

Research Assessment Exercise 2020
Impact Case Study

University: The University of Hong Kong

Unit of Assessment (UoA): Clinical Dentistry (UoA4)

Title of case study:

Children's lives and opportunities transformed through new age-assessment method based on dental development

(1) Summary of the impact

Research at HKU has established the world's first dental age assessment dataset for Asian ethnicity based on a population sample from southern China. Use of the dataset has resulted in accurate age estimation for 252 previously undocumented children in India and China enabling birth registration and giving them for the first time access to schooling and health care. To date more than 300 dentists and forensic practitioners regionally have been trained to undertake age assessment with the dataset.

(2) Underpinning research

Multiple age assessment methods have been used in different countries when evaluating children who are striving for basic human rights, including physical and sexual maturity examination, psychological interviews and radiographic bone examination. However, these variables can be significantly affected by environmental factors, resulting in inaccurate assessment by years. In addition, methods involving large radiation dosage or inspecting of genitals were found invasive and insulting [1]. The timing of all stages of tooth development follows a sequential and organized pattern, so the developing dentition can be used as a maturity indicator in children and adolescents. Dental age assessment requires a panoramic radiograph with minimal radiation dose (6.7 μ Sv), equivalent to 1-3 days of background radiation. Dental age relates more reliably to chronological age than other physical or psychological attributes, so an individual's age can be assessed from dental development with a high degree of accuracy.

The research team in Hong Kong challenged the accuracy and applicability of the classical Demirjian's method for dental age assessment which is based on a data set derived from French-Canadians in 1970s, and concluded that it is an inaccurate approach to assess subjects from any contemporary global population because it often overestimated the age of subjects by over 6 months [2, 3]. Findings from the research team suggested that ethnic-specific and up-dated reference datasets should be established, and more advanced mathematical techniques should be developed to improve the accuracy of dental age assessment [2, 3]. Recent population genetic studies have strongly suggested that the southern Chinese are the origin of many population groups in East Asia, the team have therefore developed a reference dataset based on a sample of the southern Chinese population [4]. We demonstrated that this method could assess the chronological age of southern Chinese with the overall difference of less than 2.6 weeks for boys and 1.6 weeks for girls. This realistic, valid and reliable method of age estimation that developed based on clearly defined criteria of tooth development stages and statistical analyses can be used by any researchers and related authorities in civil, legal, criminal and forensic applications around the world to estimate age accurately. The precision of the southern Chinese dataset and age assessment method has been confirmed for northern Chinese [5] and other Asian ethnic groups such as Japanese and Thai [6].

The research work described above was supported by the following grants from the Research Grants Council of the Hong Kong Special Administrative Region, China:

Dental age assessment in Southeast Asians: Is the reference data set of southern Chinese applicable? (17126115)

Funding Scheme: General Research Fund

Principal Investigator: Dr Hai Ming WONG

Period of the Grant: January 1, 2016 – December 31, 2018

Amount Awarded: HK\$656,166

Dental age assessment: Development and validation of a reference data set for the southern Chinese and its application to the northern Chinese (17122914)

Funding Scheme: General Research Fund

Principal Investigator: Dr Hai Ming WONG

Period of the Grant: January 1, 2015 – June 30, 2017

Amount Awarded: HK\$470,700

Child risk factors for delayed eruption of permanent teeth (HKU 781112)

Funding Scheme: General Research Fund

Principal Investigator: Dr Hai Ming WONG

Period of the Grant: January 1, 2013 – December 31, 2015

Amount Awarded: HK\$524,356

(3) References to the research

1. Jayaraman J., Roberts G.J., Wong H.M., McDonald F., King N.M.; Ages of legal importance: Implications in relation to birth registration and age assessment practices. *Medicine, Science and the Law*, 2016, 56(1), 77-82.
2. Jayaraman J, Wong HM, King NM, Roberts GJ. The French-Canadian data set of Demirjian for dental age estimation: a systematic review and meta-analysis. *Journal of forensic and legal medicine*. 2013; 20(5): 373-381.
3. Jayaraman J, Wong HM, King NM, Roberts GJ. Secular trends in the maturation of permanent teeth in 5 to 6 years old children. *American Journal of Human Biology*. 2013; 25: 329-334.
4. Jayaraman J, Wong HM, King NM, Roberts GJ. Development of a Reference Data Set (RDS) for dental age estimation (DAE) and testing of this with a separate Validation Set (VS) in a southern Chinese population. *Journal of forensic and legal medicine*. 2016; 43: 26-33.
5. Wong HM, Wen YF, Jayaraman J, Li J, Sun L, King NM, Roberts GJ. Northern Chinese dental ages estimated from southern Chinese reference datasets closely correlate with chronological age. *Heliyon*. 2016; 2(12): e00216.
6. Jayaraman J, Wong HM, Roberts GJ, King NM, Cardoso HF, Velusamy P, Vergara RG, Yanagita KI, Jorns TP. Age estimation in three distinct East Asian population groups using southern Han Chinese dental reference dataset. *BMC Oral Health*, accepted for publication.

(4) Details of the impact

Our project has brought significant impact in social and legal aspects.

Assessment of age is an important step in birth registration, which, in most countries is a requirement for an individual to attain his/her age-appropriate legal and social benefits. Unfortunately, according to UNICEF data, over 60% of children under the age of 5 across the world were unregistered by 2012. Our team has been pointing out the significance of birth registration to an undocumented individual in terms of social welfare and protection, helping unregistered children to obtain registration and receive the rights they are entitled to [1]. Our team has established a charitable foundation, the D.O.B (Date of Birth) Foundation [2] registered in Hong Kong and India, to promote accurate birth records

and provide dental age assessments [3]. The team's public awareness programme has reached about 500 families in rural areas of India and China. Two hundred and fifty-two undocumented children in rural orphanages in Chennai [4], Mumbai [5] and Nerul [6], India had their ages estimated. They then obtained their birth certificates at the courts with the help of local lawyers.

Our representatives joined the 9th University Scholars Leadership Symposium (USLS) 2018 organized by the United Nations (UN) in Bangkok. We raised the issues of unregistered birth and possible exploitation of children against the United Nations' Convention on the Rights of the Child (UN CRC) when a child's age cannot be legally documented in front of 1,057 delegates from 87 countries.

(5) Sources to corroborate the impact

1. Dental test can give near precise Birth Date - Expert. Med India Network for Health.
www.medindia.net/health-press-release/Dental-Test-Can-Give-Near-Precise-Birth-Date-Expert-209073-1.htm

2. The D.O.B (Date of Birth) Foundation.
<http://dobfoundation.org/>
<https://www.facebook.com/DOB-Foundation-670112423017148>
Registration document of D.O.B (Date of Birth) Foundation

3. Charity to promote birth records - HKU academics will use dental X-rays to help assess the ages of unregistered children. South China Morning Post, 28 August, 2013.
<https://www.scmp.com/news/hong-kong/article/1299877/charity-promote-birth-records>

4. Teenage woes? No more lying through the teeth - Times of India, Chennai, 12 June 2014.
<https://timesofindia.indiatimes.com/city/chennai/Teenage-woes-No-more-lying-through-the-teeth/articleshow/36409816.cms>

5. 100 children to get their age certificates via a dental research project - - Times of India, Navi Mumbai, 15 August 2015.
<https://timesofindia.indiatimes.com/city/navi-mumbai/100-children-to-get-their-age-certificates-via-a-dental-research-project/articleshow/48487575.cms>

6. 102 kids get age certificates at spl dental camp in Nerul - Times of India, Navi Mumbai, 20 August 2015.
<https://timesofindia.indiatimes.com/city/navi-mumbai/102-kids-get-age-certificates-at-spl-dental-camp-in-Nerul/articleshow/48547199.cms>