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# Impact of COVID-19 pandemic and associated restrictions in the management of oral infections – a retrospective study

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## Abstract

**Background and objectives:** During the coronavirus pandemic in 2020, restrictions were placed on the provision of dental services. Various levels of restrictions were implemented throughout the year 2020. This study sought to evaluate the impact these restrictions had on the provision of dental services at an emergency dental hospital in Melbourne, Australia.

**Methods:** This was a retrospective review of patient presentations who presented to Royal Dental Hospital of Melbourne (RDHM) for treatment of dental infections between 1<sup>st</sup> January 2019 until 31<sup>st</sup> December 2020. Patient demographic information and prescription of antibiotics were collected. Data pertaining to the pandemic period was then analysed and compared to the previous non-pandemic year, and specific analysis was undertaken during the lockdown periods of the 2020 pandemic.

**Results:** The total number of patient presentations significantly reduced from 16320 (2019) to 10383 (2020). The proportion of patients who were prescribed antibiotics was significantly higher during the lockdown periods ( $p < 0.001$ ), there was also an increase in repeat presentations (i.e. patients presenting with unresolved (or additional) complaints) when dental restrictions were imposed ( $p < 0.001$ ). There was a significant decrease in the number of patients requiring interpreter services attending during the lockdown period ( $p < 0.001$ ).

**Conclusions:** The lockdown period in Melbourne in 2020 and associated restrictions in dental service provision resulted in a significant increase in antibiotic prescriptions for dental infections. These findings may reflect inadequate dental care provision and/or unmet dental need during the 2020 lockdown period.

## Introduction

SARS-CoV-2, a novel coronavirus, was first reported in December 2019 (World Health Organization, 2020). It was responsible for severe acute respiratory syndrome known as Coronavirus disease 2019 (COVID-19). In response to this pandemic, throughout the world, several lockdowns were instigated at various levels and time frames.

The metropolitan areas of Victoria, within which the City of Melbourne and the Royal Dental Hospital of Melbourne (RDHM) are situated, went through two periods of lockdown between March – May 2020 and July – October 2020 to

manage and suppress community disease transmission of COVID-19. As an adjunct to lockdown measures, the Australian Health Protection Committee recommended nationwide restrictions on dental procedures. The restrictions aimed at providing urgent emergency treatment and deferred non-essential ones (Dental Board of Australia, 2020a, 2020b). The clinical restrictions document put forward by the Australian Dental Association (ADA) provided a breakdown on protocols to follow at each restriction level (Australian Dental Association, 2020). These are listed below:

- **Level 1:** All dental treatments using standard precautions
- **Level 2:** Provision of dental treatments that are unlikely to generate aerosols or where aerosols generated have the presence of minimal saliva/blood due to the use of rubber dam
- **Level 3:** Provision of dental treatment that do not generate aerosols and where generating aerosol is limited to management of acute dental pain, trauma or on patients at risk of negative outcomes
- **Level 4:** Only emergency dental treatments are to be managed – covering swellings, trauma, difficulty opening jaw or swallowing, nocturnal dental pain, non-healing ulcers airway issues
- **Level 5:** No routine dental treatment provided. All patients with acute dental concerns to be directed to emergency care centres.

These restrictions resulted in a significant decrease in provision of dental treatment nationwide, with a reduction of 41% in publicly funded paediatric dental services reported between March and June 2020 (Hopcraft & Farmer, 2021).

Higher level restrictions were introduced during each lockdown period and decreased thereafter following a decrease in COVID-19 presentations (Dental Board of Australia, 2020c, 2020d, 2020e, 2020f). As per recommendations from Dental Health Service Victoria (DHSV), the Royal Dental Hospital of Melbourne (RDHM) operated at a higher restriction level (Level 4) during the first COVID-19 lockdown, compared to Level 3 restrictions nationwide (Dental Health Service Victoria, in press).

## Dental antibiotic prescriptions during pandemic

Dental infections are normally treated with aerosol-generating procedures, such as root canal therapy or

extraction of teeth. Providing such definitive dental treatment reduces the need for antibiotic prescribing in dental practice, which is of benefit in addressing the global public health problem that is antimicrobial resistance.

Australian and international evidence indicates an increase in dentist-prescribed antibiotics during COVID-19 pandemic (Albelenda-Alonso et al., 2020, Mian et al., 2021, Ostrc et al., 2021, Shah et al., 2020). This can be attributed to the restrictions imposed on dental procedures, which were aimed at minimising COVID-19 transmission through aerosol generation. By thus restricting many of the definitive treatment options normally utilised in the management of dental infections, dentists were then significantly restricted in what they could offer for patients presenting with infection, leading to an increase in antibiotic prescribing as an interim measure. Furthermore, recommendations for use of antibiotics in absence of dental treatment from guidelines in Australia (Nguyen et al., 2021) and United Kingdom (National Health Service, 2020) may have also contributed. The obvious long-term consequence of such interim antibiotic prescribing is an accumulation in number and severity of untreated dental disease, resulting in more short- and long-term consequences (e.g. orofacial infections) and more extensive dental treatment in future.

## Aim

The aim of the current study is to evaluate the impact of COVID-19 pandemic and associated restrictions in usage of antibiotics for management of oral infections within the RDHM. The results obtained aim to inform policy making in public health for future pandemics.

## Methods

This is a retrospective study aimed at assessing the impact of COVID-19 pandemic-associated lockdown periods and clinical restrictions on the management of oral infections in patients who presented to RDHM. Health records for all patients who presented to RDHM for treatment of dental infections between 1<sup>st</sup> January 2019 – 31<sup>st</sup> December 2020 were retrospectively accessed. Ethics approval to the RDHM Research Review Group (Approval number: 342) and the University of Melbourne's Human Ethics Advisory

Group (Identification number: 2057636) were submitted and granted for this study.

Inclusion criteria for the study includes patients of all age groups and demographics who presented to RDHM for management of oral infections, defined as presentations that would benefit from antibiotic prescription (e.g. odontogenic infection), as listed in the ADA's Australian Schedule of Dental Services and Glossary as "927–Antibiotic prescription" (Australian Dental Association, 2022). Attempts to retrieve data on the specific type of antibiotic used for management were made but were unsuccessful.

Patients who presented to RDHM and received treatment for management of non-infective causes (defined as causes of dental symptoms that would not benefit from prescription of antibiotics e.g. dental trauma), those who exclusively received care/prescriptions over telehealth (i.e. did not present in-person) and those who presented to external clinics associated with RDHM (e.g. dental vans, private and residential setting clinics) were excluded from this study.

This study used deidentified patient data electronically obtained from Titanium electronic dental records. Data regarding patient's biological gender, age, priority population group (if available), interpreter requirement and the item code corresponding to treatment received were compiled in Microsoft Excel and securely stored. Statistical analysis was undertaken using SPSS statistics software (v29.0). Pearson's Chi-square test was used to analyse discrete quantitative data against categorical variables. Mann-Whitney test was used to analyse continuous variable (age) and shown as median and standard deviation.

## Results

The total number of patient presentations for management of dental infections from January 2019 to December 2020 is shown as a time series graph in Figure 1. During 2020, varying degrees of restrictions were imposed on dental practice. Both Figure 1 and Figure 2 show a definitive drop and subsequent rise in patient presentations that correlates with the introduction and subsequent easing of lockdown periods and clinical restrictions.

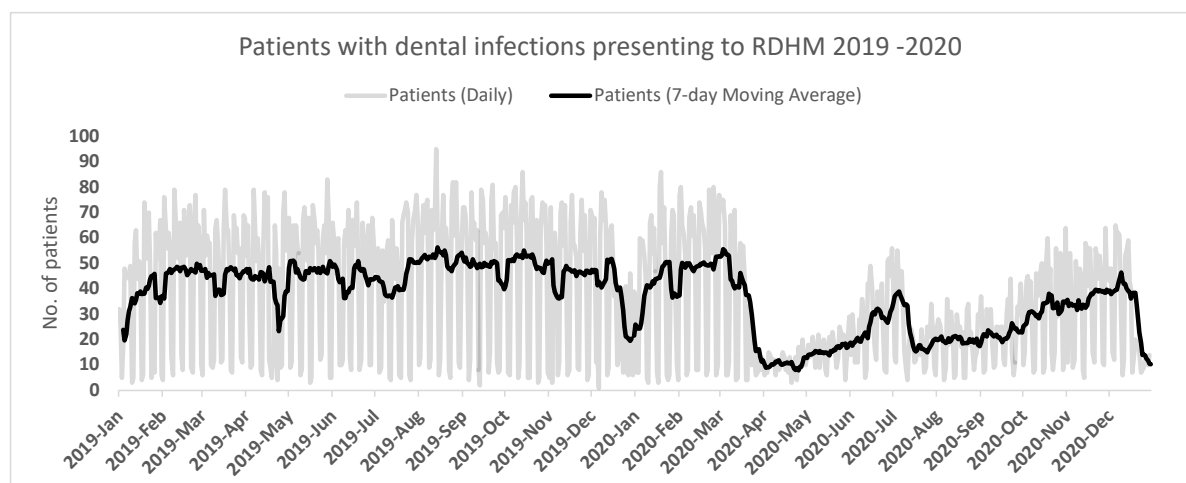


Figure 1. Time series (2019/2020) patients with dental infections presenting to RDHM

### Patient demographics

There were slightly more males presenting with oral infections to RDHM in both 2019 ( $n=9089$  or 55.7%) and 2020 ( $n=5608$  or 54%), however, this difference was not statistically significant (Table 1). However, there was a significant difference in the numbers of male and female presentations when comparing each individual restriction period in 2020 (Table 2). A greater proportion of females presented during level 1 and 2 restrictions compared to males (Table 2).

There were significantly more adult (>18yo) than child (<18yo) patients presenting to RDHM with oral infections

during all levels of restriction. The average age of adult patients was 40 and 41, in 2019 and 2020 respectively. We found a significant decrease in the total number of children presenting in 2020 ( $n=2482$ ) compared to 2019 ( $n=4292$ ), which represented a 3.6% decrease in the proportion of children presenting to RDHM (Table 1).

This study found that there was a significant change in the number of presentations from priority population subgroups. The number and proportion of patients presenting to RDHM who identified as being part of any priority population group significantly decreased in 2020 ( $n=961$ , or 9.3% of all presentations) compared to the year

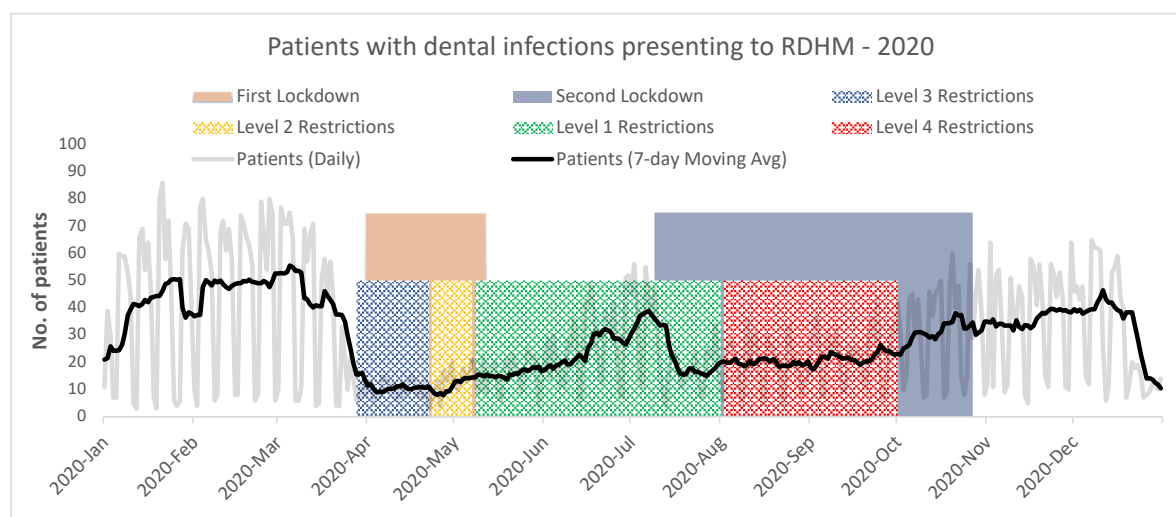


Figure 2. Time series 2020 impact of lockdown and restrictions on patient presentations for dental infections

Table 1. Selected treatment parameters and patient demographics in 2019 and 2020

	2019 (%)	2020 (%)	p-value
Total Patient presentation (n)	16320	10383	$p<0.001^a$
Repeat presentations	573 (3.5)	553 (5.3)	$p<0.001^a$
Total Antibiotics prescribed	2447 (15.0)	5223 (20.6)	$p<0.001^a$
Biological Sex			$p=0.015^a$
Male	9089 (55.7)	5608 (54)	
Female	7214 (44.2)	4768 (45.9)	
Undetermined	17 (0.1)	7 (0.1)	
Age (years)			
Child (<18 years)	4292 (26.3) Median: 7 SD: 4.71	2482 (23.9) Median: 6.5 SD: 4.36	$p<0.001^b$
Adult (>=18 years)	12028 (73.7) Median: 40 SD: 20.5	7901 (76.1) Median: 41 SD: 20.0	$p=0.02^b$
Priority population	1721 (10.6)	961 (9.3)	$p<0.001^a$
Aboriginal / Torres Strait Islanders	712 (4.4)	417 (4.0)	$p=0.17^a$
Refugee	478 (2.9)	257 (2.5)	$p=0.03^a$
Asylum seeker	206 (1.3)	128 (1.2)	$p=0.833^a$
Homeless	325 (2.0)	159 (1.5)	$p=0.006^a$
Interpreter requirement	2019 (12.4)	1145 (11.0)	$p<0.001^a$

<sup>a</sup> Pearson's Chi square test

<sup>b</sup> Mann-Whitney test

**Table 2.** Selected treatment parameters and patient demographics during clinic restriction periods in 2020

	Level 3(%) (28 Mar – 22 Apr)	Level 2(%) (23 Apr – 7 May)	Level 1(%) (8 May – 1 Aug)	Level 4(%) (2 Aug – 1 Oct)
Total Patient presentation (n)	258	198	1929	1301
Repeat presentations	12 (4.7)	10 (5.1)	185 (9.6)	161 (12.4)
Total Antibiotics prescribed	143 (55.4)	94 (47.5)	478 (24.8)	327 (25.1)
Biological Sex				
Male	132 (51.2)	81 (40.9)	914 (47.4)	655 (50.3)
Female	126 (48.8)	117 (59.1)	1014 (52.6)	646 (49.7)
Undetermined	0 (0)	0 (0)	1 (0)	0 (0)
Age				
Child (<18)	39 (15.1)	41 (20.7)	461 (23.9)	359 (27.6)
Adult (>=18)	219 (84.9)	157 (79.3)	1468 (76.1)	942 (72.4)
Priority population				
Aboriginal/Torres Strait Islanders	11 (4.3)	6 (3.0)	101 (5.2)	46 (3.5)
Refugee	9 (3.5)	6 (3.0)	47 (2.4)	23 (1.8)
Asylum seeker	2 (0.8)	1 (0.5)	28 (1.5)	21 (1.6)
Homeless	7 (2.7)	7 (3.5)	25 (1.3)	10 (0.8)
Interpreter requirement	18 (7.0)	15 (7.6)	202 (10.5)	125 (9.6)

**Table 3:** Monthly antibiotic prescription rates in 2019/2020

Month	Total patient presentation (n)		Total Antibiotics Prescribed		p-value <sup>a</sup>
	2019	2020	2019 (%)	2020 (%)	
Jan	1111	1290	190 (17.1)	201 (15.6)	p=0.314
Feb	1336	1411	178 (13.3)	162 (11.5)	p=0.143
Mar	1319	1061	199 (15.1)	173 (16.3)	p=0.416
Apr	1277	320	169 (13.2)	168 (52.5)	p<0.001
May	1518	480	195 (12.8)	177 (36.9)	p<0.001
Jun	1239	803	209 (16.9)	183 (22.8)	p<0.001
Jul	1388	739	211 (15.2)	166 (22.5)	p<0.001
Aug	1614	583	228 (14.1)	152 (26.1)	p<0.001
Sep	1410	685	242 (17.2)	166 (24.2)	p<0.001
Oct	1646	1007	234 (14.2)	199 (19.8)	p<0.001
Nov	1304	1086	196 (15.0)	201 (18.5)	p=0.556
Dec	1158	918	196 (16.9)	189 (20.6)	p=0.033

<sup>a</sup> Pearson's Chi square test

prior (n=1721 or 10.6%) and this difference was statistically significant ( $p < 0.001$ ) (Table 1). Reduction in numbers of the specific subgroups of homeless (from 325 in 2019 to 159 patients in 2020) and refugee (falling from 478 to 257 patients in 2020) populations had the most significant change in percentage of total presentations (Table 1). There was also a significant reduction in presentations from patients who required an interpreter ( $p<0.001$ ) (Table 1).

### Antibiotic prescriptions

During the lockdown periods of 2020 there was a decrease in the number of patient presentations to RDHM. Table 1 illustrates that the proportion of patients receiving antibiotic prescriptions was significantly higher in 2020 (20.6%) than in 2019 (15.0%). As a proportion, the number of patients receiving antibiotics during the lockdown periods increased

each month from April 2020 onwards, corresponding with the commencement of pandemic associated restrictions (Table 3). Whilst the increase in antibiotic prescribing was significantly increased throughout the lockdown period, the increase in proportion of antibiotics prescribed was most profound during the first two months of restrictions (April and May) as shown in Table 3.

### Discussion

The current study found that there was an increase in the proportion of patients receiving antibiotics for the treatment of dental disease during the 2020 COVID-19 related dental practice restriction periods in Melbourne. In addition, we found a significant reduction in children and patients requiring interpreters presenting during the 2020 restrictions. These changes were more pronounced





during the first lockdown period. Whilst the total number of presentations decreased, there was an increase in the number of antibiotic scripts dispensed and a corresponding increase in the number of patients re-presenting for the same condition.

No formal restrictions were initially placed on dental services at the start of the first lockdown period in March 2020 but was to be managed based on risk assessment undertaken by the clinicians and clinics (Dental Board of Australia, 2020b). However, the subsequent introduction of restrictions for dental procedures impacted the number of patients presenting to RDHM for management of dental infections. This can be seen in a drop in number of presentations between March to April and August to September, and a notable increase in repeat presentations, as seen in Table 2, during the same period. This trend has been noted to be evident state-wide, with a 18% decrease in the number of patients treated for dental issues previously reported (Department of Health, 2021). It can be attributed to the restrictions placed on dental services and the difficulty in providing definitive treatment. Subsequent easing of restrictions from April onwards and again in October showed an associated increase in patient numbers and a decrease in repeat presentations.

The current study found increased female proportions and presentation for dental infections during lockdown and lower restriction periods respectively (Table 2). This may be partly explained by the fact that female patients have increased attendance/interactions with primary care services than males in Australia (Simons *et al.*, 2023, Australian Institute of Health and Welfare, 2022a), however, female patients have also found to delay seeking assistance to primary care and dental services during COVID-19 pandemic period (Australian Institute of Health and Welfare, 2022a and 2022b, Ivancic *et al.*, 2023, White *et al.* 2022).

Furthermore, there is considerable decrease in presentation of children during restriction periods for dental infections as shown in Table 2. It may be attributed to parents and guardians aiming to decrease exposure of their children to at-risk locations during restriction periods. Although no increase in dental presentations in Emergency Departments were noted in Melbourne (Cheek *et al.*, 2021), there were unintended negative effects of increased rate of potentially preventable hospitalisations for dental infections in age group of 5-9 years in Australia (Australian Institute of Health and Welfare, 2022b).

While there was a considerable increase in Aboriginal and Torres Strait Islander hospitalisations from dental infections around Australia (Australian Institute of Health and Welfare, 2022b), there was no significant difference in their frequency of presentation at RDHM between 2019 and 2020. Other studies have demonstrated that patients who require interpreter services have a greater tendency to seek public dental services (Australian Institute of Health and Welfare, 2022b) and, as seen in Table 2, were significantly impacted at RDHM during initial restriction periods. This is likely due to pandemic restrictions affecting access to in-person interpreters, or a lack of available information on accessing services for patients of a non-English speaking background.

Strengths of this research include its detailed, month-to-month data collection, which was more detailed than many other international papers, who may have reported only differences between years (Tousi *et al.*, 2023, Šutej *et al.*, 2023). This enabled precise mapping of antibiotic prescribing trends against changes in dental treatment restrictions in Melbourne during its multiple COVID-19 lockdowns.

The main limitations of the present study relate to the retrospective research methodology, using data created for the purposes of healthcare delivery in only a single dental hospital. It is important to note that the date utilised in this study was collected five years ago, during the COVID-19 pandemic. While the time elapsed may limit the data's immediate applicability to current conditions, the findings remain relevant as the pandemic period represents a critical point of dental health service disruption – understanding such trends will inform future health policy planning.

Previous studies have shown an increasing trend in the dispensation of antibiotics for dental indications since 2017 around Australia, with a sharp upward incline from 2020 onwards (Australian Institute of Health and Welfare, 2022b, Gillies *et al.*, 2022). In comparison, British studies have identified a decrease in the dispensing rate of dental antibiotics prescriptions nationally from 2016, in accordance with antibiotic stewardship, which also sharply increased from March 2020 onwards, in response to COVID-19 (Falola *et al.*, 2023).

Such an increase in dental antibiotic prescribing during the COVID-19 pandemic appears to be a global trend, having been identified amongst dental practitioners in Norway (Tousi *et al.*, 2023), Scotland (Duncan *et al.*, 2021), Spain (Rodríguez-Fernández *et al.*, 2022), Croatia (Šutej *et al.*, 2023) and South Africa (Pillay & Rikhotso, 2024).

In the present study, the greatest increase in antibiotic prescription was noted during first lockdown period (April – May 2020) and a subsequent smaller increase during second lockdown period (Jun – Oct 2020). The levels of antibiotic prescription decreased with easing of restrictions and returned to pre-pandemic levels by November 2020 (Table 2 and Table 3).

In comparing the findings of the present study against international studies that also tracked changes in antibiotic prescribing on a month-to-month level, Duncan *et al.*'s and Thompson *et al.*'s (2022) findings in Scotland and England respectively was most similar in trend – reporting the greatest increase in antibiotic prescriptions (compared to pre-pandemic levels) occurred during lockdown period. Interestingly, in Scotland, levels of antibiotic prescribing remained higher than pre-pandemic levels until the time of article publication, in May 2021 (Duncan *et al.*, 2021). The results of the present study contrast with findings in Rodríguez-Fernández *et al.* (2022)'s Spanish study, which reported a decrease in antibiotic prescribing during lockdown, with a long-term upward trend, returning to approximately pre-pandemic levels. These perhaps reflect differences in national/regional dental practice guidelines during the COVID-19 pandemic, or perhaps even differences in pre-pandemic baseline antibiotic prescribing.

The findings of this study – in particular, a decrease in the number of presentations, increase in the proportion

of re-presentations and increase in the proportion of patients receiving antibiotics may represent the difficulty in accessing appropriate treatment for dental infections during the pandemic-associated restrictions. This particularly affected vulnerable population groups, such as refugee, homeless and linguistically diverse populations, whose barriers to accessing dental care appear to have been exacerbated during the pandemic.

These findings have obvious implications on future pandemic planning – namely, how to best provide urgent and interim dental treatment within periods of dental treatment restriction, without simply relying on/resorting to antibiotic overprescription and the long-term dental and antibiotic-resistance sequelae associated with this. Furthermore, this study identified population groups that were underrepresented and likely underserved during the pandemic period, highlighting population groups that may not have received public health messaging (e.g. how to access care) or faced insurmountable (e.g. language) barriers to accessing dental care – such population groups may warrant additional supports and funding in planning future public dental service provision.

Future research could explore patient and clinician experiences of receiving or providing dental care during the COVID-19 period through qualitative research, to identify areas that could inform future pandemic-planning, but also telehealth service delivery, for instance. While detailed data on specific antimicrobials prescribed or the rationale/clinical diagnosis was not available for all patients in the present

study, future research could analyse this data where it is available, to perhaps better understand diagnostic reasoning in the unique clinical practice environment that was the COVID-19 pandemic in metropolitan Melbourne.

## Conclusion

The main findings from this study were that there was an increase in the proportion of patients treated with antibiotics for their dental disease during the COVID-19 pandemic at a public dental hospital in metropolitan Melbourne. We also identified an increase in the number of female patients and a decrease in presentations of non-English speaking patients.

This study has shown that restrictions placed on dental practice are associated with increased rates of antibiotic prescribing and patients representing for the same condition. We have highlighted the unique challenges that the COVID-19 pandemic represented for the dental profession and wider public health policy.

## Author contribution

Conception or design of the work – AC, AS

Data collection – ASK, WZT, AS

Data analysis and interpretation – ASK, NE-A

Drafting the article – ASK, WZT, AS

Critical revision of the article – all authors

Final approval of the version to be published – all authors

## Conflict of interest

The authors declare no conflicts of interest.

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