

Institution: University of Glasgow (UofG)		
Unit of Assessment: UoA 3 (Allied Health Professions, Dentistry, Nursing and Pharmacy)		
Title of case study: <i>Childsmile</i> evaluation: shaping national child oral health improvement programmes across the world		
Period when the underpinning research was undertaken: 2006–present		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): (1) Prof Lorna Macpherson; (2) Prof David Conway; (3) Dr Wendy Gnich; (4) Dr Alastair Ross; (5) Dr Alex McMahan; (6) Dr Andrea Sherriff.	Role(s) (e.g. job title): (1) Professor of Dental Public Health; (2) Professor of Dental Public Health; (3) Research Fellow; (4) Senior Lecturer; (5) Reader in Epidemiology; (6) Senior Lecturer in Statistics.	Period(s) employed by submitting HEI: (1) 1992–present; (2) 2000–present; (3) 2008–2019; (4) 2014–present; (5) 1998–present; (6) 2007–present.
Period when the claimed impact occurred: August 2013–present		
Is this case study continued from a case study submitted in 2014? Yes		
1. Summary of the impact Dental caries affects over 520 million children worldwide, with this preventable condition strongly linked to socioeconomic inequalities. UofG research underpinned the design, implementation and evaluation of <i>Childsmile</i> , a multicomponent community child oral health improvement programme for Scotland. <i>Childsmile</i> decreased rates of dental caries among 5-year-olds in Scotland from 32% in 2014 to 26% in 2020, with the programme particularly effective among socially disadvantaged groups. Since August 2013, the <i>Childsmile</i> approach has been adopted in Chile, England, Israel, Malawi, the Netherlands, countries of Southeastern Europe and Vanuatu. In 2019, the European Commission designated the <i>Childsmile</i> methodology as public health best practice.		
2. Underpinning research Although preventable, childhood dental caries (tooth decay) is a highly prevalent global public health issue that is linked to socioeconomic and health inequality. It can cause pain, infection and hospital admissions, with impacts on school attendance and attainment. The economic burden is substantial. Our REF2014 impact case study highlighted the work of UofG researchers in developing and evaluating the Childsmile programme in Scotland. This multicomponent intervention was designed to improve oral health and reduce inequalities among children in Scotland through working with health visitors; nursery and primary school teachers; dental practitioners; health-support workers; and local communities. Evaluation is embedded within the programme to ensure rapid feedback of major findings to improve outcomes. UofG researchers have led research and evaluation of the main components of <i>Childsmile</i> (outlined below) since its inception in 2006.		
<i>Nursery supervised toothbrushing</i> The Scottish nursery supervised toothbrushing programme commenced in 2001, and was subsequently assimilated into <i>Childsmile</i> in 2006. UofG researchers (Macpherson, Conway, McMahan, Sherriff, Gnich) have conducted studies evaluating health and economic outcomes of this initiative among children aged 5 years. Analysis of linked population-level datasets collected from 99,071 children during 1987–2009 demonstrated a strong association over time between uptake of nursery supervised toothbrushing and a decline in dental caries [3.1]. This finding was further strengthened by a population-wide individual-level linked cohort study of 50,379 children born during 2009–2010, and followed up to 5 years of age (2014–2015) [3.2]. This study showed reduced odds of dental caries with increasing years of nursery supervised toothbrushing, with the greatest benefit occurring among children from the most socially disadvantaged areas of Scotland [3.2]. A health economic analysis found that costs associated with treatments for childhood dental caries had decreased from 1999 to 2010 [3.3]. The estimated annual savings to NHS Scotland of the nursery supervised toothbrushing programme exceeded the costs of implementation by almost three-fold by the eighth year (>GBP4.5 million versus GBP1.7 million, respectively) [3.3]. This research influenced uptake of supervised toothbrushing programmes in England and internationally (see section 4).		

Nursery and school fluoride varnish applications (FVA)

Modelling of cross-sectional data collected by the 2008 National Dental Inspection Programme from 43,470 children aged 5 years assessed the effectiveness and reach of the nursery and school FVA programme, which aimed to target those at greatest risk of dental caries (**Sherriff, Macpherson**) [3.4]. This research identified limited reach of the programme into disadvantaged communities, and recommended reallocation of resources towards Scottish health boards with the greatest levels of socioeconomic deprivation. This recommendation was adopted into national policy (see section 4).

Community-based dental health support workers (DHSWs)

DHSWs are embedded within the *Childsmile* programme; they help families requiring additional support to engage with primary dental care and other services. **Sherriff, Gnich, Ross and Macpherson** used data collected during 2010–2013 to evaluate the role of DHSWs within *Childsmile* via a population-wide data linkage cohort study [3.5]. They showed that, for targeted families, DHSWs were effective at facilitating child access and registration at primary care dental practices, and at an earlier stage of the child's life, to ensure timely delivery of prevention. This approach is being piloted in the Netherlands (see section 4).

3. References to the research

1. **Macpherson L, Anopa Y, Conway D, McMahon A** (2013) National supervised toothbrushing program and dental decay in Scotland. *J Dent Res*;92(2):109–113, doi:[10.1177/0022034512470690](https://doi.org/10.1177/0022034512470690). [Available on request from HEI]
2. Kidd JB, **McMahon AD, Sherriff A, Gnich W, Mahmoud A, Macpherson L, Conway DI**. Evaluation of a national complex oral health improvement programme: a population data linkage cohort study in Scotland. *BMJ Open* 2020;10:e038116, doi:[10.1136/bmjopen-2020-038116](https://doi.org/10.1136/bmjopen-2020-038116).
3. Anopa Y, **McMahon A, Conway D, Ball G, McIntosh E, Macpherson L** (2015) Improving child oral health: cost analysis of a national nursery toothbrushing programme. *PLoS One*;10(8):e0136211, doi:[10.1371/journal.pone.0136211](https://doi.org/10.1371/journal.pone.0136211).
4. Brewster L, **Sherriff A, Macpherson L** (2013) Effectiveness and reach of a directed-population approach to improving dental health and reducing inequalities: a cross sectional study. *BMC Public Health*;13:778, doi:[10.1186/1471-2458-13-778](https://doi.org/10.1186/1471-2458-13-778).
5. Hodgins F, **Sherriff A, Gnich W, Ross A, Macpherson L** (2018) The effectiveness of dental health support workers at linking families with primary care dental practices: a population-wide data linkage cohort study. *BMC Oral Health*;18:191, doi:[10.1186/s12903-018-0650-z](https://doi.org/10.1186/s12903-018-0650-z).

Grants

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4. Details of the impact

Our [REF2014](#) impact case study detailed the piloting and roll-out of *Childsmile* across Scotland. Since August 2013, *Childsmile* has been the leading exemplar for development, implementation and evaluation of child oral health improvement programmes internationally (**impact 1**), and in England (**impact 2**). UofG research has also continued to influence Scottish child oral health policy during this period (**impact 3**).

Impact 1. Expansion of Childsmile internationally

The [2019 Global Burden of Disease Study](#) found that more than 520 million children worldwide had experienced dental caries, with immediate and longer-term economic and public health implications. Considerable international recognition for *Childsmile* has occurred via dissemination of UofG research [3.1–3.5] at numerous public engagement and knowledge exchange activities and events with key stakeholders, including the 'ChildsmileEvaluation' Twitter feed ([@UoGChildsmile](#)). Since August 2013, UofG researchers have hosted colleagues from Australia, Brazil, Chile, Israel, Malawi, the Netherlands, Nigeria, Saudi Arabia, countries in Southeastern Europe and Thailand, interested in the development and evaluation of national child oral health improvement programmes. In addition, they have given invited presentations and workshops in Chile, China, Croatia, Ireland, Poland, Serbia and South Africa (2014–2019).

In 2018, UofG researchers hosted an international *Childsmile* [symposium](#) with speakers including the World Health Organization (WHO) global oral health lead, and government representatives from Chile and Israel. Subsequently, UofG researchers were asked to submit *Childsmile* as a case study for the WHO Oral Health Country/Area Profile website (hosted by the WHO Collaborating Centre at Malmö University, Sweden) [5.A]. In 2019, the European Commission adopted the *Childsmile* methodology as best practice to tackle United Nations Sustainable Development Goals for noncommunicable diseases, with *Childsmile* the only oral health improvement programme on this electronic platform [5.A].

An Israeli implementation of *Childsmile* began in 2014 [5.B], after a survey showed that only 38% of Israeli 6-year-olds were free from dental caries. Use of the *Childsmile* approach by this country was in response to the UofG cost analysis [3.3]. Nurseries participating in supervised toothbrushing rose in number from 627 in 2015 to 2,200 in 2018 [5.B]. The Ministry of Health subsequently adopted nursery supervised toothbrushing as part of the national dental service for children in disadvantaged towns and cities across Israel (2018) [5.B].

Childhood dental caries is also a major health challenge in Chile, with high prevalence and wide socioeconomic inequalities [5.C]. In 2015, the Chilean Ministry of Health established the *Sembrando Sonrisas* child oral health improvement programme with **Conway, Macpherson** and **McMahon** advising the *Sembrando Sonrisas* team. UofG researchers are continuing to support the ongoing evaluation and development of this programme [5.C]. *Sembrando Sonrisas* delivers supervised toothbrushing and FVA to over 400,000 nursery school children each year, with improvements in oral health observed among all age groups (3–6 years) since implementation; for example, the percentage of 5-year-olds with dental caries reduced from 58% in 2015 to 53% in 2019 [5.C]. The Ministry of Health highlights that support from UofG was crucial for implementation and evaluation of *Sembrando Sonrisas* as “*the guidelines and objectives [of Childsmile], despite coming from a different sociocultural context, were aligned with the objectives expected in our country, i.e. likely to reduce inequity, be cost-effective, multisectoral and focused on prevention and education*” [5.C].

In 2017, UofG researchers and WHO oral health leads gave a workshop explaining the *Childsmile* approach and appropriate strategies for Southeastern European countries where poor child oral health is rife. The workshop, sponsored by UK oral health charity The Borrow Foundation, was held in Glasgow (2018), and attended by senior policy representatives from Albania, Bulgaria, Croatia, Romania, Serbia and Slovenia [5.D]. **Conway** and **Macpherson** then led a workshop in Croatia (2018), and supported the development and initiation of a pilot nursery supervised toothbrushing programme in 2019 [5.D]. Following this workshop, Romania and Serbia have conducted baseline national child oral health surveys as a first stage, and this, together with ongoing UofG researcher input, is informing national policy development [5.D].

The Borrow Foundation also funded the development of a child oral health improvement strategy in Malawi [5.D], involving collaboration between UofG, the Malawi Ministry of Health, the University of Malawi, and the WHO Country and Regional Office for Africa. In February 2020, **Macpherson** and **Prof Jeremy Bagg** (Head of the UofG Dental School) participated in a Malawi Ministry of Health workshop to discuss the development of the first oral health policy for this country [5.D]. They are now members of a multi-agency Government Taskforce to develop and implement this policy, with *Childsmile* principles and the child oral health improvement work forming major components. According to the Acting Principal of the College of Medicine (COM), University of Malawi: “*It was very obvious to the COM team that Malawi would benefit more if the country’s oral health strategy followed a prevention model rather than treatment, partly due to the large deficiency of dentists. As such, the team concluded that Malawi needed to adopt and contextualise the Childsmile model to suit our local setting*” [5.D]. Consequently, “*the task force has so far resolved that prevention of dental disease in children will be the central concept of the development of the policy. Thus, the research work of the Childsmile programme in Scotland will be valuable in the formulation of Malawi’s oral health policy*” [5.D].

Other countries that have adopted *Childsmile* components include the Netherlands and Vanuatu. **Macpherson** and **Conway** participated in workshops with Dutch stakeholders (2018) which, along with UofG research [3.5], contributed to the development of *Gezonde Peutermonden*, a pilot programme adopting DHSW-related elements of *Childsmile* into well-baby clinics in the Netherlands [5.E]. In 2018, the UofG team was contacted by a dental volunteer from a non-governmental organisation working in Vanuatu. A survey had revealed low rates of toothbrushing among children aged 5–7 years, and the volunteer felt that the *Childsmile* model would be appropriate for use in this country. Policy for a school-based programme based on *Childsmile* (*‘Gudfala Tut Skul’*) was ratified by the Vanuatu Ministry of Health in 2019 [5.E]. The *Childsmile* evidence base [3.1, 3.3] was used in funding bids and, by February 2020, 32 schools were involved in supervised toothbrushing, with expansion to an additional 40 schools planned. FVA was adopted by 22 schools, also with plans for expansion.

Impact 2. Expansion of Childsmile to England

An overview of *Childsmile* was presented as one of two expert papers supporting the 2014 National Institute for Health and Care Excellence (NICE) formulation of guidelines on oral health (PH55). This guideline recommended the implementation of supervised toothbrushing schemes for children, with the advisory committee noting that “*lessons can be learnt from existing programmes such as Childsmile*” [5.F].

UofG research has also informed the development of child oral health policy recommendations by Public Health England (PHE) [5.G]. **Macpherson** was a member of the Steering Group developing a 2014 PHE evidence-based toolkit for local authorities, responsible for commissioning better oral health of children and young people. The toolkit recommended nursery supervised toothbrushing and FVA, with reference made to the UofG cost analysis model [3.3] and wider *Childsmile* approach [5.H]. In 2016, PHE commissioned a rapid review of the cost-effectiveness evidence for oral health interventions among children aged up to 5 years, and a bespoke return on investment (ROI) tool from the York Health Economics Consortium [5.H]. The ROI tool was designed to inform local authorities on investment in oral health programmes. UofG research [3.3] provided the only good-quality evidence on the cost-effectiveness of nursery supervised toothbrushing. In 2016, PHE published a further toolkit, based on evidence from NICE PH55 [5.F] and the ROI, to support supervised toothbrushing programmes in early years and school settings in England [5.H]. Together, these PHE documents supported the 153 upper-tier English local authorities to make the case for commissioning child oral health improvement programmes [5.G]. A PHE audit published in 2018 found that 74 of 145 local authorities surveyed (51%) had implemented nursery supervised toothbrushing [5.H].

In 2019, the UK Government promised to consult on the roll-out of a preschool and school toothbrushing scheme in its Parliamentary Green Paper, *‘Advancing our health: prevention in the 2020s’* [5.I], to reach the most socioeconomically disadvantaged children aged 3–5 years across England. A nursery supervised toothbrushing programme Steering Group, led by PHE and the UK Department of Health and Social Care, was formed to co-ordinate and advise on taking this commitment forward. **Macpherson** is a member of the Steering Group, and UofG research [3.1–3.3] provides the main evidence base [5.I].

Impact 3. Further development of Childsmile within Scotland

Between 2014 and 2020, dental caries among 5-year-olds in Scotland declined from 32% to 26%, with a 43% reduction overall since the initiation of *Childsmile* in 2006 (data source: National Dental Inspection Programme [reports](#)). UofG research showed that the nursery supervised toothbrushing programme has provided greater impact among children from the most socially disadvantaged areas [3.2]. In addition, *Childsmile* has influenced Scottish Government and NHS Scotland policy:

- In 2016, the Scottish Government committed to expanding its FVA programme in more deprived areas of Scotland [5.J] as a result of UofG findings on the limited reach into these communities of the targeted FVA component of *Childsmile* [3.4].

- The cost analysis of nursery supervised toothbrushing [3.3] was used in both the Scottish Government's 2016 national clinical strategy and the Chief Medical Officer's 2016–2017 annual report to evidence the effectiveness of preventive expenditure in improving health and reducing NHS Scotland treatment costs [5.K].
- *Childsmile* interventions were incorporated into the Scottish Intercollegiate Guidelines Network 2014 clinical guidelines (SIGN 138) [5.L] and the Scottish Dental Clinical Effectiveness Programme (2018) 5.M], with *Childsmile* considered the key implementation vehicle for delivering the recommendations.

5. Sources to corroborate the impact (PDFs uploaded for all listed items)

- International best practice: (1) The WHO Oral Health Country/Area Profile [website](#) (2018); (2) European Commission Public Health Best Practice [portal](#) and *Childsmile* information (2019).
- Israel: (1) Testimonial from the Head of the Department of Community Dentistry, Hebrew University and Hadassah Medical Organization, to substantiate implementation activities; (2) Israeli *Childsmile* data (2015–2018). See slide 11.
- Chile: (1) Testimonial from the Ministry of Health to substantiate the role of UofG research in implementation activities; (2) *Sembrando Sonrisas* [website](#) [in Spanish; English translation of the landing page available].
- Southeastern Europe and Malawi: (1) Testimonial from the Director of The Borrow Foundation to substantiate the role of UofG research in implementation activities; (2) Testimonial from the Acting Principal of COM, University of Malawi, to substantiate the role of UofG research in implementation activities.
- Other countries: (1) The Netherlands: *Gezonde Peutermonden* [website](#) [in Dutch; English translation of key pages available]; (2) Vanuatu: *Gudfala Tut Skul* [Facebook](#) page and policy document (July 2019).
- NICE [PH55 Oral health: local authorities and partners](#) (October 2014). See Recommendation 14 (p.20–p.21) and point 4.27 (p.41). Expert paper 2 presents an overview of *Childsmile*.
- Joint testimonial from the PHE National Lead for Child Oral Health Improvement and the PHE National Lead of Dental Public Health to substantiate the impact of UofG research on *Childsmile* for policy development in England.
- PHE policy documents: (1) [Local authorities improving oral health](#): commissioning better oral health for children and young people. An evidence-informed toolkit for local authorities (June 2014); (2) [PHE: York Health Economics Consortium](#). A rapid review of evidence on the cost-effectiveness of interventions to improve the oral health of children aged 0–5 years (September 2016). Anopa et al. [3.3] cited as ref. 6 (p.5–6, p.24–25, p.31); see also Tables 4–6 (p.18–24); Appendices 4–5 (p.53–57); (3) [Improving oral health](#): A toolkit to support commissioning of supervised toothbrushing programmes in early years and school settings (December 2016). See p.4, p.14; (4) [Oral health improvement programmes commissioned by local authorities](#) (May 2018). See key findings (p.5 and p.11–p.12) and discussion (p.16).
- UK Government: [Advancing our health: prevention in the 2020s](#) (July 2019). See p.5, p.51.
- Scottish Government: [Fairer Scotland Action Plan](#) (October 2016). See Fairness Action 23.
- Nursery supervised toothbrushing in Scotland: (1) Scottish Government [A National Clinical Strategy for Scotland](#) (February 2016). See section 2c (p.23); (2) Chief Medical Officer Scotland [Annual Report](#) 2016–2017. Anopa et al. [3.3] cited as ref. 93.
- [SIGN 138 Dental interventions to prevent caries in children](#) (March 2104). *Childsmile* cited throughout this document, including sections 3.4, 4.3, 5.5.2, 9.2, and 10.2.1
- Scottish Dental Clinical Effectiveness Programme [Prevention and management of dental caries in children](#) (May 2018). *Childsmile* cited throughout this document, including Appendix 2.