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# Timing and sequence of emergence of permanent teeth in the Jordanian population

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## ABSTRACT

**Objectives:** Population-specific standards of tooth emergence are essential resources for various fields of clinical and forensic dentistry. To date, such standards have not been provided for the Jordanian population. This study aimed at providing the timing and sequence of emergence of the permanent dentition in the Jordanian population.

**Methods and results:** Using multistage clustered sampling, 1240 males and 1432 females aged 4–16 years from kindergartens and primary schools in the northern, middle and southern regions of Jordan were examined for emergence of permanent teeth. The subjects were classified into 1-year age groups. For a given tooth, “present” teeth were counted and expressed as a frequency relative to the total of subjects within a given age group. Using Probit regression (SPSS version 16), the median emergence age per tooth was calculated for the total sample and for both genders. No statistically significant differences were detected between sides. In addition, mandibular teeth were generally found to emerge earlier than the corresponding maxillary teeth. However, the difference in mandibular precedence was not statistically significant in all corresponding inter-maxillary tooth pairs. Furthermore, permanent teeth were found to emerge sooner in females than in males although the inter-gender differences were non-statistically significant for first molars and central incisors.

**Conclusions:** The first standards of timing and sequence of permanent tooth emergence specific to the Jordanian population were provided and found to be consistent with those of Caucasian populations. These standards aid managing patients in paediatric dentistry, planning orthodontic therapy and forensic age estimation.

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## 1. Introduction

Updated population-specific standards on the timing and sequence of permanent tooth emergence are crucial resources for dentists and auxiliaries working in different fields of clinical dentistry such as paediatrics, orthodontics, oral pathology and surgery as well as forensic odontology. Such standards, which provide the normal age range and sequence of emergence of the permanent dentition, help diagnose untimely developmental odontogenic anomalies and make

the decision upon whether to treat or extract badly carious deciduous teeth and whether to provide space maintenance following their extraction. In addition, orthodontists frequently rely on the timing and sequence of permanent tooth emergence to decide when to begin and how to design orthodontic treatment. Furthermore, paediatric dentists, auxiliaries and investigators can refer to these standards, which represent the norms of temporal variation, in diagnosing and studying deviations and problems of tooth emergence in children with craniofacial developmental abnormalities and syndromes. Finally, such standards can find application in

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dental age estimation in the fields of forensic dental science and police investigations.

A number of biological and environmental factors have been recognised to affect the time and sequence of emergence of the permanent teeth. Biological factors are non-acquired and related to the genetically determined biological variation between individuals such as gender difference,<sup>1–5</sup> ethnic derivation,<sup>6–10</sup> craniofacial growth and craniofacial morphology.<sup>11</sup> On the other hand, environmental factors are acquired and non-genetically determined. Examples of some environmental factors that may affect the time and sequence of tooth emergence include fluoride intake,<sup>12</sup> caries,<sup>12–16</sup> premature extraction of predecessors,<sup>13,17–19</sup> physique,<sup>20–22</sup> nutrition,<sup>20,23</sup> socio-economic class<sup>24,25</sup> and secular trends.<sup>1,26,27</sup>

The significance of chronological variation in permanent tooth emergence from one population or ethnic group to another cannot be over-emphasised.<sup>6–10</sup> For example, it has been ascertained that Negroes have earlier emergence of permanent teeth than Caucasians.<sup>8</sup> Therefore, for valid clinical assessment of the timing and sequence of tooth emergence in a child, it is always recommended that dental practitioners refer to the standards of tooth emergence derived from the population to which that child belongs to. Accordingly, dental investigators all over the world have enriched the literature with studies providing population-specific standards of tooth emergence.<sup>1–7,9,28–35</sup> Whilst a limited number of studies on tooth emergence have been conducted on the Middle Eastern or Arab populations,<sup>3,5,34</sup> none have reported data for the Jordanian population specifically. For that reason, dentists working in Jordan have still been referring to the standards available in the textbooks of oral anatomy<sup>36,37</sup> (derived from papers reporting old studies conducted on American or British populations) in management of their patients.

The aim of this study was to provide the first standards specific to the Jordanian population on the timing and sequence of emergence of the permanent dentition to act as valid resources for dental clinicians working in Jordan and treating Jordanian children and adolescents. Such standards will be the basis for future studies investigating the timing and sequence of emergence of the permanent dentition in children with various craniofacial developmental abnormalities and syndromes. In addition, the same methodology followed in this study is intended to be re-used for providing the first Jordanian standards on deciduous tooth emergence.

## 2. Materials and methods

For this cross-sectional study, data were collected from 2672 school children and adolescents: 1432 females and 1240 males aged 4–16 years. All participants were Jordanian citizens of Arab ancestry. Ethnically, 95–97%<sup>a</sup> of Jordanians are Caucasoid Arabs who have been living in the region for several generations. Therefore, the subjects of this study are assumed to have common ancestry with minimal ethnical divergence. All the selected participants were healthy and did not suffer from any systemic illnesses.

The study received ethical approval from the Committee of Research on Humans in Jordan University of Science and Technology through the Deanship of Research. In addition, the study was approved by the Ministry of Education as the sample was derived from pupils at primary schools and kindergartens.

In order to cover the geographical regions of Jordan, the population of Jordan was classified into northern, middle and southern regions. The Governorates of Irbid, Amman and Karak were the most populous in their regions and assumed to demonstrate the greatest variation according to many of the factors influencing the time of tooth emergence such as the socio-economic class, urban–rural distribution, fluoride intake, caries, untimely loss of predecessor teeth, nutrition and access to dental care. For this reason, those governorates were chosen to represent the northern, middle and southern regions respectively. It is worth to mention that the Governorate of Amman is the most populous in Jordan followed by the Governorate of Irbid and about half of the Jordanians live in both governorates.<sup>a</sup> On the other hand, the Governorate of Karak is relatively less populated but the most populous in its region.<sup>a</sup>

Each of the selected governorates contained urban and rural districts. All of the districts within one governorate were included in the sampling process. In all urban districts, there were kindergartens and 3 types of primary schools; governmental, private and UNRWA.<sup>b</sup> On the other hand, all rural districts contained governmental schools, some contained kindergartens and none contained UNRWA's or private schools. However, participant selection did not consider variation in school type or the correlated socio-economic class.

The sampling was based on multistage clustering. Within each urban district, two schools per school type (one for boys and one for girls) and one kindergarten were randomly selected. Most of the selected private schools were mixed gender schools. In such situations, only one private school was selected per urban district. In the rural districts, two governmental primary schools (one for boys and one for girls) and a kindergarten (if present) were selected.

The Governorates of Irbid and Amman are presumably similar in terms of the distribution of school types and kindergartens. School children in both governorates are not believed to be different with respect to the urban–rural living standards, socio-economic status, level of nutrition and the access to dental care and dental education. Therefore, it is assumed that there are no substantial differences between subjects from the Governorates of Irbid and Amman according to the above-mentioned factors. Nevertheless, the potential differences between the northern and middle regions of Jordan according to those factors are intended to be investigated and presented in future publications.

On the other hand, school children in the Governorate of Karak are supposed to have relatively different urban–rural living standards and lower levels of socio-economic class, nutrition and access to dental care and dental education. Fortunately, the number of subjects included from the

<sup>a</sup> <http://en.wikipedia.org/wiki/Jordan#Demographics>.

<sup>b</sup> United Nations Relief and Works Agency of Palestinian Refugees in the Near East.

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