Age assessment of young people: Preliminary findings of a blind study using a multifactorial approach.

Authors: Diana Birch Youth Support; Professor Richard MacKenzie Division of Adolescent Medicine Children's Hospital Los Angeles; Ellen Iverson MPH CHLA

Background
In recent years developed countries have increasingly been visited by unaccompanied minors seeking refuge from war, famine or abuse. Many are trafficked for sexual exploitation. The majority of these young people are undocumented and it falls on the authorities in their host countries to establish their age and often to challenge their minor status. To date no accurate method of age assessment has been available and methods assessing single parameters such as dental age are notoriously unreliable. The purpose of the present study was to evaluate the overall accuracy of a multifactorial approach to age assessment which assessed age on five axes of maturity with the aim that the combined result would be more accurate than a single parameter.

Methods
A multifactorial age assessment was carried out on 351 individuals of known age (10 to 22 years) by a researcher who was 'blinded' to their chronological ages. The assessment involved clinical evaluation of developmental age on five axes – A physical growth; B physical development; C sexual maturity; D dental maturity and E emotional / cognitive development. An overall assessed age was estimated in consideration of all these factors. Assessed and actual ages were finally compared by an independent researcher.

Results
Results showed close correlation between estimated and actual age values. Pearson's correlation coefficient (Alpha between actual & estimated) was 0.983 and this was highly significant at the <0.001 level.

The mean difference between chronological and estimated age was -0.1475 years (representing an overestimate of approximately 1.75 months) and 89.2% of estimates were within one year of chronological age. The range of differences was -2.00 years to +1.9 years with a standard deviation of 0.589 years. (7.16 months)

Conclusions
This preliminary analysis indicates that a multifactorial method can be employed to give an acceptably accurate estimate of age and represents a significant advance in this difficult area. Such an advance is long overdue to assist border agencies and immigration officials as well as social work and health professionals endeavouring to work with traumatised minors. Further analysis will consider the relative reliability of the five axes (sub-parameters)

Key words: asylum refugee immigration children age assessment

Background

In recent years developed countries have increasingly been visited by unaccompanied minors seeking refuge from war, famine or abuse. Many are trafficked for sexual exploitation. The majority of these young people are undocumented and it falls on the authorities in their host countries to establish their age and often to challenge their minor status [1].

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The purpose of the present study was to evaluate the overall accuracy of a multifactorial approach to age assessment which assessed age on five axes of maturity with the aim that the combined result would be more accurate than a single parameter.

Methods

In a study of 351 individuals aged 10 to 22 years a multifactorial age assessment was carried out on persons of known age by a researcher who was 'blinded' to their chronological ages. The subjects were children and young people seen in their schools in Afghanistan and selected for inclusion by their school principals on the basis of their chronological ages being recorded in the school records and on the basis that both the young people and their parents consented to participation. The Kabul and Jalalabad schools boards and the trustees of the Charity Youth Support and its Afghan division 'Youth Support Afghanistan' gave approval for the field study and analytical and statistical support was provided by the Division of Adolescent Medicine of the Children's Hospital Los Angeles. This work was conducted in Afghanistan due to the fact that the vast majority of young people presenting as unaccompanied asylum seekers in Europe, and increasingly elsewhere such as Australia, are Afghan and frequent controversies involve age assessment in this ethnic group.

The head teachers at schools in Kabul and Jalalabad took pupils out of their classrooms and sent them to a designated room within the school to be assessed as a mixed age group so that the researcher would not be aware of the class level attended.

The assessment of subjects involved a clinical evaluation of developmental age in terms of five parameters – A physical growth; B physical development; C sexual maturity; D dental maturity and E emotional / cognitive development. The primary

[1] Crawley, H. When is a child not a child? Asylum, age disputes and the process of age assessment. Immigration Law Practitioners Association. 2007

researcher was a paediatrician and adolescent medicine specialist who was experienced in seeing Afghan children.

In order to make these evaluations, anthropometric measures were taken, facial characteristics such as facial hair was recorded, a clinical inspection of the mouth and dental examination took place and a discreet enquiry was made as to sexual characteristics. Intimate and sexual examination was not possible since the assessment strictly adhered to cultural practices and expectations including the examiner being dressed in traditional Islamic manner. An assistant who spoke Pashtu and Dari and who was of the same gender as the subjects was present throughout to assist with personal questions. A member of the school staff was also present.

Throughout the assessment the subjects were engaged in conversations about their families and their daily lives including activities and expectations. They were also observed playing and interacting with each other. Their class-work was observed and abilities noted. In this manner an estimate of emotional / cognitive maturity was made.

An overall assessed age was estimated in consideration of all these factors. In so doing ethnic factors and familial characteristics were taken into account as were issues related to malnutrition and chronic illness.

The actual ages of the subjects was provided by the school principals and collated in a database by an independent worker who identified the individuals by case number only.

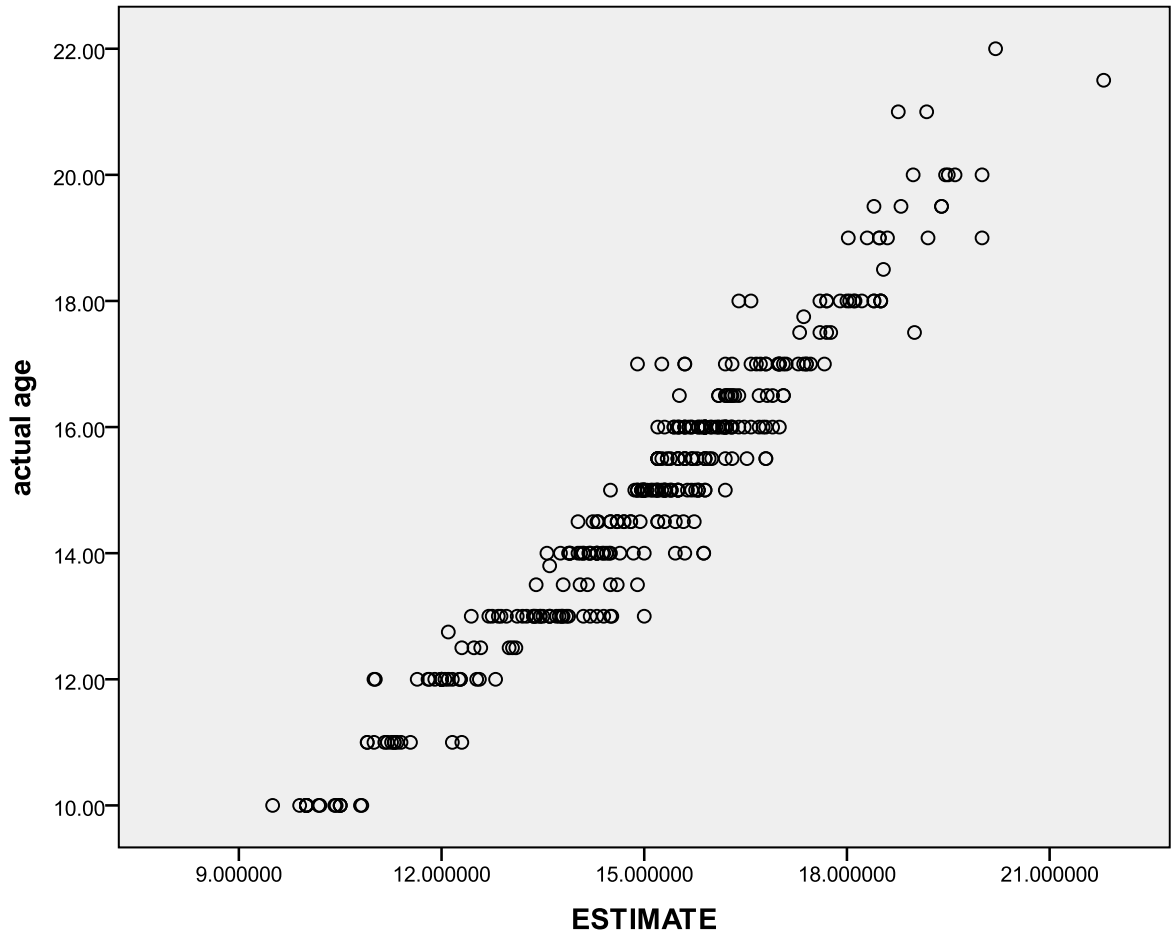
The database of assessed ages and database of actual ages were supplied to the collaborating hospital research department and compared by an independent researcher.

Results

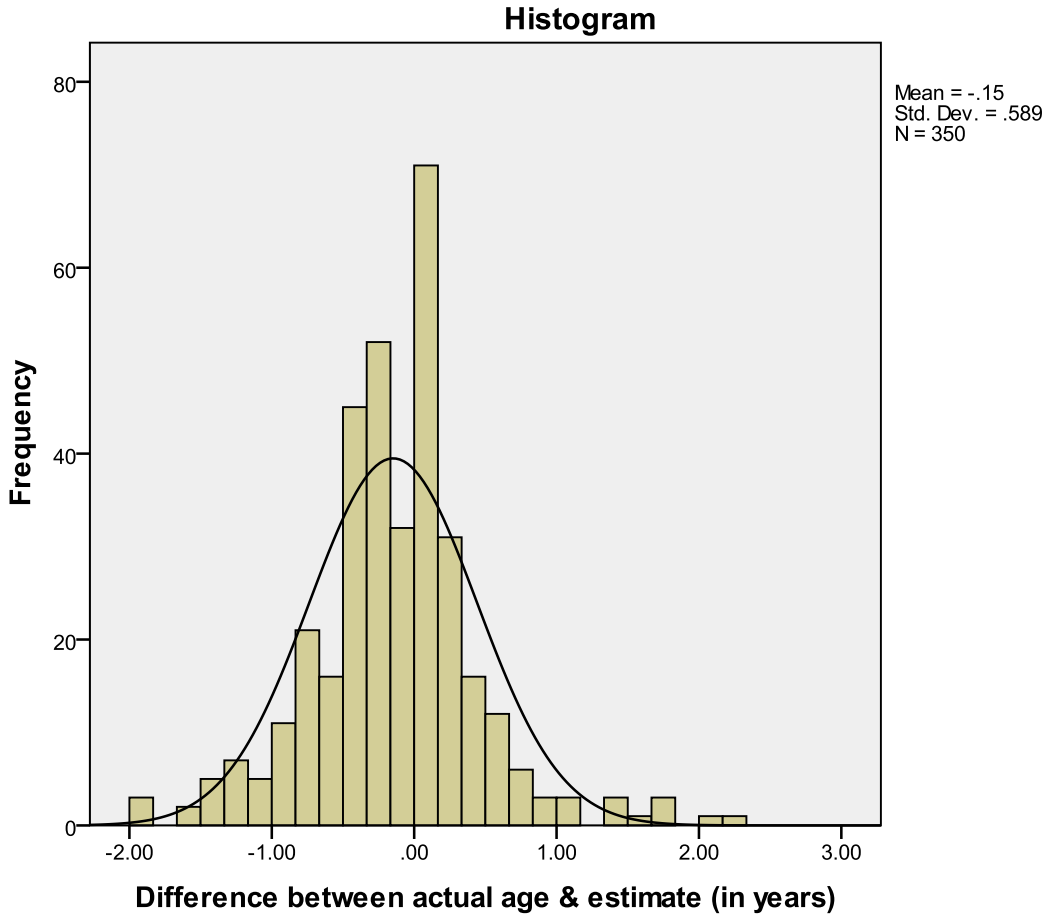
A total number of 351 individuals aged 10 to 22 years were assessed of which 303 were males and 48 females. (NB females are less accessible in Afghanistan and moreover very few females present as unaccompanied asylum seekers) Of these subjects 101 were in the age range 10-14 years (of which 21 female); 212 were aged 14 to 18 years (16 females) and 38 were aged 18 and over (11 females).

Results showed that estimated and actual values for age were closely correlated and the Pearson's correlation coefficient (Alpha between actual & estimated) was 0.965 and the correlation between actual age and estimated age was highly significant (at the <0.001 level). Results for males were marginally better than females with correlation coefficients of 0.97 and 0.95 respectively.

A simple scatterplot illustrated that estimate and actual values were closely correlated.



The mean difference between true age and estimated age was -0.1475 years (which represents an overestimate of approximately 1.75 months) and 89.2% of estimates were within one year of the true age. The range of differences was -2.00 years to 1.9 years with a standard deviation of 0.589 years. (7.16 months)



Discussion

Border authorities differ in their approach to the age assessment of those claiming to be minors under the age of 18 years. In the European Union only seven of the 22 member states consider the assessment by a doctor; dental analysis is considered by ten and skeletal x-rays by 16 states with non medical interview being employed by 20 members[2].

Guidelines for the non medical interview, generally conducted by social workers, have been established in the United Kingdom by the 'Merton judgement' [3] in which the Judge in determining the outcome of a case involving an Asylum seeker and the London Borough of Merton, clarified the issues pertinent to a non-medical age determining interview process. The practice guidelines and Merton Judgement provide a good blueprint for interview and non-medical assessment but the true value of the assessment will lie in the experience and expertise of the interviewers and their ability to adhere to the guidelines, to carry out a satisfactory interview and most importantly, to be able to evaluate the information obtained and place it in accurate perspective.

Whilst all age assessment techniques have wide margins of variability, a non-medical assessment relies very heavily on one axis alone, the interview, and is thus very limited in its scope and accuracy. A multi-factorial assessment (holistic) will always be more accurate than interview alone since it will include that same interview material, but assessed in the light of other factors.

Medical assessments can take several forms. For example:- A specific examination of a single parameter such as dental development or endocrine (hormonal) status; An investigative approach such as dental x-rays or bone x-rays to determine bone age; A multi-factorial or holistic examination looking at several parameters of development and maturity.

Medical methods assess 'maturity' and one must assess this 'maturity' in the context of medical knowledge and clinical judgement with respect to what one would normally expect to find in an individual of various ages.

An assessment based on any single parameter is subject to a wide range of possible values and dental and bone age have wide variations in comparison with some other parameters. With respect to dental ages - the average difference between chronological age and that predicted from looking at third molar (wisdom teeth) development has been quoted as 1.6 years with a standard deviation of 1.2 years in

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[2] European Migration Network. Unaccompanied Minors – an EU comparative study. European Migration Network 2010

[3] The Queen on the application of B v London Borough of Merton, [2003] EWHC 1689 (Admin) (14 July 2003):

the 'ABFO study' [4] which is widely regarded as the standard knowledge base for North American youth. This would mean that 95 % of the population (ie ±2 standard deviations) would be encompassed within a span of almost 5 years. Further variations are introduced when one considers race, sex and diet plus issues such as prior tooth extractions which can provide added space in the jaw encouraging earlier eruption of the third molar (wisdom) teeth.

Bone age has wide variations and ethnic ranges. The standard used in the past has been the Greulich and Pyle atlas[5] which is outdated as a standard. The range of values for differences in skeletal and chronological ages in a European study was very wide, indicating great individual variability [6] and several studies have shown Turkish children to be more than one year advanced in age. Bone age estimates were significantly advanced in 15-17 aged boys and overestimated chronological age by almost a year (0.88-0.98 years).[7] Standard deviation of ages for boys 12 to 18 years of age was also more than a year.

There is evidence that *radiography (X-rays) of bones and teeth, which is increasingly relied upon by immigration authorities, is imprecise, unethical and potentially unlawful, and should not be used for age assessment.*[8]

In the United Kingdom, the Royal College of Paediatrics and Child Health have expressed concern regarding the use of X-rays in Asylum seeking children[9]. To quote*:-* *The Royal College of Paediatrics and Child Health understand that the Home*

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[4] Mincer 'The ABFO Study of third molar development and its use as an estimator of Chronological age' Journal of forensic Science Vol 38 no 2 379-390

[5] Greulich WW, Pyle SI 1959 Radiographic Atlas of Skeletal Development of the Hand and Wrist. 2nd ed. Stanford University Press, Stanford, CA

[6] Mora S; Boechat, M. I; Pietka E; Huang HK; Gilsanz V. "Skeletal Age Determinations in Children of European and African Descent: Applicability of the Greulich and Pyle Standards" Pediatric Research Vol. 50, No. 5, 2001

[7] Büken B, Safak AA, Yazici B, Büken E, Mayda AS. "Is the assessment of bone age by the Greulich-Pyle method reliable at forensic age estimation for Turkish children?" Forensic Sci Int. 2007 Dec 20;173(2-3):146-53. Epub 2007 Mar 27.

[8] A. Aynsley-Green A; Cole T.J.; Crawley H; Lessof N.; Boag L.R.; Wallace R.M.M. - Medical, statistical, ethical and human rights considerations in the assessment of age in children and young people subject to immigration control. British Medical Bulletin Volume 102, Issue 1 Pp. 17-42 April 2012

[9] Royal College of Paediatrics and Child Health : X-Rays and Asylum Seeking Children: Policy Statement Published Monday 19th November 2007 The Policy Statement issued by the Royal College of Paediatrics in November 2007

Office is proposing the routine use of bone X-rays to determine the age of young asylum seekers. We have expressed our concern about this and requested that action is taken to reverse this decision. There is no good research evidence for the use of X-rays for age-assessment, and we urge that the Home Office reviews its position.

They also recommend that paediatricians should be involved in a multifactorial approach [10]:- *'... There are significant difficulties when young people claim asylum who may not have documentation or even knowledge of their age. We consider that paediatricians have a valuable contribution to make in the assessment of these young people. There are important dimensions of age assessment, where the training and expertise of paediatricians is central. We reiterate the view stated in the 1999 College guideline [11] that "There is no single reliable method for making precise estimates. The most appropriate approach is to use a holistic evaluation, incorporating narrative accounts, physical assessment of puberty and growth, and cognitive, behavioural and emotional assessments." A paediatric assessment is an integral part of such a holistic evaluation.'*

Whilst agreeing with the above statement, it is important to further note that whilst a paediatrician can be adept at assessing younger children, the added expertise and knowledge of an adolescent specialist must be employed in order to assess adolescent teenagers and young adults.

In terms of general principles [12] - The professional assessment of age depends on two main factors. Broadly speaking one could say that they are based on 'Individual Factors' – judged by clinical evaluation; and 'Population Factors' – judged by measurement and comparison with data sets and peer groups.

The first part of the assessment process is *the clinical evaluation* of the individual by a specialist experienced in the development and medical features of the age group concerned. The importance of this aspect of clinical judgement cannot be overemphasised. Without the clinical judgement of an experienced professional, the interpretation of results is flawed, raw measures are meaningless and an accurate assessment is impossible.

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[10] The Royal College of Paediatrics and Child Health 'The role of paediatricians in the age assessment of unaccompanied young people seeking asylum' February 2009

[11] Royal College of Paediatrics and Child Health: The Health of Refugee Children - Guidelines for Paediatricians (November 1999)

[12] Birch DML. Asylum seeking children Including adolescent development and the assessment of age. Youth Support Publications 2010

The second part of the process involves looking at how the individual compares with others of the 'same age'. In other words considering the clinical findings, is it 'likely' that this person is about as old as they appear to be or as old as they are claiming? Do the measurements make sense in the light of the clinical judgement? Is there reason to suppose that this individual might differ from the general 'mean' for his possible peer group? For example do we have reason to believe that he is from a very tall family and would therefore become very tall himself? Has he suffered from starvation and thus may be stunted in his growth and likely to be smaller than his peers? In order to answer this issue one must be familiar with the norms for the population in question and whatever datasets might be available.

This present study has involved a clinical evaluation of 'developmental age' or 'maturity' on five axes. (A physical growth; B physical development; C sexual maturity; D dental maturity and E emotional / cognitive development). In clinical practice it is commonly noted that young people develop at differing rates both from their peers and also with respect to these different axes. For example the tallest boy in the class or the one who reaches his peak growth velocity first is not necessarily the brightest in the class or the first to grow a moustache or cut his back teeth. In looking at a cross section of maturity or developmental ages for an individual it is therefore common to see a scatter of results and hence an overall view taking these differing values into consideration is likely to give a more accurate estimate than taking one of these axes or parameters in isolation.

The combination of information in a multifactorial view is an established method of improving accuracy. Medical researchers and scientists have been accused of disregarding evidence from multiple sources and thus limiting the advance of knowledge. [13] Sir Iain Chalmers referred to the tendency of scientists to look at individual studies in isolation, rather than as part of a systematic review of the "body of evidence" on a given subject. An example quoted in the introduction to a standard textbook on 'Meta-analysis' [14] was the failure to collate information on sudden infant death syndrome (SIDS) which could have prevented '*over 10,000 infant deaths in the UK and at least 50,000 in Europe, the USA and Australasia'.* [15]

The validity of a multifactorial approach can be established by statistical approaches such as Meta-analysis which provides the methodology to aggregate multiple studies

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[13] Chalmers I. 'The scandalous failure of scientists to cumulate scientifically' James Lind Library, Oxford and The Centre for Health Sciences Research Cardiff University 2005

[14] Borenstein M; Hedges LV; Higgins JPT; Rothstein HR 'Introduction to Meta-Analysis' John Wiley and Sons, 2009

[15] Gilbert R; Salanti G, Harden M; See S. "Infant sleeping position and the sudden infant death syndrome: systematic review of observational studies and historical review of recommendations from 1940 to 2002", International Journal of Epidemiology, Oxford University Press 2005

for a general conclusion or alternatively a simpler method of simulation such as the 'Monte Carlo' approach is readily available to medical researchers to test their assumptions and illustrate results. This simulation method has been widely used in the paediatric field [16] and was also employed to validate the combination of results for the five axes of maturity addressed in this study.[17]

Further evaluation of the results obtained from the separate axes of development will be explored in order to determine the relative accuracy of the sub-parameters and their validity in differing ethnic populations.

The exact manner of combination of results from the subgroups (parameters) will also require further consideration with respect to any weighting which should be applied to compensate for differing accuracy or degrees of standard deviations between the subgroups.

This present study has initially considered whether by using a multifactorial approach to age assessment, one can assess the age of children and young people within limits which are of practical use in the management of unaccompanied asylum seeking minors. If one considers the standard deviation of results in this study which is just over 7 months, the accuracy is greatly improved over single parameter methods which on average have a standard deviation of about 2 years and can in the instance of anthropomorphic measures alone can give an unhelpful spread of 4 to 5 years [18] particularly in the upper age ranges.

In practical terms - The standard deviation demarcates that whilst 68% of cases will be assessed within 7.16 months of their actual age, 32% of ages would by definition, lie outside these limits. The main issue, however, with respect to the assessment of the age of undocumented Asylum seekers, is whether or not an individual is in the 16% who might be in the upper tail of the distribution, i.e. older than the age estimate. The possible overestimate of the younger children's age is not of such importance in the legal context of 'status' wherein whether the subject is a child, or an adult over the age of 18 years is the salient issue. Hence in answering such a question of status, the "age-below" status will be estimated with 84% confidence utilising the one standard deviation range.

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[16] Jacobson SH, Sewell EC. Using Monte Carlo simulation to determine combination vaccine price distributions for childhood diseases. Health Care Manag Sci. 2002 Apr;5(2):135-45

[17] Birch DML; Sutton BR; 'Validation of use of Five Categories of Parameters to produce a more accurate assessment - A Monte Carlo Simulation' (in Asylum seeking children Including adolescent development and the assessment of age. Youth Support Publications 2010)

[18] Royal College of Paediatrics and Child Health. The Health of Refugee Children - Guidelines for Paediatricians 1999.

Conclusions

This paper presents a preliminary analysis of the feasibility and accuracy of a multifactorial approach to age assessment of young people. Further papers will investigate details of the parameters employed in the assessment but this initial analysis indicates that the method can be employed to give an acceptably accurate estimate of age and represents a significant advance in this difficult area. Such an advance is long overdue to assist border agencies and immigration officials as well as social work and health professionals endeavouring to work with traumatised minors.