have less of them. Comparing the former with the latter at any point during the life course – that is, at any age – will reveal marked differences in rates of dental caries and gum disease and in the number of missing teeth. Moreover, those differences will be progressively greater as they move along the life course, as witnessed by the progressive widening of SES inequalities in incremental tooth loss among the Dunedin Study cohort (Thomson 2012b).

### **Applying life-course thinking**

Table 2 summarises some observations from research in oral health for which interpretation is enhanced by using life course thinking. Each is considered briefly below (for a

**Table 2.** Some phenomena for which the life-course approach offers invaluable insights.

Phenomenon	Key reports
Age-associated widening of socio-economic differentials in oral disease	Thomson (2012a)
Intergenerational continuity in oral health	Shearer et al. (2011a)
Better OHRQoL in old age	Slade and Sanders (2011)
Associations between tooth loss and cognitive function in older adults	Thomson and Barak (2021)
Associations between periodontitis and various NCDs	Slots (2017)

more detailed exposition of each, the reader is encouraged to consult the primary sources).

First, the scale of inequalities in the common oral conditions by socio-economic status increases with age, with steadily greater differentials observed as people pass from adolescence to early adulthood and then through middle age. This is most clearly apparent with incremental tooth loss in the Dunedin cohort, whereby the ratio of the proportion having lost teeth due to dental caries between those of lifelong low SES and those of lifelong high SES increased from 2.8 at age 26 to 3.2 by age 38 (Thomson 2012b).

Second, there is intergenerational continuity at work, with higher rates of oral disease and tooth loss observable in the children of parents who themselves have poor oral health (Shearer et al. 2011a, 2011b, 2012). Self-rated maternal oral health assessed in 1977–78 when Dunedin Study members were 5 years old was not only associated with the children's deciduous dentition dental caries experience at that time but it was strongly associated with their accumulated permanent dentition caries experience 27 years later, at age 32. This reflects marked continuity in the abovementioned financial, human and social capital (Frytak et al. 2002) which determines health status.

Third, there is the seemingly paradoxical observation of more favourable self-reported oral health and oral-health-related quality of life (OHRQoL) in older adults than in younger ones despite the former having greater accumulated oral disease experience and tooth loss (Slade and Sanders 2011). This is thought to arise at least partly from their gradual adaptation to their dental status as it worsens with age, along with a degree of stoicism which is necessary to allow coping with the gradual onset and accumulation of the 'decrepitude' of old age.

Fourth, associations observed between higher numbers of missing teeth and worse cognitive function among older adults have been interpreted erroneously as causal (Cerutti-Kopplin et al. 2016; Thomson and Barak 2021). Cognitive function in childhood plays a critical role here. Not only is there marked continuity in cognitive function between childhood and adulthood (with a Pearson's  $r$  of +0.8 for the correlation between IQ in childhood and at age 38; Thomson and Barak 2021), but the former is crucial in determining a person's share of all three types of capital. Recent work in the Dunedin Study showed that children in the highest quartile of cognitive function are not only far more likely to end up as high-SES adults, but they will have the lowest accumulated oral disease by their late 30s (on almost any aspect of oral disease or self-care). For example, one in twenty of them had lost three or more teeth due to dental caries by age 38, whereas the corresponding proportion among those in the lowest quartile of childhood cognitive function was more than one in four (Thomson et al. 2019). This suggests strongly that the latter group were less successful in accumulating the financial, human and social capital which was necessary for sustaining low oral disease rates over the period from childhood to mid-adulthood. Consider, then, the implications of that ongoing, slowly-accumulating divergence in oral disease experience over the following three decades: the differences between those groups in their oral health in old age will be considerable. By then, of course, similar differentials will have manifested in their experience of NCDs, most of which will have been diagnosed and be under treatment by then. Anyone conducting an epidemiological study of oral and systemic diseases would inevitably observe strong associations between them. How such associations are interpreted is crucial.

Fifth, and similarly, causality has been ascribed to associations observed between periodontitis experience and a wide range of NCDs (Slots 2017; Hajishengallis 2022). While a great deal of effort and funding has been expended on describing and explaining those associations over the last three decades, persisting methodological issues and relatively weak and inconsistent effect sizes continue to cast doubt on that body of work. Perhaps most tellingly, as Pihlstrom et al. (2018) put it, ‘there is still no definitive evidence that treating oral disease has any clinically meaningful effect on the prevention, treatment or outcomes of any systemic disease’. The same issues apply to the periodontitis-system disease ‘link’ as to the tooth loss and cognition association. NCDs (including periodontal attachment loss) accumulate through life; any investigation is likely to uncover an association, but it is unlikely to be causal because the conditions share common risk factors (Sheiham and Watt 2000).

## Conclusions

Understanding the oral health of older people can be enhanced when it is considered as a continuation of their journey through the various developmental epochs that comprise the life course. Cross-sectional studies of age differences are informative, but their findings warrant careful interpretation.

## Disclosure statement

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