VERTAISARVIOITU
KOLLEGIALT GRANSKAD
PEER-REVIEWED
www.tsv.fi/tunnus

Accepted for publication
14.5.2025

Apollonia 1/2026
Review

Minor or adult? A different approach in the Nordic countries vs Europe

Svend Richter, Sigrid Ingeborg Kvaal, Rebecca Gahn,
Mari Metsäniitty, Sara Tangmose Larsen

Around 1 out of 5, or 150 million children, under the age of 5 worldwide are unregistered or lack a birth certificate. Unaccompanied minor migrants have many benefits that are inaccessible to adults. It is evident that the age of migrants is one of the key variables that must be ascertained. Equally, it is important that juveniles are housed under safe conditions, including not with adults who are professing to be children.

In contrast to teeth, bone growth is dependent on nutrition and external factors. Teeth and bone develop independently and, consequently, it might be a good argument for using both dental and bone development in medical age estimation.

The Nordic countries use dental development to estimate the age especially by staging wisdom teeth from radiographs. All countries also estimate age based on skeletal maturity. In addition, Finland and Denmark use physical maturity criteria and Denmark uses sexual maturity. Various recognised scientific methods are used by the different countries.

All EU + countries, except Ireland, approve some form of medical age assessment. 21 use dental radiograph analysis and 16 dental observations. 23 countries use carpal (hand/wrist) radiographs, 14 collarbone radiographs and 2 knee MRIs and 8 sexual maturity observations.

Keywords: Age assessment, unaccompanied minors, Nordic countries, Europe

Clinical relevance

Around 1 out of 5 children under the age of five worldwide are unregistered or lack a birth certificate. Unaccompanied minors have benefits in asylum processes; therefore, their age must be ascertained. All of the Nordic countries stage wisdom teeth from radiographs and all also estimate age based on skeletal maturity. Teeth and bone develop independently, hence the use of both is beneficial. In addition, Finland and Denmark use physical maturity and Denmark sexual maturity. All EU+ countries, except Ireland, approve some form of medical age assessment. Dentists should have a basic understanding of medical age estimations in order to be able to answer questions from patients.

Unaccompanied minors are children under the age of 18 years (1), who have been separated from both their parents and other relatives and are not being cared for by an adult who, by law, is responsible for doing so.

Today, around 1 out of 5, or 150 million children, under the age of 5 worldwide are unregistered or lack a birth certificate (Figure 1). This essential document serves as proof of registration and is critical for acquiring nationality and ensuring that children can enjoy their rights from birth (2). In Table 1 and Figure 2, the percentage of children with a birth registration on a global level is illustrated.

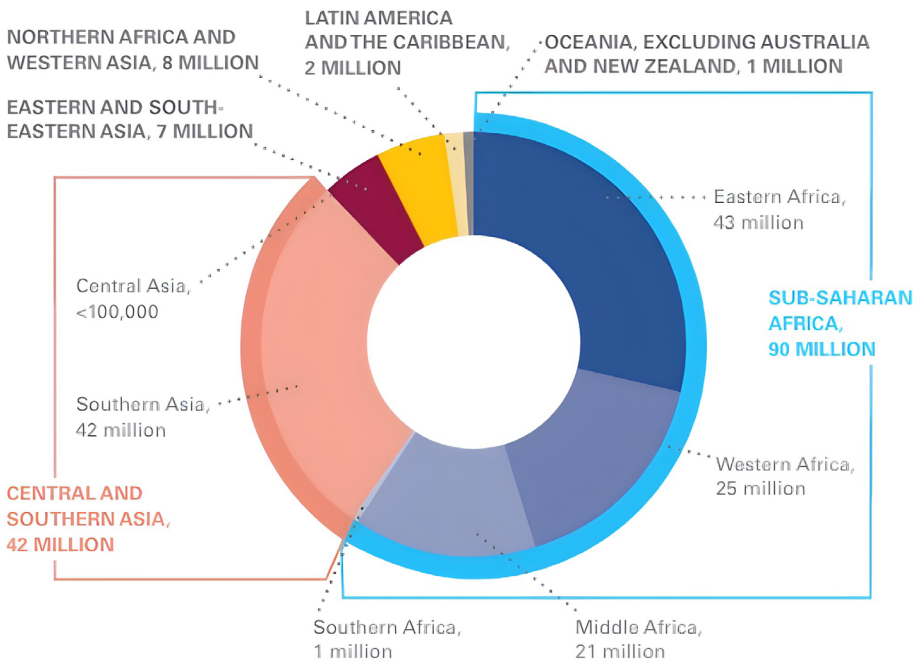


Figure 1. Number of infants under age 1 whose births are not registered, by region. Source UNICEF 2024 (2).

Countries and area	Children under 1 year	Children under 5 years
East Asia and Pacific	85	93
Europe and Central Asia	99	100
Eastern Europe and Central Asia	99	99
Western Europe	100	100
Latin America and Caribbean	90	95
Middle East and North Africa	87	89
North America	100	100
South Asia	71	76
Sub-Saharan Africa	46	52
Eastern and Southern Africa	52	46
West and Central Africa	43	57
Least developed countries	43	49
World	**71**	**77**

Table 1. Percentage of birth registration of children under the age of 1 and 5 worldwide. Source: UNICEF 2024 update (3).

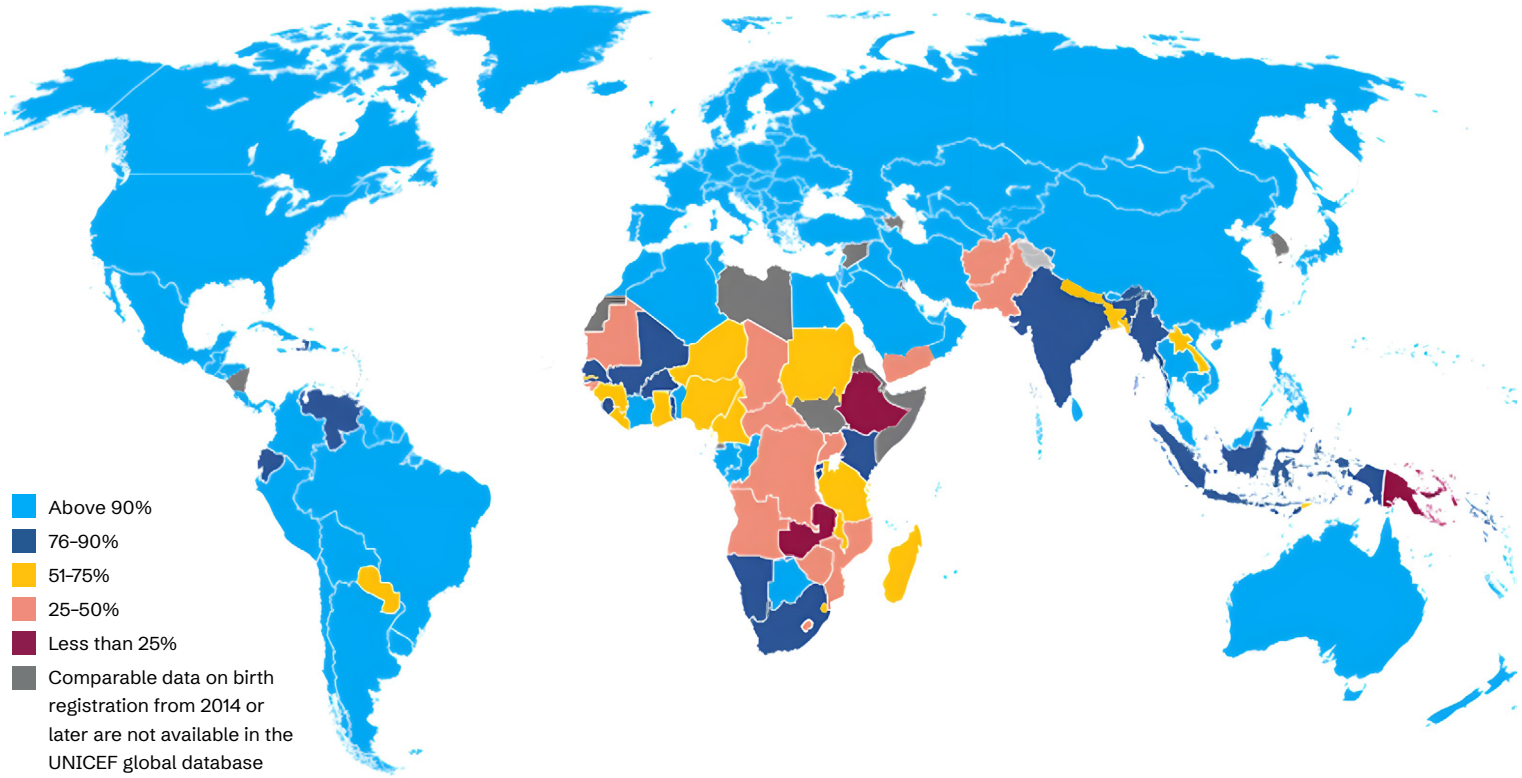


Figure 2. Percentage of children under age 5 whose births are registered. Source UNICEF 2024 (2).

Countries with the lowest level of birth registration are primarily in Sub-Saharan Africa

A rapidly growing child population means that if current trends continue, there could be close to 115 million unregistered children under the age of 5 in sub-Saharan Africa by 2030 (2).

Many migrants in Europe and the Nordic countries come from Africa and South Asia, stating that they are unaccompanied minors and submitting credentials which are questioned. It is, therefore, evident that the age of migrants is one of the key variables that must be ascertained, since it carries significant legal implications. Many benefits that unaccompanied minors have in asylum processes are usually inaccessible to adult migrants. Equally, it is important that juveniles are housed under safe conditions, including not with adults who are professing to be children (4).

Children have different rights from those of adults

Unaccompanied minors constitute a vulnerable group and are legally entitled to protection and special treatment, including the right to a guardian, education and healthcare (2, 5). National legislation determines the acquisition of specific rights and obligations at varying age thresholds (5). In the Nordic countries, key legal age thresholds include 15 years, which is the age of criminal responsibility and sexual consent, except for sexual consent in Finland and Norway, where it is 16 years. The age of majority for all Nordic countries is 18 years (6, 7).

The effect of ethnicity, diseases and nutrition on age analysis

In the past, ethnicity was often considered to play a significant role in medical age assessment (8). However, more recent studies have challenged this perspective, suggesting that the ethnicity may not significantly impact the dental development or skeletal maturity (9–12). The studies that suggest that ethnicity could influence dental maturity (13) could be subjected to age mimicry, meaning that the differences are more likely to reflect variations in the study populations (14). Others attribute these differences to variations in socioeconomic factors (15).

Stress and living conditions, as well as systematic diseases, are also believed to impact skeletal and dental development (16, 17). Skeletal age is often delayed in individuals from lower socioeconomic backgrounds, leading to an underestimation of their chronological age (18, 19). A study by Cardoso shows that socioeconomic factors impact skeletal growth more than dental development, indicating that dental development is

less influenced by environmental factors (18). Consequently, individuals from lower socioeconomic backgrounds may be assessed as being younger than their actual age.

AGFAD

The Arbeitsgemeinschaft für Forensische Altersdiagnostik (AGFAD) is a multidisciplinary working group that brings together forensic pathologists, forensic odontologists, radiologists, and anthropologists. Its primary goal is to harmonise different evidence-based approaches that are used in forensic age estimation and to ensure the quality of the assessments based on available scientific data and expert opinions. AGFAD works to develop and standardise guidelines and methodologies for determining age, particularly in situations where the age of individuals is uncertain, such as in cases involving migrants without any valid identification (20).

Ionising radiation

X-rays, a type of ionising radiation, are useful for diagnostic purposes, including an assessment of dental and skeletal development. Ionising radiation is a type of energy released by atoms that can be viewed as either electromagnetic waves or photons and can be harmful to humans. However, people are exposed to natural sources of ionising radiation, including background radiation and man-made sources, such as medical radiation (21).

Age assessment in the Nordic countries

Iceland

An agreement between the University of Iceland and the Directorate of Immigration (UTL) on age assessment was not renewed, as the university believed that psychological interviews had not been carried out. There has been criticism towards the use of medical age estimation, i.e. in the university. It went so far that the university did not authorise age assessment at the Faculty of Odontology. To fulfil social responsibilities, forensic odontologists undertook the assessment on a private basis. An agreement has now been signed between the UTL and the National Police Commissioner to host the assessments.

Two forensic odontologists perform age estimations. A panoramic radiograph and intra-oral radiographs of third molars are analysed according to Liversidge (8), Mincer et al. (22), Kullman et al. (23) and AlQahtani et al. (24). Skeletal age is estimated from the hand and wrist according to Greulich and Pyle (25). The margin of error is given by the averages and SD of each method. The final results are submitted as to whether it is likely that the applicant is younger than 18 years of age. The applicant benefits from any doubt.

Denmark

Medical age estimations are performed by request of the Danish Immigration Service. A physical examination is conducted by a forensic pathologist and includes an interview that gathers anamnestic information on general health and upbringing conditions, as well as anthropometric measurements of height and weight, and a visual assessment of secondary sexual development based on Tanner stages (26).

Bone age is assessed by a radiologist, using a radiograph of the left hand-wrist and the Greulich and Pyle (GP) atlas method (25). Dental age is evaluated through panoramic radiographs, complemented by radiographs of all four third molars. The crown and root development of these molars is analysed by a forensic odontologist, using the 10 stages (C½ - Ac) by Gleiser and Hunt, modified by Köhler (27). Each of the four third molars contributes one stage. Reference studies by Köhler, Haavikko, and Mincer (22, 27, 28) are used to determine mean chronological ages for each stage.

The final dental age is calculated by averaging the individual dental ages and rounding down to the nearest age. Bone and dental ages are then combined to produce a conclusive age estimate, which includes a most likely age/age range and a margin of error at +/- 1, 2, and 3 standard deviations (SDs), using an SD of +/- 1 year. This approach accounts for an overall range of approximately 8–9 years.

Sweden

To determine if asylum seekers are under or over the age of 18, a medical age assessment is offered by the Swedish Migration Agency to unaccompanied migrants without credible documents, or there is an uncertainty of age after interviews with social services (29). The procedure is voluntary and requires written consent from the applicant (30). Since 2016, the Swedish National Board of Forensic Medicine has been commissioned to conduct medical age assessments, both within the asylum process and in criminal proceedings.

The chosen method is based on a validated statistical model that determines the developmental stage of the third molar in combination with a skeletal indicator, i.e. MRI of the distal femur (31), radiographs of the hand and wrist (32) or CT scans of the clavicle (33) based on the age threshold being evaluated in relation to the 15-, 18- and 21-year-old threshold (34).

Radiographs of the third molar are analysed according to Demirjian (35). Assessments are presented as probabilities that a person is over or under the age

threshold of interest and not as an exact chronological age. The margin of error is always included in the statement (34). For the staging of third molars, two forensic odontologists assess a panoramic radiograph, blinded and independently. If assessments diverge, the lower stage is chosen.

The forensic odontologist must have knowledge of age estimation and undergo a calibration exercise, with a minimum result of 0.8 (Cohens Kappa). The same requirements are used for assessing skeletal maturity.

Norway

If the Norwegian Directorate of Immigration (UDI) is in doubt as to whether an applicant is a minor when seeking asylum, the applicant is asked to undergo an age assessment. Current practice involves only a radiograph of one of the wisdom teeth. Two experienced dentists gauge the developmental stage according to Demirjian's stages (35).

BioAlder, which is a statistical calculation model based on hand skeleton and lower left wisdom tooth development and yields 75% and 95% prediction intervals for chronological age and based on results from radiographs of the wisdom tooth and hand skeleton (7). When the application is processed, UDI will always consider the report from BioAlder, together with the other details about age.

Finland

According to the Aliens Act (36), the immigration authorities refer asylum seekers to the Finnish Institute for Health and Welfare (THL) for a forensic age assessment. In criminal proceedings, the police can refer an immigrant to THL for an age assessment (37). The person must give written consent for the radiographic examinations. The applicant and their legal representatives shall be given information concerning the age assessment, methods used and potential health effects, as well as information on the consequences of undergoing and refusing the age assessment (37).

The assessment is largely based on dental development and is always performed by two forensic odontologists, one of whom is affiliated with THL. They need to have a special competence in forensic odontology, a specialised training programme (38). The examinee is first interviewed, including their medical history, and the measurement of height and weight is performed. A forensic age assessment includes a dental panoramic radiograph and a radiograph of the left hand and wrist, including BoneXpert analysis (an autonomous and validated AI tool that calculates age) (39).

Figure 3. To determine whether an immigrant is a minor or an adult, third molars are useful.

Age assessment in Europe, EU+ countries

It is recommended to rely on governmental information on age assessments more than NGOs (nongovernmental organisation), often voluntary organisations operating independently of any government, typically one whose purpose is to address a social or political issue and often rely on voluntary donations (40).

No reliable information was obtained from some European countries; therefore, only the 30 so-called EU+ countries will be discussed.

In 2022, the European Asylum Support Office (EASO) became the European Union Agency for Asylum (EUAA). It offers practical guidance, key recommendations and tools on the implementation of the best interests of the child. It also brings up-to-date information on the methods conducted by EU+ states (5, 41).

Twelve EU+ countries use a holistic and/or multidisciplinary approach when assessing applicants' age, and 15 not. An age assessment process conducted in another EU+ country is accepted in 9 EU+ countries and not accepted and reassessed in 16 countries (41).
In Table 2, all EU + countries, except Ireland, approve some form of medical age assessment. 21 use dental radiographs and 16 dental observations. 23 countries use carpal (hand/wrist) radiographs, 14 collarbone radiographs and 2 knee MRIs and 8 sexual maturity observations (5, 41).

Advantages of using more than one dental method

Because of the wide variation in material and statistical methods, different dental age estimations will give different answers when applied to the same material. It has been recommended to use more than one method,

and some believe that this would give more accurate results. With the current knowledge, it is more important to look at the background material which constituted the research material and the statistical approach (Figure 3).

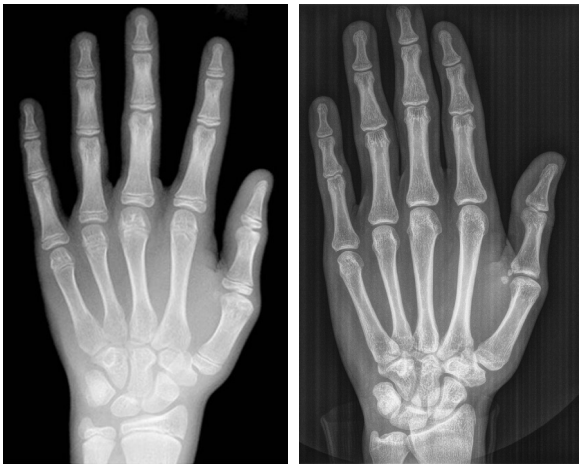
Advantages of using estimation analysis of teeth and bone together

In the same way that dental development is staged, so is bone growth. The most commonly used bones are those in the hand/wrist (Figure 4). Like teeth, these bones are graded according to an atlas (25). Teeth and bone develop independently; consequently, it might be a good argument for using both dental and bone development. Research has demonstrated that there is a close correlation between bone and dental age (43). If bone age and dental age are close, it might also be close to chronological age, but if they differ, one must look for a reason behind such a difference.

Staging, whether in bone or teeth, is always subjective. BoneXpert is the only automatic and objective grading (39) process. Although Norway, at present, only uses Demirjian's stages on wisdom teeth, the BioAge tables are based on a very large sample from all over the world (7).

Presentation of age estimation, age range, and other results

All age estimates inherently involve uncertainty, which must be communicated in forensic statements (9). Ideally, age assessments should be based on multiple biological traits, with the results including a margin of error (43). Some advocate for expressing this uncertainty through a Bayesian or transition analysis approach in order to reduce the age-mimicry bias (11, 44). The AGFAD propose using the minimum-age as a conservative approach, reducing the unethical risk of erroneously assessing children as adults (6). However, this can lead to more adults being misclassified as children, potentially compromising the protection of minors' rights and privileges.



A B

Figure 4. A, B. According to Greulich and Pyle (25), left (A): 14 years old boy, skeletal development is still ongoing; right: Epiphyseal lines disappear in males at around age 19 and in females at around age 18, as skeletal development comes to an end.

Integrating multiple biological traits into a single age estimate presents significant challenges, including the need for large reference samples and complex computational methods (7, 34, 44, 45). While Denmark, Iceland and Finland still base the age estimate on reference samples reporting mean ages and standard deviations, Norway and Sweden have successfully developed models that use a Bayesian approach for age assessment. The BioAlder presents age estimates as either 75% or 95% probability intervals (7), whereas the Swedish age assessment method reports likelihood ratios, indicating how probable specific developmental stage combinations are for individuals aged, e.g. 18 years or older when compared to those under 18 years (34).

To reduce inconsistencies in age estimation practices, the Nordic countries should work toward a more unified approach to forensic age estimation in unaccompanied asylum-seeking migrants where the age is questioned. ■

Table 2. Overview of the procedural safeguards in use during age assessment processes in 30 EU + countries.

30 EU+ state	NON-MEDICAL METHODS					MEDICAL METHODS							
	Documents submitted	Estimations based on physical appearance	Age assessment interview	Social service assessment	Psychological interviews	Dental observation	Physical development	Sexual maturity observation	Carpal (hand/ wrist) X-ray	Knee MRI	Collar bone X-ray	Dental X-ray	Other
Austria	√	√	√			√	√	√	√		√	√	
Belgium	√		√	√		√			√		√	√	
Bulgaria	√	√				√	√		√				
Croatia	√	√		√	√	√	√	√	√			√	
Cyprus	√		√	√		√			√			√	
Czech Republic	√								√				
Denmark	√		√				√	√	√			√	
Estonia	√	√	√	√	√		√	√	√		√	√	
Finland	√					√	√		√			√	
France	√		√		√				√		√	√	
Germany	√	√	√	√	√	√	√	√ **	√		√	√	
Greece	√	√	√	√	√	√	√					√	
Hungary	√	√	√			√		√	√			√	***
Iceland	√		√						√			√	
Ireland	√	√	√	√									
Italy	√	√	√	√	√ *	√	√	√	√			√	
Latvia						√	√		√		√	√	
Lithuania	√	√							√		√		
Luxembourg									√		√		***
Malta	√		√						√				
Netherlands	√	√									√		
Norway	√	√	√									√	
Poland	√	√				√	√		√			√	
Portugal	√	√				√			√			√	****
Romania		√				√		√	√		√	√	
Slovakia	√	√ (68)		√ (69)		√			√		√	√	
Slovenia	√	√							√		√		
Spain	√		√							√	√		
Sweden	√		√	√						√		√	
Switzerland	√	√	√			√	√				√	√	
	27	18	17	10	6	16	12	8	23	2	14	21	3

(*) For victims of trafficking in human beings or vulnerable persons
(**) Visual assessment
(***) Pelvic bone X-ray
(****) Fourth rib (PT)

(68) The initial estimation of age is only a guide, if it is determined by this estimation that a person is a minor. If he/she claims to be a minor and is suspected to be an adult, a medical examination is always undertaken. So the principle of benefit of the doubt is used in this initial estimation.
(69) In SK there are only some consultations with social workers.

Table 2. Overview of the procedural safeguards in use during age assessment in 30 EU+ countries.

SVEND RICHTER
DDS, MSc, Associate professor emeritus, Forensic odontologist, Faculty of Odontology, University of Iceland
svend@hi.is
Orcid ID: 0000-0002-9504-4043

SIGRID INGEBORG KVAAL
BDS, dr. odont, Associate professor emerita, Faculty of Dentistry, University of Oslo
s.i.kvaal@odont.uio.no
Orcid ID: 0000-0002-3825-9048

REBECCA GAHN
DDS, Forensic odontologist, Department of Forensic Medicine, The National Board of Forensic Medicine, Sweden
Rebecca.gahn@rmv.se
Orcid ID: 0009-0006-3480-1561.

MARI METSÄNIITTY
DDS, PhD, forensic odontologist, Finnish Institute for Health and Welfare
mari.metsaniitty@thl.fi
Orcid ID: 0000-0001-8437-1607

SARA TANGMOSE LARSEN
MD, PhD, Forensic Pathologist, Department of Forensic Medicine, Section of Forensic Pathology, University of Copenhagen, Denmark
saral@sund.ku.dk
Orcid ID: 0000-0002-2210-7576

References

1. Convention on the Rights of the Child, Article 1. 1989, UN General Assembly resolution 44/25. [https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-rights-child].
2. United Nations Children's Fund. Birth registration (December, 2024). UNICEF, New York.
3. United Nations Children's Fund. The Right Start in Life: Global levels and trends in birth registration. 2024 update. UNICEF, New York.
4. Cummaudo M, Obertova Z, Lynnerup N, Petaros A, de Boer H, Baccino E et al. Age assessment in unaccompanied minors: assessing uniformity of protocols across Europe. Int J Legal Med 2024; 138(3): 983–95. https://doi.org/10.1007/s00414-024-03157-8
5. European Asylum Support Office (EASO). Age assessment practices in EU+ countries: updated findings. EASO Practical Guide Series. Luxembourg: Publication Office of the European Union; 2018.
6. Larsen ST, Arge S, Lynnerup N. The Danish approach to forensic age estimation in the living: how, how many and what's new? A review of cases performed in 2012. Ann Hum Biol 2015; 42(4): 342–7. https://doi.org/10.3109/03014460.2015.1044469
7. Bleka Ø, Rolseth V, Dahlberg PS, Saadé A, Saadé M, Bachs L. BioAlder: a tool for assessing chronological age based on two radiological methods. Int J Legal Med 2019; 133(4): 1177–89. https://doi.org/10.1007/s00414-018-1959-5
8. Liversidge HM. Timing of human mandibular third molar formation. Ann Hum Biol 2008; 35(3): 294–321. https://doi.org/10.1080/03014460801971445
9. Schmeling A, Reisinger W, Loreck D, Vendura K, Markus W, Geserick G. Effects of ethnicity on skeletal maturation: consequences for forensic age estimations. Int J Legal Med 2000; 113(5): 253–8. https://doi.org/10.1007/s004149900102
10. Cameriere R, De Luca S, Ferrante L. Study of the ethnicity's influence on the third molar maturity index (I3M) for estimating age of majority in living juveniles and young adults. Int J Leg Med 2021; 135(5): 1945–52. https://doi.org/10.1007/s00414-021-02622-y
11. Thevissen PW, Fieuws S, Willems G. Human dental age estimation using third molar developmental stages: does a Bayesian approach outperform regression models to discriminate between juveniles and adults? Int J Legal Med 2010; 124(1): 35–42. https://doi.org/10.1007/s00414-009-0329-8
12. Pechnikova M, Gibelli D, De Angelis D, de Santis F, Cattaneo C. The "blind age assessment": applicability of Greulich and Pyle, Demirjian and Mincer aging methods to a population of unknown ethnic origin. Radiol Med 2011; 116(7): 1105–14. https://doi.org/10.1007/s11547-011-0694-5
13. Olze A, Schmeling A, Taniguchi M, Maeda H, van Niekerk P, Wernecke K-D et al. Forensic age estimation in living subjects: the ethnic factor in wisdom tooth mineralization. Int J Legal Med 2004; 118(3): 170–3. https://doi.org/10.1007/s00414-004-0434-7
14. Rolseth V, Mosdøl A, Dahlberg P, Ding Y, Bleka Ø, Skjerven-Martinsen M et al. Age assessment by Demirjian's development stages of the third molar: a systematic review. Eur Radiol 2019; 29(5): 2311–21. https://doi.org/10.1007/s00330-018-5761-z
15. Schmidt PS, SerrÃo EA, Pearson GA, Riginos C, Rawson PD, Hilbish TJ et al. Ecological Genetics in the North Atlantic: Environmental Gradients and Adaptation at Specific Loci. Ecology 2008; 89 (11 Suppl): S91–107. https://doi.org/10.1890/07-1162.1
16. Atar M, Körperich EJ. Systemic disorders and their influence on the development of dental hard tissues: A literature review. J Dent 2010; 38(4): 296–306. https://doi.org/10.1016/j.jdent.2009.12.001
17. Adler C. Disorders of Skeletal Development. Bone Diseases. Springer; 2000: 31–63. https://doi.org/10.1007/978-3-662-04088-1_3
18. Cardoso HFV. Environmental effects on skeletal versus dental development: Using a documented subadult skeletal sample to test a basic assumption in human osteological research. Am J Phys Anthropol 2006; 132(2): 223–33. https://doi.org/10.1002/ajpa.20482
19. Schmeling A, Reisinger W, Geserick G, Olze A. Age estimation of unaccompanied minors. Part I. General considerations. Forensic Sci Int 2006; 159 Suppl 1: S61–4. https://doi.org/10.1016/j.forsciint.2006.02.017
20. Schmeling A, Grundmann C, Fuhrmann A, Kaatsch HJ, Knell B, Ramsthaler F et al. Criteria for age estimation in living individuals. Int J Legal Med 2008; 122(6): 457–60. https://doi.org/10.1007/s00414-008-0254-2
21. Abalo KD, Rage E, Leuraud K, Richardson DB, Le Pointe HD, Laurier D et al. Early life ionizing radiation exposure and cancer risks: systematic review and meta-analysis. Pediatr Radiol 2020; 51(1): 45–56. https://doi.org/10.1007/s00247-020-04803-0
22. Mincer HH, Harris EF, Berryman HE. The A.B.F.O. study of third molar development and its use as an estimator of chronological age. J Forensic Sci 1993; 38(2): 379–90. https://doi.org/10.1520/JFS13418J
23. Kullman L, Johanson G, Akesson L. Root development of the lower third molar and its relation to chronological age. Swed Dent J 1992; 16(4): 161–7.
24. AlQahtani SJ, Hector MP, Liversidge HM. Brief communication: The London atlas of human tooth development and eruption. Am J Phys Anthropol 2010; 142(3): 481–90. https://doi.org/10.1002/ajpa.21258
25. Greulich WW, Pyle SI. Radiographic atlas of skeletal development of the hand and wrist. 2. painos. Stanford University Press; 1959.

26. Tanner JM. Growth at Adolescence. C. C. Thomas; 1955.

27. Köhler S, Schmelzle R, Loitz C, Püschel K. Development of wisdom teeth as a criterion of age determination. Ann anat 1994; 176(4): 339–45.

28. Haavikko K. The formation and the alveolar and clinical eruption of the permanent teeth. An orthopantomographic study. Suom Hammaslaak 1970; 66(3): 103–70.

29. SFS 2005:716. Utlänningslag (2005:716). [https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/utlanningslag-2005716_sfs-2005-716/].

30. Migrationsverket. Rutin: Informera om medicinsk åldersbedömning. 2025.

31. Krämer JA, Schmidt S, Jürgens KU, Lentschig M, Schmeling A, Vieth V. Forensic age estimation in living individuals using 3.0T MRI of the distal femur. Int J Legal Med 2014; 128(3): 509–14. https://doi.org/10.1007/s00414-014-0967-3

32. Anderson M. Use of the Greulich-Pyle ”Atlas of Skeletal Development of the Hand and Wrist” in a clinical context. Am J Phys Anthropol 1971; 35(3): 347–51. https://doi.org/10.1002/ajpa.1330350309

33. Schmeling A, Schulz R, Reisinger W, Mühler M, Wernecke KD, Geserick G. Studies on the time frame for ossification of the medial clavicular epiphyseal cartilage in conventional radiography. Int J Legal Med 2004; 118(1): 5–8. https://doi.org/10.1007/s00414-003-0404-5

34. Heldring N, Rezaie AR, Larsson A, Gahn R, Zilg B, Camilleri S et al. A probability model for estimating age in young individuals relative to key legal thresholds: 15, 18 or 21-year. Int J Legal Med 2024; 139(1): 197-217. https://doi.org/10.1007/s00414-024-03324-x

35. Demirjian A, Goldstein H, Tanner JM. A new system of dental age assessment. Hum Biol 1973; 45(2): 211-27.

36. Finlex. Lainsäädäntö. Ulkomaalaislaki 301/2004 ja lain muutokset 389/2023 saakka. [http://www.finlex.fi/fi/laki/ajantasa/2004/20040301].

37. Metsäniitty M, Varkkola O, Waltimo-Sirén J, Ranta H. Forensic age assessment of asylum seekers in Finland. Int J Legal Med 2017; 131(1): 243–50. https://doi.org/10.1007/s00414-016-1498-x

38. Metsänitty M. Age assessment in Finland and dental development in Somali. Department of Forensic Mediceine, University of Helsinki; 2019.

39. Thodberg HH, van Rijn RR, Jenni OG, Martin DD. Automated determination of bone age from hand X-rays at the end of puberty and its applicability for age estimation. Int J Legal Med 2016; 131(3): 771–80. https://doi.org/10.1007/s00414-016-1471-8

40. Karns M. Nongovernmental organization. Encyclopaedia Britannica. 2025.

41. European Asylum Support Office (EASO). Age assessment practices in EU+ countries: updated findings. EASO Practical Guide Series. Luxembourg: Publication Office of the European Union; 2021.

42. Haugen M, Teigland A, Kvaal S. Assessing agreement between skeletal and dental age estimation methods. Institution: Norwegian computing centre 2013 Report Number: Samb/2/13. Oslo; 2013.

43. Sironi E, Vuille J, Morling N, Taroni F. On the Bayesian approach to forensic age estimation of living individuals. Forensic Sci Int 2017; 281: e24–9. https://doi.org/10.1016/j.forsciint.2017.11.007

44. Tangmose S, Thevissen P, Lynnerup N, Willems G, Boldsen J. Age estimation in the living: Transition analysis on developing third molars. Forensic Sci Int 2015; 257: 512.e1-7. https://doi.org/10.1016/j.forsciint.2015.07.049

45. Thevissen PW, Alqerban A, Asaumi J, Kahveci F, Kaur J, Kim YK et al. Human dental age estimation using third molar developmental stages: Accuracy of age predictions not using country specific information. Forensic Sci Int 2010; 201(1–3): 106–11. https://doi.org/10.1016/j.forsciint.2010.04.040