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Original Article

Longitudinal Associations Between Early-Life Dental Caries Trajectories and Midlife Mental Health Outcomes

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ABSTRACT

Dental and psychological health significantly contribute to overall wellness. Cavities in young children's teeth are tied to declines in physical and oral health, alongside faster aging by midlife, yet their impact on mental wellness remains uncertain. To assess if cavities in early childhood, dental decay in adolescence and adulthood, and long-term dental health trends correlate with psychological conditions in individuals in their forties, using evidence from two New Zealand cohort studies. Information on childhood cavities and adult mental health was gathered from the Dunedin Multidisciplinary Health and Development Study and the Christchurch Health and Development Study. Generalized Linear Models (GLMs) were applied to explore relationships between cavities at age 5 and mental health issues at ages 45 and 40 in the Dunedin and Christchurch cohorts, respectively. Further Dunedin Study analyses examined how patterns of decay in permanent teeth from ages 9 to 45 related to mental health at age 45. Adjustments included factors like gender, birth health conditions, childhood economic status, childhood intelligence, and adult temperament. No clear connection was found between early childhood cavities and mental health problems in midlife in either study group. In the Dunedin cohort, those with worsening dental decay trends in permanent teeth showed higher instances of psychological issues at age 45 compared to those with minimal decay. People with consistently poor dental health over time are more prone to mental health struggles in their forties. A lifelong trend of unfavorable dental conditions signals reduced psychological health in adulthood.

Keywords: Longitudinal research, Cavities, Psychological health, Public health, Dental epidemiology, Oral wellness

Introduction

Dental health issues and psychological disorders (defined as disruptions in cognition, behavior, or emotions that hinder social, familial, academic, or occupational functioning) [1] arise from a mix of biological, behavioral, and societal influences, making them highly dependent on one's living conditions. They share overlapping risk factors with each other and with other noncommunicable diseases (NCDs), such as low socioeconomic status (SES), tobacco use, excessive alcohol consumption, stress, and poor dietary habits [2, 3]. Factors like poverty, social disparities, and early life adversities (such as abuse or neglect) increase the likelihood of developing both oral health problems and mental health challenges [4].

The relationship between oral health issues—such as cavities, gum disease, and tooth erosion—and mental disorders operates bidirectionally. Individuals with psychological conditions face a greater risk of developing dental caries, tooth loss, and periodontal issues compared to those with stable mental health [5]. For instance,

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adults with depression tend to have more untreated cavities [6], missing teeth [7, 8], and are less likely to seek dental care [9] than their mentally healthy counterparts. This could stem from inadequate self-care, increased intake of sugary foods or drinks, co-occurring tobacco or alcohol use, side effects of certain medications [3], or obstacles to dental care access due to cost or anxiety [3, 8]. Conversely, poor oral health and its physical, emotional, and social consequences can erode self-worth, reduce confidence, and lead to social withdrawal or loneliness, potentially worsening or sustaining mental health issues [3]. These effects may be intensified by dental anxiety and diminished quality of life related to oral health [10].

A person's earliest years lay the groundwork for their future, as formative experiences shape lifelong health and development. Factors like economic struggles [11], childhood traumas (ACEs) [12], poor behavioral regulation [13], and diminished cognitive skills [14] are connected to unfavorable physical and mental health outcomes in adulthood. Ties between early dental decay and midlife health have been noted, covering both personal health perceptions and objective measures in adults. Cavities in young children's teeth have been associated with weakened oral health [15], self-assessed general well-being [16], and faster physical decline by midlife [17].

Though the link between dental health and psychological well-being has been widely studied among adults [3, 5, 18, 19], no research has yet followed this connection across a full life course. Poor dental condition in childhood could serve as a warning sign for later mental health difficulties. This work builds on earlier studies by investigating long-term relationships between tooth decay in both primary and permanent teeth and mental health outcomes in midlife.

The study's objectives are to: (1) explore whether early childhood cavities are associated with mental health issues by ages 40 to 45 years in two New Zealand (NZ) cohort studies; and (2) evaluate whether dental decay during adolescence and adulthood, alongside caries patterns from ages 9 - 45 years, relates to psychological challenges in midlife.

Materials and Methods

Research design and cohort description

This study utilizes data from two New Zealand longitudinal cohorts: the Dunedin Multidisciplinary Health and Development Study and the Christchurch Health and Development Study (denoted as the Dunedin and Christchurch studies, respectively). Both projects have amassed extensive information from diverse sources, covering areas like oral wellness, physical health, and psychological conditions.

The Dunedin Study tracks 1037 individuals (91% of eligible births; 52% male), born from April 1, 1972, to March 31, 1973, in Dunedin, New Zealand. This cohort mirrors the socioeconomic breadth of New Zealand's South Island, with most participants of European descent, alongside 7.5% identifying as Māori and 1.5% as Pacific individuals. Data collection started at birth, with the longitudinal study formalized at age 3 years. Follow-up evaluations occurred at ages 5, 7, 9, 11, 13, 15, 18, 21, 26, 32, 38, and most recently at age 45 years, involving 938 (94%) of the 997 surviving cohort members. Each stage secured ethical approval and participants' written consent.

The Christchurch Study encompasses 1265 individuals (97% of total births; 50.2% male), born between April 15 and August 5, 1977, in Christchurch, New Zealand. The group reflects the socioeconomic diversity of the South Island, with the majority of European heritage and approximately 13% identifying as Māori or Pacific people. Assessments were conducted at birth, at 4 months, yearly from ages 1 to 16, and subsequently at ages 18, 21, 25, 30, 35, and 40 years, with 904 (74%) of the 1222 surviving members participating at age 40. Each phase obtained ethical clearance and written consent from participants.

Caries in primary teeth and life-course patterns in permanent teeth

For the Dunedin cohort, dental decay at age 5 was recorded using standardized WHO protocols. In Christchurch, equivalent information for 5- to 6-year-old children came from routine School Dental Service records. Caries were quantified with the dmft index, and participants were grouped into three levels: no decay (dmft = 0), moderate decay (dmft = 1–4), or extensive decay (dmft ≥ 5). The specific procedures for oral examinations in both studies have been detailed in earlier reports [20, 21].

Within the Dunedin Study, additional caries evaluations were conducted at ages 9, 15, 18, 26, 32, 38, and 45. Dentists inspected teeth according to WHO methods, counting four surfaces on incisors and canines and five on premolars and molars. Data were summarized using dmf/DMF indices at both the tooth and surface levels.

Analysis of these repeated measures allowed the identification of trajectories of permanent tooth decay spanning ages 9 to 45 (n = 975) [15]. Six distinct trajectory patterns emerged: low caries rate, moderate caries maintained, moderate caries unmaintained, high caries with restorations, high caries with tooth loss, and high untreated caries. Full details are presented in **Table 1**.

Table 1. Trajectories of Permanent Tooth Decay in the Dunedin Cohort[a]

Trajectory group	% Membership[b] (n)	Summary description
Group 1: Low caries rate	43.9% (431)	Consistently low levels of untreated decay (DS), filled surfaces (FS), and teeth lost due to caries (MT).
Group 2: Moderate rate, maintained	24.6% (240)	Moderate caries levels, peaking near ages 26–32, with a steady rise in the number of filled surfaces.
Group 3: Moderate rate, unmaintained	20.0% (194)	Similar moderate pattern with peaks in the late 20s/early 30s, but showing fewer restorations and greater tooth loss compared with Group 2.
Group 4: High rate, restored	5.9% (57)	High overall caries burden accompanied by a sharp increase in restored surfaces.
Group 5: High rate, tooth loss	3.3% (31)	High decay rates followed by declining DS and FS from about age 32, while tooth loss from caries steadily rose.
Group 6: High rate, untreated	2.2% (22)	Very high decay experience, with DS continuing to rise and showing no clear peak even by age 45.

[a] Detailed descriptions in reference [15].
[b] Percent of participants assigned to each trajectory.

Assessment of mental disorders in mid-adulthood

In the Dunedin cohort, mental health evaluations were performed at multiple points starting at age 11, with the latest assessment at 45 years. Trained clinicians, unaware of prior participant data, conducted interviews using the Diagnostic Interview Schedule. Participants were asked about symptoms experienced in the previous year according to DSM criteria. Disorders were classified into three broad categories: internalizing disorders (major depression, generalized anxiety, social or specific/simple phobias, agoraphobia, panic disorder, and PTSD), externalizing disorders (ADHD, conduct disorder, and dependence on alcohol, tobacco, cannabis, or other drugs), and thought disorders (OCD, mania, schizophrenia). Composite variables were computed for "any internalizing disorder," "any externalizing disorder," "any thought disorder," and "any mental disorder at age 45." A separate measure, "lifetime mental disorder by age 45," incorporated all assessments conducted at ages 11, 13, 15, 18, 21, 26, 32, 38, and 45.

Mental health evaluation at age 40

At 40 years old, participants from the Christchurch cohort underwent an extensive psychiatric assessment covering symptoms experienced in the previous 12 months. Data were collected using the Composite International Diagnostic Interview (CIDI). To determine DSM-5 diagnoses, the study employed tailored survey items. Evaluated conditions included internalizing disorders such as generalized anxiety disorder, major depression, specific/simple phobia, social phobia, panic disorder, and agoraphobia; eating disorders including bulimia, PTSD; binge eating disorder and anorexia; and manic episodes. Externalizing disorders encompassed cannabis dependence, alcohol dependence, dependence on other drugs, and tobacco dependence. From these assessments, summary indicators were created for "any externalizing disorder," "any internalizing disorder," and "any mental disorder at age 40." A cumulative measure of lifetime mental disorders by age 40 combined diagnostic data from ages 15 to 16, 18, 21, 25, 30, 35, and 39–40.

Covariates

Selection of covariates was guided by prior research identifying psychosocial factors affecting general health and oral health. These included sex, perinatal complications, family socioeconomic status (SES) during childhood, childhood IQ, and adult personality traits. Adult personality was included due to its established relationship with psychological well-being and mental health outcomes in mid-adulthood. Family SES at birth was measured using

the Elley-Irving scale, which ranks New Zealand occupations from 1 (professional) to 6 (unskilled laborer). Perinatal complications were recorded shortly after birth and categorized as 0 (none) or 1+ (one or more complications). Childhood IQ was measured using the Wechsler Intelligence Scale for Children–Revised (WISC–R) and standardized to population norms (mean = 100, SD = 15).

Adult personality was assessed differently in each cohort. In Dunedin, the Multidimensional Personality Questionnaire (MPQ) provided scores for three superfactors: negative emotionality, positive emotionality, and constraint. In Christchurch, personality was measured with the Big-Five inventory, with neuroticism, extraversion, and conscientiousness mapped to approximate the MPQ superfactors. All scores were standardized into Z-scores (mean = 0, SD = 1).

Statistical analysis

Initial evaluations examined connections between mental health conditions and dental decay at ages 5 or 5–6 years, analyzed separately for each cohort. Generalized Linear Models (GLMs) were applied to explore links between tooth decay at age 5 or 6 years and psychological issues at ages 45 and 40 for the Dunedin and Christchurch groups, respectively. These models used a Poisson distribution with a log link and robust variance estimation to compute incidence rate ratios for mental health disorders based on "any decay experience" (dmft > 0 at age 5). Statistical analyses were performed with Stata/SE 17.0 (StataCorp LLC, College Station, TX, USA). Models adjusted for variables like gender, neonatal health, childhood economic background, early intellectual capacity, and adult personality characteristics, guided by a directed acyclic graph. Reporting followed STROBE guidelines.

For the Dunedin cohort, two analyses were conducted: first, we investigated whether participants in the top quartile of dmfs/DMFS scores at ages 5, 9, 15, 18, 26, 32, 38, and 45 years had elevated rates of psychological conditions at age 45 years compared to those in lower quartiles or with no caries; second, we assessed whether long-term patterns of permanent dentition decay from ages 9 to 45 years correlated with increased mental health issues at age 45 years. The "low decay rate" group served as the reference for these comparisons. All analyses controlled for gender, birth health conditions, childhood socioeconomic circumstances, cognitive ability in youth, and adult behavioral traits.

Findings

Within the Dunedin cohort, outcomes for midlife psychiatric health could be linked with early childhood dental records for 830 participants when considering internalizing disorders, and for 833 participants when examining externalizing or thought-related conditions. In the Christchurch cohort, comparable data at age 40 were available for 824 individuals for internalizing outcomes and 820 individuals for externalizing ones. When childhood caries at age 5 or 6 was combined with information on lifetime psychiatric history, usable data were present for 912 Dunedin participants and 970 Christchurch participants.

Reports of mental health difficulties in the year preceding assessment showed that 39.0% of Dunedin members at age 45, and 33.0% of Christchurch members at age 40, met criteria for at least one disorder. Looking across the life span, cumulative rates were very high: 85.5% of the Dunedin group had experienced a diagnosable disorder between ages 15 and 45, while 83.1% of the Christchurch group had done so between ages 14 and 40. Preliminary comparisons suggested no systematic association between caries in the primary dentition and the presence of midlife disorders in either sample **(Table 2)**.

Table 2. Distribution of mental disorders at midlife (age 45 in Dunedin, age 40 in Christchurch) by dental status at age 5/5–6 (dmft > 0).

Outcome[a]	**Dunedin Study**				**Christchurch Study**			
	IRR	95% CI	p	n	IRR	95% CI	p	n
Internalizing disorders[a] (any)	1.13	0.90–1.42	0.284	817	1.02	0.79–1.31	0.909	817
Externalizing disorders (any)	0.93	0.73–1.18	0.545	820	1.03	0.77–1.39	0.824	817
Thought disorders (any)	1.22	0.67–2.20	0.520	817	—	—	—	—
Generalized anxiety disorder	0.90	0.52–1.57	0.717	816	0.94	0.35–2.51	0.904	817
Any of six anxiety disorders	1.38	1.04–1.85	0.028	816	1.03	0.69–1.53	0.884	817

Major depression	0.75	0.55–1.03	0.075	817	1.06	0.73–1.55	0.746	817
Specific (simple) phobia	1.84	1.11–3.04	0.018	797	1.39	0.77–2.50	0.273	817
Social phobia	1.24	0.75–2.04	0.399	801	1.09	0.52–2.31	0.819	817
Alcohol dependence	1.04	0.71–1.52	0.839	817	1.00	0.55–1.80	0.987	817
Tobacco dependence	1.04	0.71–1.52	0.842	816	1.09	0.76–1.56	0.624	817
Conduct disorder	0.93	0.75–1.15	0.509	817	—	—	—	—
Any mental disorder (overall)	1.01	0.86–1.20	0.866	817	1.00	0.82–1.21	0.965	817
Lifetime prevalence[b]	1.03	0.98–1.08	0.305	875	0.99	0.93–1.05	0.639	817

CI = confidence interval; IRR = incidence rate ratio.

[a] Adjusted for sex, childhood cognitive ability, socioeconomic background, perinatal complications, and personality characteristics in adulthood. Reference = caries-free children (dmft = 0).

[b] Dunedin definition: any disorder diagnosed from 11 to 45 years; Christchurch definition: any disorder from 14 to 40 years.

After adjusting for covariates, participants in Dunedin with a history of dental caries at age 5 were more likely to present with any of six forms of anxiety, including simple phobia, at age 45. This finding, however, was not reproduced in Christchurch **(Table 3)**. Further stratification of dental severity (grouping by dmfs/DMFS scores of 1–4 or ≥5) did not indicate stable or consistent relationships with psychiatric outcomes (data not shown).

Table 3. Midlife mental disorders (ages 45 and 40) by childhood caries experience at 5/5–6 years in Dunedin and Christchurch.

Outcome[a]	**Dunedin Study**				**Christchurch Study**			
Internalizing disorder[a] (any)	1.13	0.90–1.42	0.284	817	1.02	0.79–1.31	0.909	817
Externalizing disorder (any)	0.93	0.73–1.18	0.545	820	1.03	0.77–1.39	0.824	817
Thought disorder (any)	1.22	0.67–2.20	0.520	817	—	—	—	—
Generalized anxiety	0.90	0.52–1.57	0.717	816	0.94	0.35–2.51	0.904	817
Six anxiety diagnoses (any)	1.38	1.04–1.85	0.028	816	1.03	0.69–1.53	0.884	817
Major depressive disorder	0.75	0.55–1.03	0.075	817	1.06	0.73–1.55	0.746	817
Specific/simple phobia	1.84	1.11–3.04	0.018	797	1.39	0.77–2.50	0.273	817
Social phobia	1.24	0.75–2.04	0.399	801	1.09	0.52–2.31	0.819	817
Alcohol use disorder	1.04	0.71–1.52	0.839	817	1.00	0.55–1.80	0.987	817
Nicotine dependence	1.04	0.71–1.52	0.842	816	1.09	0.76–1.56	0.624	817
Conduct disorder	0.93	0.75–1.15	0.509	817	—	—	—	—
Any psychiatric disorder	1.01	0.86–1.20	0.866	817	1.00	0.82–1.21	0.965	817
Lifetime prevalence[b]	1.03	0.98–1.08	0.305	875	0.99	0.93–1.05	0.639	817

Legend — CI = confidence interval; IRR = incidence rate ratio.

[a] Models controlled for sex, childhood IQ, childhood socioeconomic status, perinatal complications, and adult personality; reference category = no caries (dmft = 0).

[b] Lifetime case-window definitions: Dunedin = diagnoses between ages 11 and 45; Christchurch = diagnoses between ages 14 and 40.

In the Dunedin cohort, individuals falling into the upper 25% of DMFS at ages 26, 32, 38 or 45 accounted for a disproportionate share of tobacco-dependence cases identified at age 45. A related but distinct pattern was seen for externalizing psychopathology: membership of the top DMFS quartile at age 32 — and again for top-quartile status at ages 38 and 45 — was linked to a higher occurrence of externalizing diagnoses by age 45 **(Figure 1)**. Comparisons are made against participants in lower quartiles or those without caries.

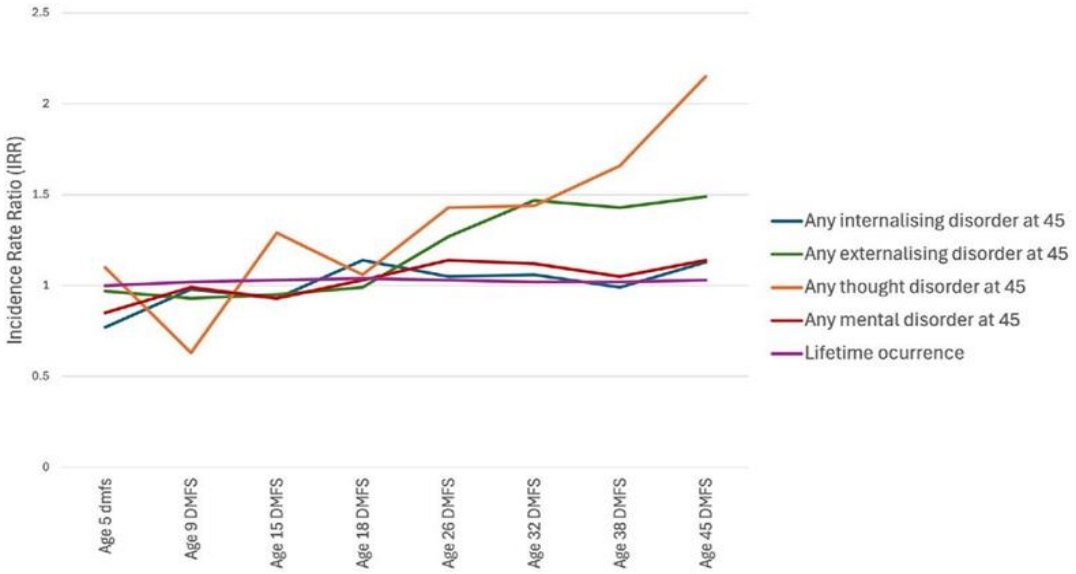

Figure 1. Relationship of top-quartile dmfs/DMFS scores measured from age 5 through 45 with psychiatric outcomes at age 45 in Dunedin participants.

Tracking permanent dentition decay between ages 9 and 45 revealed clear mental health links in the Dunedin cohort. Members of the "Moderate, unmaintained" group as well as those in the "High-rate" categories (including restored teeth, extractions, and untreated decay) showed greater odds of developing externalizing problems than individuals classified in the "Low-rate" trajectory **(Table 4)**. Within the high-rate profiles, those defined by tooth loss and untreated decay also displayed an increased likelihood of thought disorder by midlife. Participants following the "High-rate, tooth loss" pathway were further distinguished by higher chances of having any psychiatric condition by age 45 when compared with low-rate peers. Although the "Moderate, unmaintained" and other high-rate groups (restored or untreated) showed effects in the same direction, the magnitudes were smaller. In addition, participants placed in moderate-level or high untreated trajectories more often carried a lifetime history of one or more psychiatric diagnoses than those with persistently low caries rates.

Table 4. Permanent dentition decay patterns in relation to psychiatric diagnoses at age 45 in the Dunedin cohort, with controls for sex, socioeconomic background and IQ in childhood, perinatal factors, and adult personality traits.

Predictor	**Any internalizing disorder (n=893)**	**Any externalizing disorder (n=896)**	**Any thought disorder (n=893)**	**Any disorder (n=893)**	**Lifetime prevalence (n=944)**
	IRR (95% CI), p	IRR (95% CI), p	IRR (95% CI), p	IRR (95% CI), p	IRR (95% CI), p
Permanent dentition caries patterns					
Low-caries trajectory	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate, maintained	1.00 (0.76–1.30), 0.972	1.22 (0.87–1.70), 0.254	0.95 (0.41–2.17), 0.895	0.98 (0.79–1.21), 0.865	1.07 (1.01–1.14), 0.024
Moderate, unmaintained	0.98 (0.73–1.32), 0.895	1.89 (1.39–2.57), <0.001	1.80 (0.85–3.80), 0.126	1.04 (0.84–1.30), 0.719	1.09 (1.03–1.16), 0.005
High, restored	1.09 (0.70–1.70), 0.713	1.70 (1.05–2.75), 0.031	1.47 (0.43–4.97), 0.537	1.11 (0.79–1.56), 0.556	1.05 (0.93–1.17), 0.427
High, tooth loss	1.43 (1.00–2.03), 0.050	2.58 (1.69–3.93), <0.001	3.90 (1.43–10.61), 0.008	1.36 (1.02–1.80), 0.033	1.04 (0.95–1.13), 0.444

High, untreated	1.16 (0.64–2.12), 0.620	2.79 (1.78–4.36), <0.001	5.02 (1.75–14.40), 0.003	1.29 (0.89–1.88), 0.175	1.12 (1.04–1.21), 0.002
Sex					
Female	Ref.	Ref.	Ref.	Ref.	Ref.
Male	0.65 (0.51–0.81), <0.001	0.93 (0.73–1.19), 0.555	0.67 (0.37–1.21), 0.185	0.80 (0.67–0.95), 0.012	0.91 (0.86–0.96), 0.001
Childhood socioeconomic background					
High	Ref.	Ref.	Ref.	Ref.	Ref.
Medium	0.76 (0.56–1.04), 0.088	0.70 (0.51–0.97), 0.033	0.67 (0.31–1.44), 0.309	0.72 (0.57–0.91), 0.006	0.92 (0.86–0.99), 0.021
Low	0.79 (0.54–1.13), 0.199	0.79 (0.55–1.15), 0.226	0.43 (0.18–1.07), 0.069	0.72 (0.55–0.95), 0.021	0.97 (0.90–1.04), 0.376
Childhood IQ	0.99 (0.98–1.00), 0.018	1.00 (0.99–1.01), 0.461	0.99 (0.97–1.01), 0.359	0.99 (0.99–1.00), 0.006	1.00 (1.00–1.00), 0.206
Personality traits					
Negative emotionality	1.38 (1.25–1.53), <0.001	1.29 (1.16–1.43), <0.001	1.76 (1.38–2.25), <0.001	1.33 (1.23–1.44), <0.001	1.08 (1.05–1.10), <0.001
Positive emotionality	0.97 (0.88–1.07), 0.567	1.02 (0.91–1.13), 0.790	0.98 (0.76–1.27), 0.902	0.98 (0.91–1.06), 0.689	0.98 (0.96–1.01), 0.145
Constraint	0.99 (0.88–1.11), 0.832	0.79 (0.70–0.89), <0.001	0.96 (0.73–1.26), 0.765	0.90 (0.83–0.98), 0.018	0.96 (0.93–0.98), 0.001
Perinatal health complications					
None	Ref.	Ref.	Ref.	Ref.	Ref.
One or more	1.10 (0.89–1.35), 0.392	1.06 (0.85–1.33), 0.586	1.01 (0.59–1.72), 0.980	1.15 (0.98–1.34), 0.092	0.99 (0.94–1.04), 0.627

Abbreviations: CI = confidence interval; IRR = incidence rate ratio.

Results and Discussion

Drawing on two longitudinal birth cohorts tracked into middle adulthood, this investigation adds to the understanding of links between dental and mental health in four main respects. First, when examined as a single measure, caries in primary teeth at age 5 or 5–6 did not predict psychiatric outcomes later in life. Second, findings from the Dunedin cohort showed that individuals in the highest quartile of DMFS scores were more prone to externalizing disorders at age 45, particularly dependence on tobacco. Third, beginning in the early thirties, greater cumulative caries experience corresponded with elevated risks of externalizing conditions. Finally, analyses of permanent dentition decay patterns from ages 9 through 45 demonstrated that individuals with heavier caries burdens were more likely to exhibit mental health problems at age 45 as well as over their lifetime.

An examination of primary tooth decay at age 5 showed no predictive value for the presence of psychiatric disorders by ages 40 or 45. Earlier work with these two cohorts had linked early caries (at 5–6 years) to weaker self-rated health [16] and to biological markers of poor health and accelerated aging in midlife [17]. Building on that, we anticipated that dental decay in early childhood might also forecast later psychological problems. The evidence here did not support that assumption: a single assessment of caries at age 5 was unrelated to mental health outcomes in midlife.

At age 40 in Christchurch, 33% of participants met diagnostic criteria for at least one disorder; in Dunedin at 45 years, the rate was 39%. These figures suggest that possible connections between early dental decay and adult psychiatric health may only become visible as individuals move into later life stages, when both physical and mental functioning tend to deteriorate. Another explanation is that oral health indicators measured during adolescence or adulthood may be better predictors of psychological problems than childhood dental history.

Earlier reports from the Dunedin project showed that those with long-term positive mental health were not distinguishable from others on the basis of childhood socioeconomic background, cognitive test scores, or physical health [22]. What did separate them was having a protective personality profile combined with no family history of psychiatric illness, a rare combination. Other research points to the importance of adult experiences in shaping vulnerability to depression and anxiety [23]. Nevertheless, a smaller group of affected individuals can trace their difficulties to early-life risk factors such as parental psychiatric illness, adverse experiences in childhood, behavioral problems, or particular personality dispositions [24].

Dunedin Study findings indicated that individuals with the heaviest caries burden (those in the top quartile of DMFS) by age 45 were more likely to show externalizing and thought disorders as well as tobacco dependence at the same age, pointing toward overlapping oral and psychological health challenges in adulthood. Comparable associations have been observed in prior cross-sectional research, although most of that work has focused on older adults (50+) and emphasized links with depressive symptoms [25–27]. A more recent umbrella review expanded this evidence, highlighting relationships between caries experience and serious psychiatric illness or substance misuse [5]. In general, adults suffering from depression, anxiety, eating disorders, or addictions tend to present higher rates of tooth decay or edentulousness than those without psychiatric diagnoses. Using longitudinal data beginning in the early 30s, the present analysis further showed that participants with greater caries accumulation were disproportionately affected by externalizing disorders by age 45.

Sustained poor oral health, particularly in those following the least favorable caries pathways—labeled "high-rate, tooth loss" and "high-rate, untreated caries"—was also linked to greater odds of developing externalizing or thought disorders at midlife. In other words, participants who carried the heaviest lifetime oral disease burden, either through tooth loss or large amounts of unmet treatment need, displayed worse psychological outcomes entering their fifth decade. Evidence from Japanese [28], English [29], Chinese [30], and American [31] cohorts has also tied tooth loss, complete edentulism, and denture reliance to depressive symptoms in older populations. However, those studies primarily targeted internalizing conditions and did not rely on life course data on caries trajectories.

It is increasingly recognized that oral diseases, psychiatric conditions, and other chronic NCDs often share overlapping determinants: lower socioeconomic status, alcohol consumption, smoking, psychosocial stress, poor nutrition, and physical inactivity. Individuals whose dental health remains poor across their lives typically experience multiple psychiatric disorders as well. These longitudinal associations suggest common etiological pathways, where intertwined behavioral, social, and psychological mechanisms operate in both directions. People assigned to the worst oral health trajectories likely also faced broader social disadvantages, reinforcing the case for tailoring healthcare systems to respond to populations with both dental and psychiatric needs.

Clinicians should also recognize the challenge of dental anxiety or phobia, as patients with such conditions frequently have more decayed or missing teeth, poorer oral-health–related quality of life (OHR-QoL) [32], and often avoid dental services [33]. This underscores the importance of preventive investment in dental health from childhood onwards, as oral health directly shapes not only quality of life, but also psychological well-being over time. We propose that the observed associations arise largely from shared social and commercial determinants—the "causes of the causes"—that influence both oral disease and mental disorders through interacting behavioral and psychosocial processes. For policy, it is crucial that global oral health strategies acknowledge these structural drivers of chronic conditions. One example is the integration of sugar reduction policies within the World Health Organization's framework for NCDs [34].

Strengths and limitations

This research has several notable advantages. First, it draws upon two large, population-based birth cohorts with strong follow-up into midlife and minimal attrition. Second, oral health was assessed through standardized indices (dmfs/DMFS), ensuring comparability. Third, information on psychiatric outcomes was obtained from community-based participants, not restricted to treatment-seeking individuals. Fourth, analyses incorporated a wide set of covariates recognized as crucial for both general health and psychosocial outcomes. Fifth, personality characteristics were included as a control variable, given their known influence on health trajectories, survival, and midlife outcomes [35].

There are also some limitations. Although both samples were designed to be representative, participants were predominantly of European descent, mirroring the demographic profile of New Zealand's South Island during the recruitment period. Furthermore, being an observational design, causal inferences cannot be claimed, and

unmeasured or residual confounding cannot be excluded. Finally, detailed caries trajectory analyses were possible only in the Dunedin study, due to the greater availability of longitudinal dental records.

Conclusion

Findings indicate that caries in the primary dentition at age 5/6 was not predictive of midlife psychiatric disorders. However, from the mid-20s onwards, individuals with greater caries experience demonstrated an increased likelihood of externalizing disorders and tobacco dependence by age 45. Moreover, when examined across the life span, cumulative oral disease trajectories in permanent dentition revealed that those with persistently poor dental health also had a higher prevalence of mental health problems in mid-adulthood.
These results underscore the importance of public health initiatives targeting the structural and social determinants underlying both oral and mental conditions during childhood, adolescence, and adulthood. A continuous history of dental disease appears to signal elevated risk for poorer psychological well-being later in life, highlighting the need for integrated preventive strategies.

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References

1. Wertz J, Caspi A, Ambler A, Broadbent J, Hancox RJ, Harrington H, et al. Association of history of psychopathology with accelerated aging at midlife. JAMA psychiatry. 2021;78(5):530-9.
2. World Health Organization. World mental health report: transforming mental health for all. Geneva: World Health Organization; 2022.
3. Joury E, Kisely S, Watt RG, Ahmed N, Morris AJ, Fortune F, et al. Mental disorders and oral diseases: future research directions. J Dent Res. 2023;102(1):5-12.
4. World Health Organization. Mental health action plan 2013–2020. Geneva: World Health Organization; 2013.
5. Choi J, Price J, Ryder S, Siskind D, Solmi M, Kisely S. Prevalence of dental disorders among people with mental illness: an umbrella review. Aust N Z J Psychiatry. 2022;56(8):949-63.
6. Delgado-Angulo EK, Sabbah W, Suominen AL, Vehkalahti MM, Knuuttila M, Partonen T, et al. The association of depression and anxiety with dental caries and periodontal disease among Finnish adults. Community Dent Oral Epidemiol. 2015;43(6):540-9.
7. Arora G, Humphris G, Lahti S, Richards D, Freeman R. Depression, drugs and dental anxiety in prisons: a mediation model explaining dental decay experience. Community Dent Oral Epidemiol. 2020;48(3):248–55.
8. Kisely S, Najman JM. A study of the association between psychiatric symptoms and oral health outcomes in a population-based birth cohort at 30-year-old follow-up. J Psychosom Res. 2022;157:110784.
9. Okoro CA, Strine TW, Eke PI, Dhingra SS, Balluz LS. The association between depression and anxiety and use of oral health services and tooth loss. Community Dent Oral Epidemiol. 2012;40(2):134–44.
10. Lopes AG, Ju X, Jamieson L, Mialhe FL. Oral health related quality of life among Brazilian adults with mental disorders. Eur J Oral Sci. 2021;129(3):e12774.
11. Poulton R, Caspi A, Milne BJ, Thomson WM, Taylor A, Sears MR, et al. Association between children's experience of socioeconomic disadvantage and adult health: a life-course study. Lancet. 2002;360(9346):1640-5.
12. Anda RF, Felitti VJ, Bremner JD, Walker JD, Whitfield CH, Perry BD, et al. The enduring effects of abuse and related adverse experiences in childhood: a convergence of evidence from neurobiology and epidemiology. Eur Arch Psychiatry Clin Neurosci. 2006;256(3):174–86.

13. Moffitt TE, Arseneault L, Belsky D, Dickson N, Hancox RJ, Harrington H, et al. A gradient of childhood self-control predicts health, wealth, and public safety. Proceedings of the national Academy of Sciences. 2011;108(7):2693-8.
14. Thomson WM, Broadbent JM, Caspi A, Poulton R, Moffitt TE. Childhood IQ predicts age-38 oral disease experience and service-use. Community Dent Oral Epidemiol. 2019;47(3):252–8.
15. Ruiz B, Broadbent JM, Thomson WM, Ramrakha S, Hong CL, Poulton R. Differential unmet needs and experience of restorative dental care in trajectories of dental caries experience: a birth cohort study. Caries Res. 2023;57(4):524–35.
16. Ruiz B, Broadbent JM, Murray Thomson W, Ramrakha S, Boden J, Horwood J, et al. Is childhood oral health the 'canary in the coal mine'for poor adult general health? Findings from two New Zealand birth cohort studies. Community Dent Oral Epidemiol. 2023;51(5):838-46.
17. Ruiz B, Broadbent JM, Thomson WM, Ramrakha S, Moffitt TE, Caspi A, et al. Childhood caries is associated with poor health and a faster pace of aging by midlife. J Public Health Dent. 2023;83(4):381-8.
18. Kisely S, Sawyer E, Siskind D, Lalloo R. The oral health of people with anxiety and depressive disorders—a systematic review and meta-analysis. J Affect Disord. 2016;200:119–32.
19. Cademartori MG, Gastal MT, Nascimento GG, Demarco FF, Corrêa MB. Is depression associated with oral health outcomes in adults and elders? A systematic review and meta-analysis. Clin Oral Investig. 2018;22(8):2685–702.
20. Evans RW, Beck DJ, Brown RH. Dental health of 5-year-old children: a report from the Dunedin multidisciplinary child development study. N Z Dent J. 1980;76(346):179–86.
21. Fergusson D, Horwood J. Relationships between exposure to additional fluoride, social background and dental health in 7-year-old children. Community Dent Oral Epidemiol. 1986;14(1):48–52.
22. Schaefer JD, Caspi A, Belsky DW, Harrington H, Houts R, Horwood LJ, et al. Enduring mental health: Prevalence and prediction. J Abnorm Psychol. 2017;126(2):212.
23. Melchior M, Moffitt TE, Milne BJ, Poulton R, Caspi A. Why do children from socioeconomically disadvantaged families suffer from poor health when they reach adulthood? A life-course study. Am J Epidemiol. 2007;166(8):966–74.
24. Moffitt TE, Caspi A, Harrington H, Milne BJ, Melchior M, Goldberg D, et al. Generalized anxiety disorder and depression: childhood risk factors in a birth cohort followed to age 32. Psychological medicine. 2007;37(3):441-52.
25. Anttila SS, Knuuttila MLE, Sakki TK. Relationship of depressive symptoms to edentulousness, dental health, and dental health behavior. Acta Odontol Scand. 2001;59(6):406–12.
26. Coles E, Chan K, Collins J, Humphris GM, Richards D, Williams B, et al. Decayed and missing teeth and oral-health-related factors: predicting depression in homeless people. J Psychosom Res. 2011;71(2):108-12.
27. Tyrovolas S, Koyanagi A, Panagiotakos DB, Haro JM, Kassebaum NJ, Chrepa V, et al. Population prevalence of edentulism and its association with depression and self-rated health. Sci Rep. 2016;6(1):37083.
28. Yamamoto T, Aida J, Kondo K, Fuchida S, Tani Y, Saito M, et al. Oral health and incident depressive symptoms: JAGES project longitudinal study in older Japanese. J Am Geriatr Soc. 2017;65(5):1079-84.
29. Rouxel P, Tsakos G, Chandola T, Watt RG. Oral health—a neglected aspect of subjective well-being in later life. J Gerontol B Psychol Sci Soc Sci. 2018;73(3):382–6.
30. Zhang X, Hu X, Zhang Y, Sun J, Chen G. Longitudinal association between oral status and depressive symptoms among Chinese older adults—China, 2014–2018. China CDC Wkly. 2021;3(40):842–6.
31. Matsuyama Y, Jürges H, Dewey M, Listl S. Causal effect of tooth loss on depression: evidence from a population-wide natural experiment in the USA. Epidemiol Psychiatr Sci. 2021;30:e38.
32. Israel S, Moffitt TE, Belsky DW, Hancox RJ, Poulton R, Roberts B, et al. Translating personality psychology to help personalize preventive medicine for young adult patients. J Pers Soc Psychol. 2014;106(3):484.
33. Sukumaran I, Taylor S, Thomson WM. The prevalence and impact of dental anxiety among adult New Zealanders. Int Dent J. 2021;71(2):122–6.
34. Benzian H, Daar A, Naidoo S. Redefining the non-communicable disease framework to a 6×6 approach: incorporating oral diseases and sugars. Lancet Public Health. 2023;8(11):e899–904.
35. Crocombe LA, Broadbent JM, Thomson WM, Brennan DS, Slade GD, Poulton R. Dental visiting trajectory patterns and their antecedents. J Public Health Dent. 2011;71(1):23–31.