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Ngā Tuhinga o te Hauora me te Taiao

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Environmental Health Intelligence New Zealand
Rapu Mātauranga Hauora mo te Taiao – Aotearoa

Missing data impedes the surveillance of child oral health

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Data reported by the Community Oral Health Services (COHS) appears to show that there is a narrowing gap in the oral health status of 5-year-olds between fluoridated and non-fluoridated areas of New Zealand. As water fluoridation has been shown to provide a robust and consistent benefit to oral health, we investigated the composition of the COHS dataset to determine the potential cause. We found that the coverage of the COHS has decreased in many parts of New Zealand, particularly in the Auckland region, where only about 51% of 5-year-olds were seen by COHS-affiliated practitioners in 2019, compared to 77% in 2010. This is a critical point, as the Auckland region accounts for over half of all 5-year-olds in fluoridated areas across New Zealand, but an insignificant number of the non-fluoridated population.

An apparent decline in indicators of oral health (prevalence of dental caries and decayed, missing, or filled teeth) over time confined to the Auckland region has resulted in a dampening effect on the reported oral health of the fluoridated group– but not that of non-fluoridated children across New Zealand. We separated the three DHBs that make up the Auckland region from the rest of the dataset to demonstrate this. Doing so made it clear that the oral health of children living in fluoridated areas outside the Auckland region has been steadily improving and has been consistently better than those in non-fluoridated areas. These results suggest that Community Oral Health Service statistics are not complete, or there is unequal access to the services in the Auckland region. Therefore, because of the influence of the Auckland data on the national picture, the national statistics from the COHS do not accurately portray the oral health status of fluoridated and non-fluoridated areas in New Zealand and cannot be used in decision-making or policy development.

Introduction

In New Zealand, children are entitled to free basic oral health services until their 18th birthday. The New Zealand Community Oral Health Service (COHS) provides annual dental examinations and follow up support for children from birth.

Data from the COHS is published annually for 5-year-olds and children in Year 8 (12–13 years of age). These statistics provide a summary of the key measures of:

(i) prevalence of children enrolled in the scheme who are caries-free
(ii) mean number of decayed, missing or filled teeth (dmft in baby teeth, DMFT in adult teeth).

Water fluoridation can provide a major level of protection against tooth decay, particularly for children (Royal Society of New Zealand 2014, Schluter et al. 2020). As part of our surveillance of water quality indicators linked to human health, EHINZ publishes a factsheet with oral health statistics reported by fluoridation status. Recently, we observed unusual trends in these published data when comparing children in fluoridated and non-fluoridated areas, particularly 5-year-olds.

We have investigated the potential causes, including changes in coverage of the COHS over time (particularly in the Auckland region).

Data

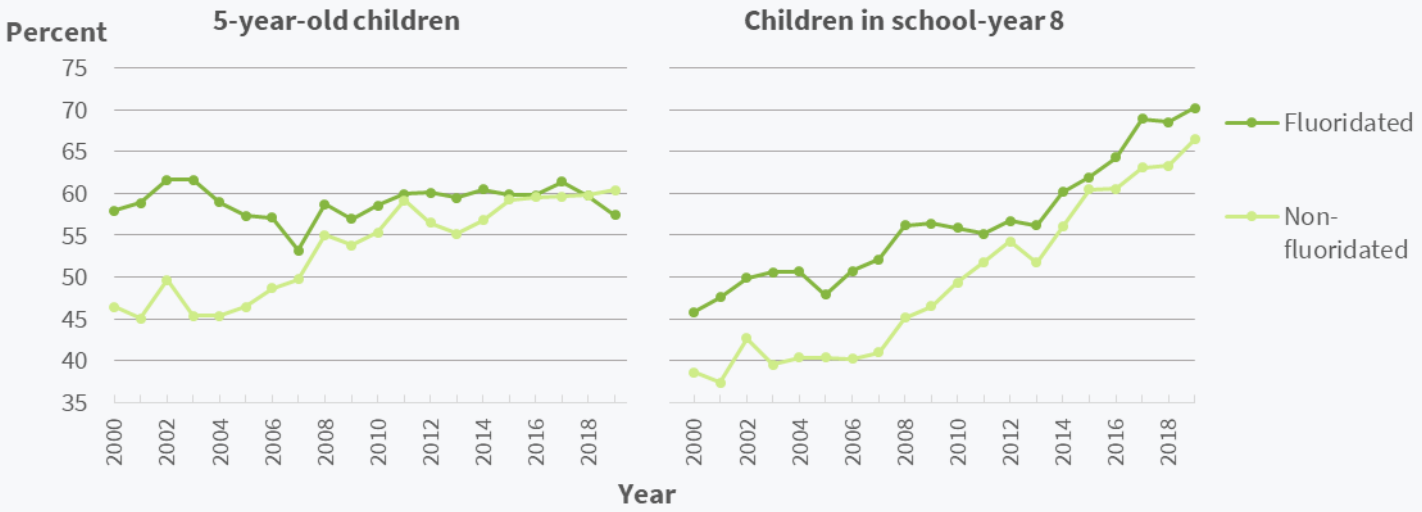
The data used analysed in this report are from the Community Oral Health dataset. Where fluoridated and non-fluoridated populations are compared, readers should be aware that these portray only a crude indication of the levels of oral health among the two groups. Further complicating factors involving the composition of the sample population and the provision of oral care services may influence the visible trends. Therefore, the analysis presented should not be interpreted as evidence for or against the effectiveness of water fluoridation. This investigation intends to illustrate how linking data collection to service delivery may influence the accuracy of analyses that rely on the service-level information.

A narrowing gap between fluoridated and non-fluoridated groups

Between 2000 and 2019, the percentage of 5-year-old children and those in school-year 8 who were caries-free (i.e. had no past or current dental decay experience) increased in both the fluoridated and non-fluoridated groups (Figure 1).

However, the gap between the fluoridated and non-fluoridated groups narrowed, particularly among 5-year-olds. The percentage of caries-free 5-year-olds from fluoridated areas has remained relatively static since 2010. The same measure for children in non-fluoridated areas has improved steadily, closing the gap from more than 10% in favour of the fluoridated group to 1% difference or less.

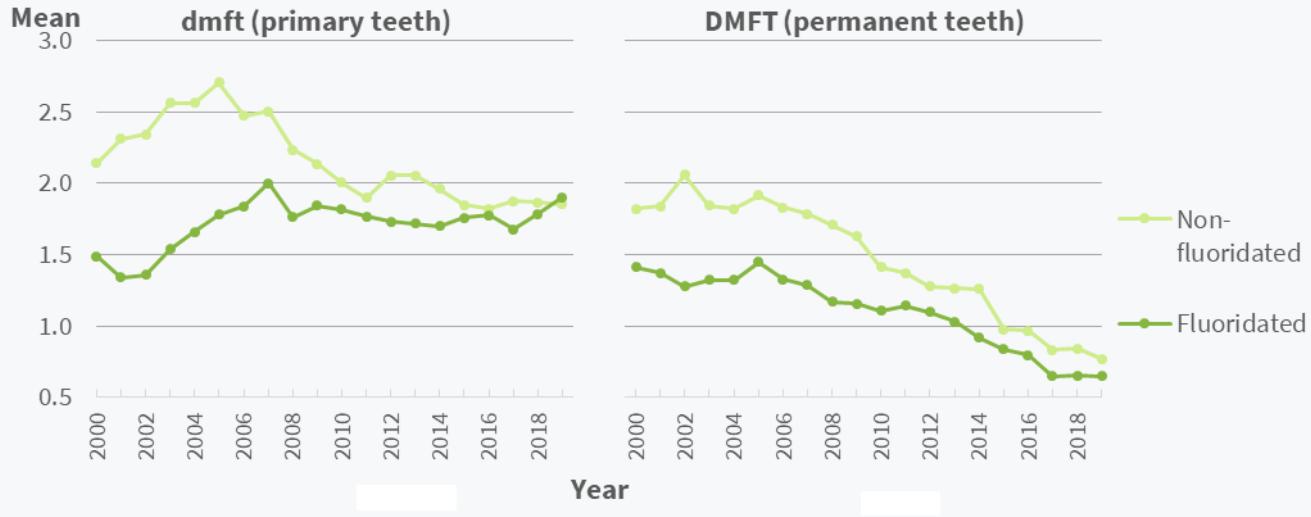
Figure 1: Percent of 5-year-old children and children in school-year 8 seen by Community Oral Health Services who were caries-free, by fluoridation status, 2000–19



Source: Ministry of Health 2020

Over time, a similar trend is evident in mean decayed missing or filled teeth (dmft/DMFT) (Figure 2). Children in fluoridated areas initially had better oral health status, but the difference between the fluoridated and non-fluoridated groups has narrowed. A lack of improvement among 5-year-olds from fluoridated areas from around 2008 onward is also visible.

Figure 2: Mean dmft (5-year-old children) and DMFT (children in school-year 8) among children examined by Community Oral Health Services, by fluoridation status



Source: Ministry of Health 2020

Figures 1 and 2 suggest that between 2000 and 2019, the gap in caries-free levels and mean dmft/DMFT between fluoridated and non-fluoridated areas has decreased, particularly among 5-year-olds. The narrowing gap would seem to contradict the scientific evidence that access to fluoridated water should provide a noticeable improvement benefit to oral health.

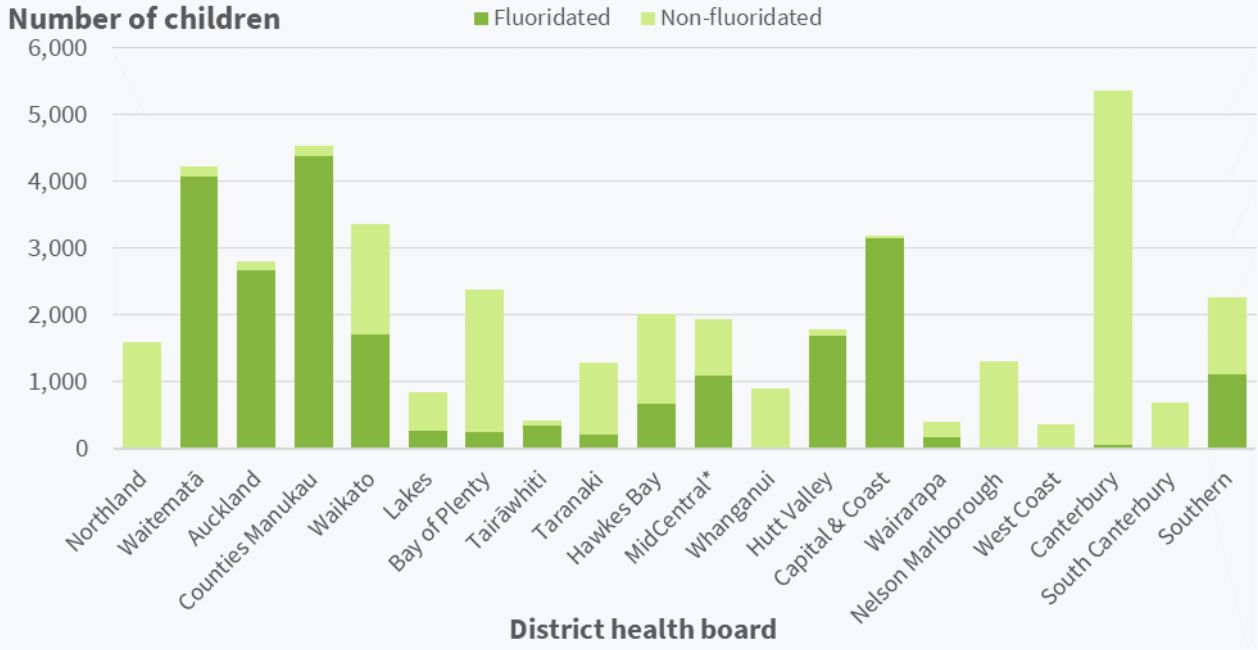
As this was contrary to expectation, further investigation of the data showed that the 'fluoridated' group is mainly children from the Auckland region.

The fluoridated and non-fluoridated groups are not evenly distributed

When interpreting the above statistics, it is helpful to understand which regions are fluoridated and non-fluoridated. The main fluoridated regions in New Zealand in 2019 were Auckland and Wellington (Figure 3). In 2019, Waitematā, Auckland, and Counties Manukau DHBs alone contributed about 54% of the fluoridated group of 5-year-olds (11,134 out of 20,693 children).

This suggests that the Auckland region DHBs would strongly influence the national-level statistics that compare fluoridated and non-fluoridated areas.

Figure 3: Number of 5-year-old children seen by Community Oral Health Services, by DHB and fluoridation status, 2019

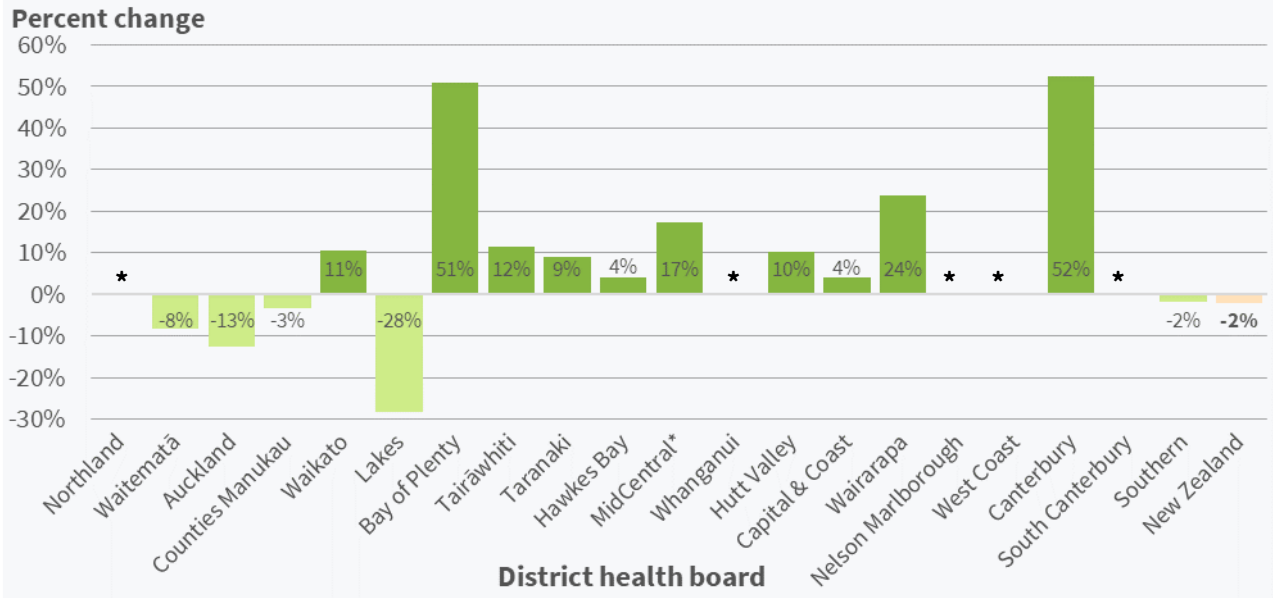


Note: MidCentral DHB's figures are for the change to 2018 due to problems with data collection in 2019.
Source: Ministry of Health 2020

The percentage of caries-free children decreased in only a few DHBs

Between 2010–2019, the proportion of caries-free 5-year-olds in fluoridated areas declined in only four DHBs: Waitematā, Auckland, Counties Manukau and Lakes (Figure 4). Despite most DHBs showing improvements, the national trend for fluoridated areas was a minor decrease in the caries-free percentage

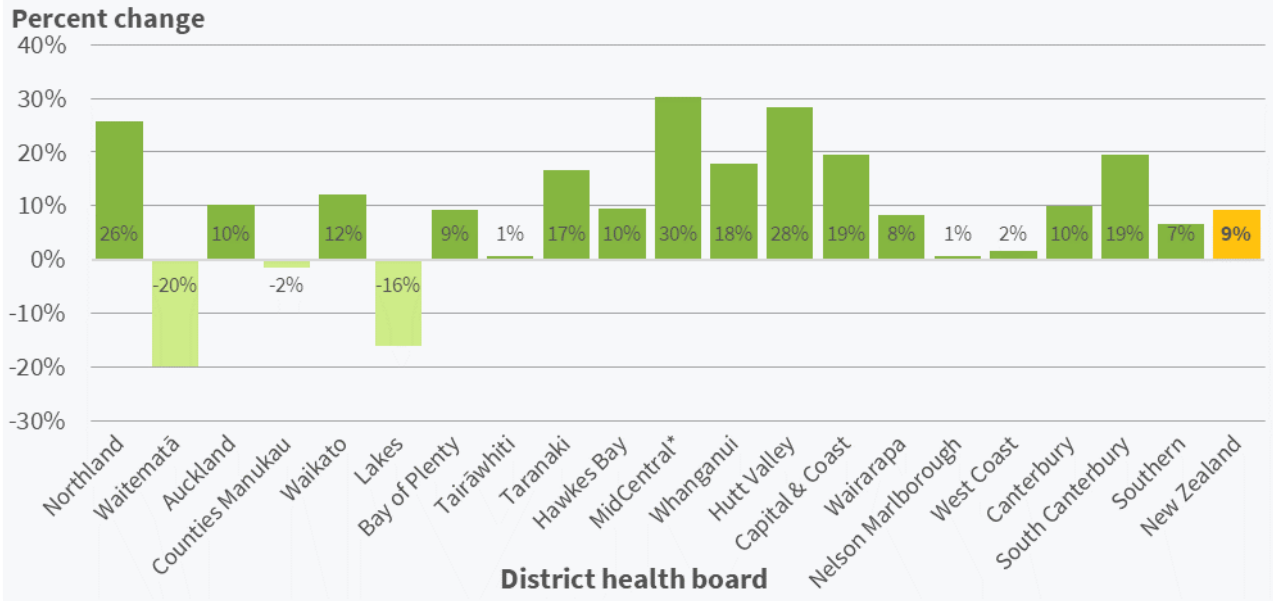
Figure 4: Change in caries-free percentages in 5-year-olds from the 'fluoridated' group between 2010 and 2019, by DHB



Note: MidCentral DHB's figures are for the change to 2018 due to problems with data collection in 2019. DHBs marked with a * have no children with access to fluoridated water.
Source: Ministry of Health 2020

There was a similar pattern for the 'non-fluoridated' group (Figure 5). Three of those four DHBs (Waitematā, Counties Manukau and Lakes) were again the only ones to exhibit a decline in oral health, but this time there was an improving national trend.

Figure 5: Change in caries-free percentages in 5-year-olds from the 'non-fluoridated' group between 2010 and 2019, by DHB



Note: MidCentral DHB's figures are for the change to 2018 due to problems with data collection in 2019.
Source: Ministry of Health 2020

This analysis indicates that coverage of the Community Oral Health Services appears to have decreased, particularly in Auckland

Access to the Community Oral Health Service was investigated as an underlying factor in these patterns. Table 1 shows a substantial decrease in the Community Oral Health Services coverage from 2010 to 2019, particularly in the Auckland region.

In 2019, an estimated 63% of 5-year-olds (39,658 children) were seen by Community Oral Health Services, down from 77% (44,752 children) in 2010 (Table 1). The reduction in coverage was greater in the Auckland region DHBs, with coverage as low as 51–52% in 2019. Only 11 DHBs had coverage rates of at least 70% in 2019. In all, 10 out of 20 DHBs saw a smaller percentage of their resident 5-year-olds in 2019 than were seen in 2010. This, combined with the growth in population over the 2010s, has led to the shrinking in the coverage of the COHS in these DHBs.

Table 1: Changes in estimated population, number of children seen by Community Oral Health Services, and estimated coverage of Community Oral Health Services, for 5-year-olds, between 2010 and 2019

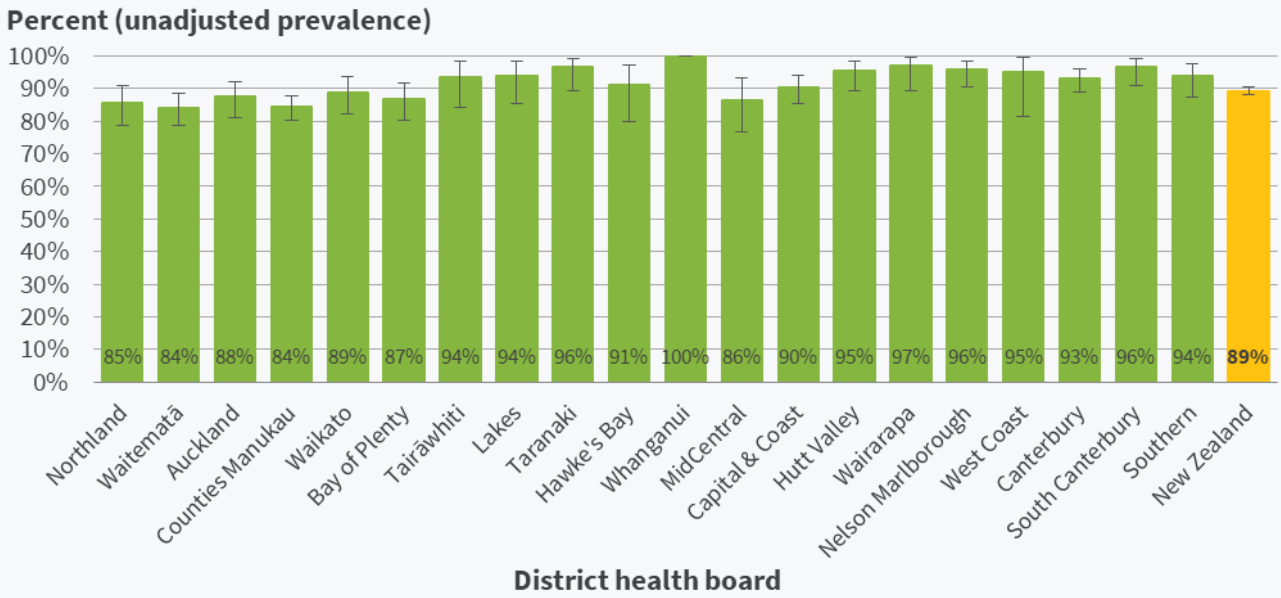
DHB	2010			2019			Percentage change from 2010 to 2019		
	Estimated population	*Children seen*	*Coverage*	*Estimated population*	*Children seen*	*Coverage*	*Population change*	*Change in number seen*	*Coverage change*
New Zealand	**58,080**	**44,752**	**77%**	**63,390**	**39,658**	**63%**	**9%**	**-11%**	**-19%**
Northland	2,270	1,124	50%	2,520	1,584	63%	11%	41%	**27%**
Waitematā	6,970	5,672	81%	8,370	4,227	51%	20%	-25%	**-38%**
Auckland	5,430	4,059	75%	5,390	2,805	52%	-1%	-31%	**-30%**
Counties Manukau	7,540	5,576	74%	8,750	4,541	52%	16%	-19%	**-30%**
Waikato	5,270	3,863	73%	5,820	3,354	58%	10%	-13%	**-21%**
Lakes	1,580	1,153	73%	1,570	847	54%	-1%	-27%	**-26%**
Bay of Plenty	2,900	1,967	68%	3,300	2,383	72%	14%	21%	**6%**
Tairāwhiti	770	614	80%	740	420	57%	-4%	-32%	**-29%**
Taranaki	1,500	1,442	96%	1,720	1,277	74%	15%	-11%	**-23%**
Hawkes Bay	2,190	1,554	71%	2,430	2,009	83%	11%	29%	**17%**
MidCentral*	2,180	1,702	78%	2,390	2380	100%	10%	40%	**28%**
Whanganui**	820	861	*105%*	860	887	*103%*	5%	3%	***Nil***
Hutt Valley	1,940	1,644	85%	2,020	1,774	88%	4%	8%	**4%**
Capital & Coast	3,540	2,994	85%	3,650	3,189	87%	3%	7%	**3%**
Wairarapa	540	461	85%	570	386	68%	6%	-16%	**-21%**
Nelson Marlborough	1,690	1,060	63%	1,750	1,302	74%	4%	23%	**19%**
West Coast	380	590	*155%*	370	357	96%	-3%	-39%	***Nil***
Canterbury	6,220	5,028	81%	6,560	5,357	82%	5%	7%	**1%**
South Canterbury	650	564	87%	740	692	94%	14%	23%	**8%**
Southern	3,700	2,824	76%	3,880	2,267	58%	5%	-20%	**-23%**

Notes:
* MidCentral DHB's figures are for the change to 2018 due to problems with data collection in 2019.
** The number of children seen in Whanganui DHB in 2010 and 2019, and West Coast DHB in 2010 exceeded the population estimates for those years. No adjustments to the population estimate or number seen have been made to account for this. As the figures suggest that close to maximum coverage was likely to have been achieved in both years, cases where the calculated coverage exceeds 100% are treated as if the DHB achieved full (i.e. 100%) coverage in that year.
Source: Ministry of Health 2020, Statistics New Zealand (2022)

New Zealand Health Survey data show a different pattern of coverage

While the data from Community Oral Health Services reports that dental workers saw only 63% of the country's 5-year-olds, data from the New Zealand Health Survey presents a different picture. In 2017–20, an estimated 89.3% of 5–9-year-olds reported having visited a dental health care worker in the previous 12 months, according to the New Zealand Health Survey. At the DHB level, the figure exceeded 80% in all cases (Figure 6).

Figure 6: Percent of 5–9-year-old children who saw a dental care worker in the previous 12 months, 2017–20



Source: New Zealand Health Survey 2017-20 (Ministry of Health 2022)

It should be noted that the NZHS data cover a larger age group (5–9 years) than the Community Oral Health Services (5-year-olds). Additionally, the NZHS relies on parental/caregiver recall of whether their child had seen an oral health care worker in the previous 12 months, for any reason, not exclusively for an examination. Nonetheless, there remains a large discrepancy between the NZHS and the Community Oral Health Services data, particularly for the Auckland region.

The discrepancy in coverage can be explained by the NZHS statistics not being limited to only COHS-affiliated practitioners. Instead, it reports the percentage of children who accessed either public or private care and includes all types of dental care workers, even those that might not conduct checks for tooth decay, e.g. orthodontic specialists.

However, the question of public versus private care highlights a drawback of the COHS dataset. If a child does not interact with the public dental care system - whether by necessity caused by overloaded practices or simply by the preference of their caregiver – then information about their oral health status is never captured in a way that is available to researchers or policy makers.

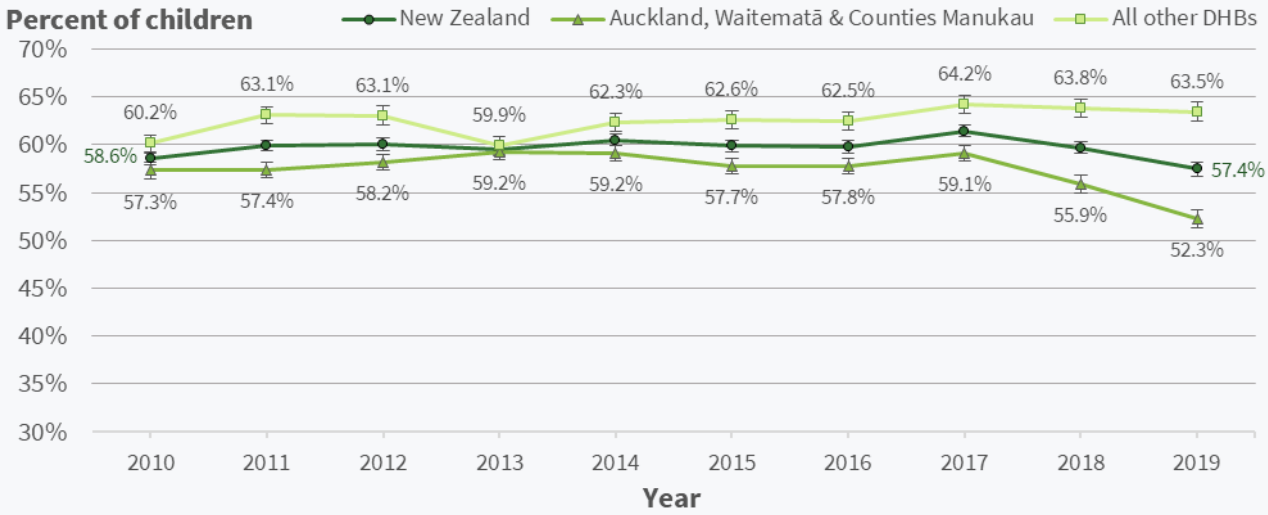
The national fluoridated/non-fluoridated trends are determined by the Auckland region

To show the large impact of the Auckland region on the fluoridated data, Figures 7 and 8 present the changes in caries-free percentage among 5-year-olds, with separate trendlines for:

- all children seen by oral health services nationwide
- children from the Auckland region (Waitematā, Auckland and Counties Manukau DHBs)
- children from all other DHBs (i.e. excluding the three Auckland DHBs listed above).

For children from fluoridated areas (Figure 7), removing the Auckland region DHBs produces a significant[1] improvement in caries-free percentages, and changes the trend from 2010 to 2019 from a decrease in caries-free percentage to an increase. The Auckland region DHBs show a decline of 5 percentage points between 2010–19, due to a sharp drop from 2017 onwards.

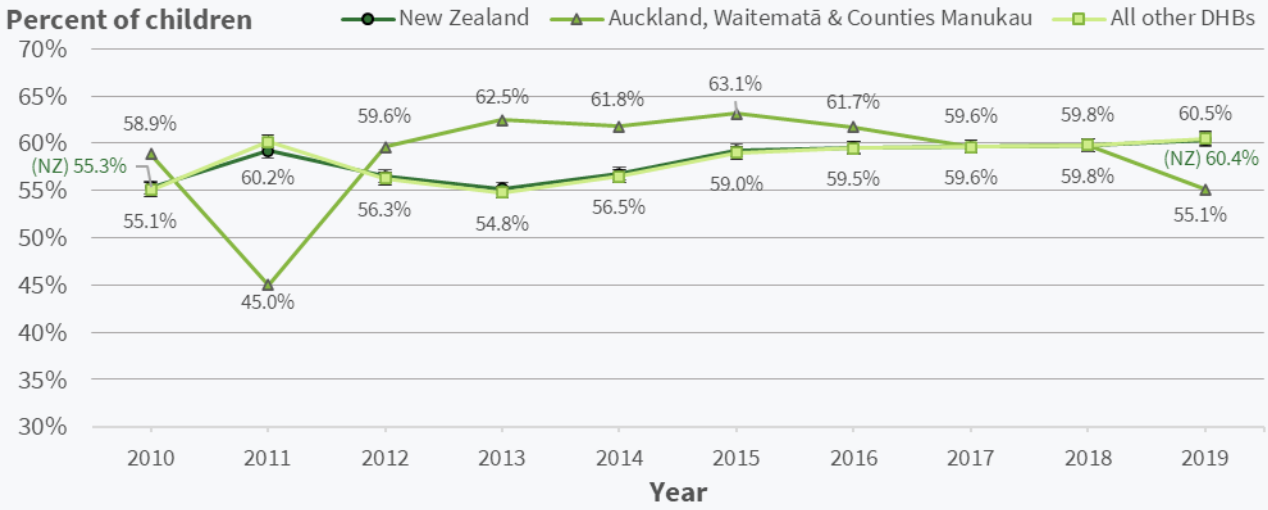
Figure 7: Percent of 5-year-old children from fluoridated areas who are caries-free, by groups of DHBs



Source: Ministry of Health 2020

The same approach applied to children from non-fluoridated areas (Figure 8) showed that removing the Auckland-region DHBs did not produce any significant difference between the national and 'All other DHBs' trendlines. This is because the three Auckland-region DHBs provide such a small element of the non-fluoridated group (439 out of 18,965 five-year-olds seen in 2019). The minimal impact of the Auckland region meant the non-fluoridated group retained its positive trend, contributing to the narrowed gap between the fluoridated and non-fluoridated groups.

Figure 8: Percent of 5-year-old children from non-fluoridated areas who are caries-free, by groups of DHBs



Source: Ministry of Health 2020

This analysis shows that, outside of the Auckland region, children in fluoridated areas still had a higher prevalence of being caries-free (63.5%) than children in non-fluoridated areas (60.5%) in 2019. In the Auckland region, the trend is unclear, due to the substantial decrease in coverage of Community Oral Health Services for 5-year-olds from 2010 to 2019.

[1] Based on non-overlapping 95% confidence intervals, calculated based on the methodology outlined in APHO (2008)

Discussion

The national-level Community Oral Health statistics are not a reliable surveillance tool for comparing the effect of fluoridation status on oral health of children

Surveillance data should ideally reflect the total population, to reduce the chance of the national trend being unduly influenced by a local one. However, the COHS data is not designed as a surveillance tool; it is an administrative dataset with service-level data that only captures those making use of the services.

Using an administrative dataset to monitor the difference between fluoridated and non-fluoridated areas relies on the dataset reflecting the actual population and including all events. However, when one region (such as Auckland) has coverage issues, this can be problematic for surveillance and can make for an unfair comparison between fluoridated and non-fluoridated areas. Being aware of any coverage issues, particularly at the regional level, is important when analysing and interpreting the data.

Potential reasons for the apparent decrease in coverage of Community Oral Health Service

We suggest that some potential reasons for the decrease in coverage of the COHS might include:

(i) access issues
(ii) data reporting errors
(iii) lack of full coverage of all oral health care providers.

Access issues are most likely driving the lower coverage of Community Oral Health Services. Under-resourcing, staff shortages, and backlogs of children requiring check-ups in the Auckland region DHBs (and elsewhere) have led to prioritising children from higher-needs groups or areas with inherently worse oral health. In May 2022, around one in seven positions in the Auckland regions' dental services were unfilled (Phare, 2022).

Since those high-needs groups/areas represent such a large proportion of the COHS fluoridated group, this could explain why the percentage of caries-free five-year-olds appears not to have changed much in contrast to that of children in non-fluoridated areas.

Different regions will also have different norms for recall times between visits, that may change to reflect prioritisation of the high-needs groups, i.e. higher needs groups will be recorded more regularly, while children with lower needs (and so presumably better health) will register in the data less frequently.

The hiatus in dental care during the COVID-19 lockdowns have worsened pre-existing backlogs. In turn, larger backlogs may drive more children needing dental care to use the private system, particularly those not belonging to a prioritised group. If this becomes the case, the COHS data will grow further skewed away from accurately representing children's oral health.

Data reporting errors by some service providers may be causing some children to go unreported in the final dataset. The Community Oral Health Service records have repeatedly suffered from data collection issues that resulted in a DHB's data being excluded - most recently in 2019, in which MidCentral DHB's results were not published. Undetected data collection and reporting problems might contribute a small amount to the apparent drop in coverage.

Limited inclusion of oral health care providers in the Community Oral Health Services may also explain some of the apparent decrease in coverage. For example, certain (mainly private) oral health care providers may not have their data included in the COHS dataset at all. A drop in COHS coverage could reflect children whose families have the financial wherewithal to afford it moving to private clinics to avoid being caught in the logjammed public system.

Overall, we consider that the drop in Community Oral Health Services coverage in certain regions is worth investigating. The appropriate agencies (such as regional child dental providers) could investigate whether all care providers within their area are providing data, and/or if there are data collection or reporting errors that are affecting their region's data.

The assignment of fluoridation status for children in the Community Oral Health Service dataset is based on the address of the child's school, not their residential address. This means that a child counted in the fluoridated data might live in a residence supplied with non-fluoridated water and vice versa. Because assigning fluoridation status on the basis of home address would be unreasonably complex given the numbers of people involved, this is a reasonable use of a proxy measurement. Using this proxy measure may lead to some misclassification but is unlikely to have a major impact on the statistics, particularly in larger regions that are all either fluoridated or non-fluoridated.

The issue is further vexed by assuming that all water sources that are supposed to be fluoridated in principle are also fluoridated *in fact* – such as occurred in Wellington in 2021 when fluoridation was temporarily removed from some supplies without notice. Additionally, there is a possibility that the fluoridation records used to sort schools into the proper group is not always updated to reflect changes in the fluoridation status of the relevant supply, leading to misclassification.

A final characteristic of the COHS data to be aware of is that they are only raw data, unadjusted for a number of influential factors. Using unadjusted data to compare fluoridated and non-fluoridated areas is less likely to capture the effect on oral health explicitly caused by water fluoridation than analyses adjusting for differences such as sex, residential address and area-level deprivation (Schluter et al 2020).

What about older children?

In this investigation, we opted to focus only on the section of the COHS dataset that deals with 5-year-old children, as the 'surface-level' interpretation of the national time-series (Figures 1 & 2) appeared to show that whatever was causing the narrowed gap between the fluoridation groups was having a more pronounced effect. We expect that our findings related to the delivery of oral care and the other points discussed above will still hold true to some degree for older children, allowing for possible differences caused by better oral health habits in older children, the relative robustness of permanent teeth or prolonged exposure to fluoride.

The Community Oral Health data is flawed, but not without value

At the time the data used in this investigation was gathered, oral health record-keeping was fragmented in the sense that each DHB was responsible for its own records. The impending move to a centralised system in the form of the Electronic Oral Health Record (EOHR), which will bring with it new standards for oral health data collection and reporting, may improve the quality of the national-level data over the aggregate COHS dataset. This may go some way to resolve the data quality issues that we have identified – though it will not overcome issues in the data caused by operational aspects of oral care.

Until the EOHR is fully operational, it is still worthwhile and necessary to monitor the impacts of community water fluoridation as part of a national surveillance programme. This monitoring will be particularly important given the Three Waters reforms, and the recent transfer of responsibility to the Director General of Health for decisions about community water fluoridation. Despite the limitations we have identified, the COHS dataset is currently the only resource available that allows this. However, our analyses show that national-level comparisons of fluoridated and non-fluoridated areas are no longer suitable, due to variations in coverage by DHB.

We consider that there is still value in the COHS data at the DHB level. By considering statistics at the DHB level, comparisons may still be made between fluoridated and non-fluoridated areas, without data issues in one region impacting on the analysis of other regions. The DHB level is preferable to the provider regions as the latter still allows for varying water fluoridation levels, access to dental care and other factors between DHBs to influence the comparison.

Furthermore, we consider it important to continue to monitor the coverage of Community Oral Health Services dataset by DHB, to show the likely reliability and representativeness of the dataset for each DHB.

Conclusion

The analysis of the community oral health service dataset shows that over the past ten years of records, the apparent trend in the oral health of young New Zealanders is being unduly influenced by the variable provision of oral health services around the country. Two factors in particular are in play. First, the weighting of the fluoridated group towards children in a single region is having a significant dampening effect on the apparent trend for the group as a whole. Second, a reduction in

the coverage of the COHS – which was especially noticeable in certain DHBs – suggests that either access to oral care, targeting of oral care services, data reporting issues or a combination of all of these may be influencing the trend still further.

Consequently, the dataset does not provide a reliable picture of the trends in child oral health over time and cannot accurately compare the oral health of children from fluoridated and non-fluoridated areas when the statistics are considered at the national level. This illustrates a pitfall inherent in relying on service-level data as a public health surveillance tool, as the community oral health service data is not *designed* to be a surveillance tool. Despite being unsuitable for surveillance use, it is still one of very few available options to monitor children's oral health over time, particularly in the absence of a dedicated oral health survey, the last of which was conducted in 2009. Moreover, it is the only publicly available data source that makes any mention of water fluoridation, which is certain to gain significance as control over water fluoridation is now centralised under the Director-General of Health.

Suppose the effects of low coverage in the Auckland region (and elsewhere) are not alleviated or forewarned of by the dataset's publisher. In that case, there is a real risk that the COHS data may be used to relate a perspective on the oral health of New Zealand's children or on the effectiveness of water fluoridation that is incorrect.

Acknowledgements: Thanks are due to the below for their assistance in peer-reviewing this paper

- Jonathan Broadbent (University of Otago)
- Kathryn Fuge (Te Whatu Ora – Health New Zealand)

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