DUNEDIN STUDY CONCEPT PAPER FORM

Provisional Paper Title: Investigating the long-term association between oral health and middle ear health, and outcomes on hearing

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Please describe your proposal in 2-3 pages with sufficient detail for helpful review.

Objective of the study:

This study aims to investigate the association between oral hygiene and middle ear health. The oral and nasal cavities are closely interconnected via the Eustachian tube, and share common microbiota. Previous studies, such as one by Topcuoglu and colleagues (2012) showed the presence of genetically similar anaerobic bacteria (*Fusobacterium nucleatum, and Treponema denticola*) in saliva, nasopharyngeal, and middle ear effusion samples. Inflammation and swelling of the Eustachian tube, tonsils, and adenoids as a result of an ear infection can trap middle ear fluid and facilitate the rapid growth of bacteria (Heikkinen & Chonmaitree, 2003). Elevated levels of *Streptococcus mutans* in children with otitis media with effusion (OME) – middle ear inflammation and infection – have also been observed to be associated with dental caries (Kashyap et al., 2019).

Given the interconnectedness of our ears, noses, and throats, it has been hypothesized that there would be an association between oral and ear disease. Previous studies have explored the relationship between the oral hygiene index (representing biofilm and debris on teeth), and middle ear effusion, compliance, and pressure measurements (Esra, Banu & Erdinc, 2013), or history of ear infections (Nelson

et al., 2005) in children. Both studies found no associations. However, comparatively small sample sizes (59, and 126 children), and the range of participant ages (3-12 years, and 2-5 years), could have contributed to high variability in the data.

The Dunedin study data provide a better opportunity to explore this positive association between oral hygiene and middle ear health, and to address limitations identified in the existing literature. There are also available data for the same cohort (all aged the same) across a number of phases, which can provide information on whether the association (if any) changes from early childhood years to teenage years, and also in adulthood.

Data analysis methods:

1. Does childhood plaque index OHI-S (Broadbent et al., 2011) (low, medium, high) associate with:
   - Dental caries in childhood P5-9 (dmft score)
   - Otological status (hearing variable characterizing OME in childhood P5-9)

2. Does longitudinal trajectories of plaque index OHI-S (low, medium, high) associate with:
   - Dental caries in adulthood P45 (dmft score)
   - Hearing ability in adulthood P45
   - Listening ability in adulthood P45

Variables needed at which ages:

Dental variables:
- Plaque Index (OHI-S) for P5-9
- Plaque Index (OHI-S) longitudinal trajectory
- Dental caries (dmft score) for P5-9
- Dental caries (dmft score) for P45

Hearing variables:
- Otological status variable (for P5-9)
- Mid-frequency pure tone hearing average at P45
- High-frequency pure tone hearing average at P45
- Listening in spatialized noise at P45 (objective listening ability)
- Mean SSQ questionnaire at P45 (subjective listening ability)

Other variables for use in adjustment:

- Sex
- Childhood SES
- Occupational noise exposure in adulthood
- Cumulative lifetime smoking
- Adult education level

Significance of the Study (for theory, research methods or clinical practice):

The Dunedin study data provide a better opportunity to explore associations between oral hygiene and middle ear health, and to address limitations identified in the existing literature. So far, studies have found no relationship between poor oral health and middle ear disease, but this could be due to relatively smaller sample sizes with a wide age range. It is a two-way association in that bacteria found in the mouth can travel through the Eustachian tube and influence bacterial growth in the middle ear, and vice versa.

From a public health perspective, it would be important for health awareness promotions to inform families (with evidence) that their children's health is contingent on multiple interlinked factors. Finding a substantial association between oral and aural health could also benefit universal/national early-childhood screening endeavors (such as the B4 School Check in New Zealand), as governments could work towards streamlining services, identifying clinical problems, and administering treatment earlier to ensure optimal development.

The Dunedin study also has data for the same cohort (all aged the same) across a number of phases, which can provide information on whether the association (if any) changes from early childhood years to teenage years, and also in adulthood. Looking at this in the context of other variables (such as SES, smoking, and education levels) could give us insight into what mediating factors may be protective or risky to age-related dental decay and hearing deterioration. Thus far, there seems to be no literature available on longitudinal trajectories of oral and aural relationships.

References:

Broadbent, J.M., Thomson, W. M., Boyens, J.V. & Poulton, R. (2011). Dental plaque and oral health during the first 32 years of life. *Journal of the American Dental Association, 142*(4), 415-426.

Esra, E., Banu, O.I. & Erdinc, A. (2013). Poor oral hygiene and middle ear infections: Any relationship? *Indian Journal of Otolaryngology and Head & Neck Surgery, 65*(2), 173-176. DOI 10.1007/s12070-012-0616-4

Heikkinen, R. & Chonmaitree, T. (2003). Importance of respiratory viruses in acute otitis media. *Clinical Microbiology Reviews, 16*(2), 230-241. DOI: 10.1128/CMR.16.2.230–241.2003

Kashyap, N., Katlam, T., Avinash, A., Kumar, B., Kulshrestha, R. & Das, P. (2019). Middle ear infection in children and its association with dental caries. *Dental Medicine: Medicine and Pharmacy Reports, 92*(3), 271-276. DOI: 10.15386/cjmed-1043

Nelson, S., Nechvatal, N., Weber, J. & Canion, S. (2005). Dental caries and ear infections in preschool-aged children. *Oral Health and Preventative Dentistry, 3*(3), 165-171.

Topcuoglu, N., Keskin, F., Ciftci, S., Paltura, C., Kulekci, M., Ustek, D. & Kulekci, G. (2012). Relationship between oral anaerobic bacteria and otitis media with effusion. *International Journal of Medical Sciences, 9*(3), 256-261. DOI: 10.7150/ijms.4382