Secular trends in dental development

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Secular trends are phenomena in physical maturation that are not cyclical or seasonal but develop over a relatively long period. An analysis of these patterns is of interest because they help us to understand the relationship between human development and the environment, as well as physiological aspects of intergenerational relationships in growth.

More importantly, secular trends can serve as indicators of developments in public health as it changes over time.¹ To give an example: the average age of menarche was 17.5 years during the 1800s and since then has decreased progressively at a rate of two to three months per decade. In 2006, a study on Dutch males found that their average age of menarche was 12.53 years.² Another positive trend was observed with regard to average body height: a study of Dutch males found that their height had increased from 165 cm in 1860 to 181 cm in 1990.³

In addition to skeletal development, secular changes have been reported with regard to body weight, body mass index and other physiological aspects of the human body, such as the dental arch or facial dimensions and other orofacial structures. They can be attributed to several factors, including changes in genetic pattern, socio-economic status, as well as nutrition, health and climatic conditions. Unlike skeletal development, however, dental maturation remains relatively unaffected by other maturation phenomena.³ The secular changes observed in dental development, which includes dental maturation and emergence, are reflections of these minor changes that have been occurring over several years.

While dental maturation is the development of the anatomical components of a tooth, a process that starts with the initiation of crown formation in utero and continues until closure of the root apex in the early twenties, dental emergence is the eruption of a tooth into its relative position in the arch.

There is evidence that secular trends exist for both of these processes. For example, research has demonstrated delayed dental maturation in the remains of eighteenth-century children compared with dental records of children living in modern England.⁴

By analysing the maturation of a permanent tooth, Nadler also found that children living in the 1900s showed advanced maturation compared with children born two decades earlier.³

A similar trend was observed in dental emergence in a study that found advanced emergence in Japanese children from the 1960s compared with children in 1954.⁶ Detected mostly in the permanent dentition, and to a minimal extent in the primary dentition, this finding was verified by research involving children in Finland, Germany and Hong Kong.

Dental development is a sequential process that varies substantially between the sexes and between populations with different ethnicities. For example, many studies have reported advanced dental development in females compared with males, a finding that is prevalent in all population groups. Similarly, advanced dental emergence has been observed in African-American children compared with Chinese and Japanese children.

Various secular trends have also been found in maxillary and mandibular dentition. There is a wide agreement that the latter is more advanced in dental maturation, as well as emergence, since mandibular teeth are the first to erupt in the oral cavity in both the primary and permanent dentitions.

Nadler reported advanced dental maturation based on evaluation of only the growth pattern of a mandibular canine. The reason for this approach comes from an earlier study that found a correlation between the maturation of mandibular canines and ossification centres in the hand. This study also concluded that a strong relationship exists between dental and skeletal development.³ The use of a single tooth type to analyse secular trends has been criticised by several authors for ignoring that each tooth exhibits different patterns of maturation. It has been suggested that all developing teeth must be included in the analysis in order to confirm a secular change. In our own study of 5- and 6-year-old children in Hong Kong, we found accelerated maturation of permanent teeth in children born in 2001 compared with children born in 1991. However, this trend was observed only in the maxillary dentition. As agreed by other investigators, in both year cohorts, females showed advanced development compared with males.⁷

With such strong evidence, we need to bring the applicability of common dental atlas charts, such as those developed by Schour and Massler, whose tables and charts are based on institutionalised American Caucasian children in the 1820s,⁸ to the current population into question. A recent study conducted in London tested the applicability of old and modern dental charts and found that the older charts were inaccurate. However, most clinical textbooks in dentistry still reproduce these charts, mainly because few other population-specific dental charts exist.

There is a need for evidence-based dental charts created from modern and healthy samples identified by sex and ethnicity. Once created, they could not only serve as an eminent tool in forensic dentistry for estimating the age of subjects with undocu-