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ESTIMATION OF AGE FROM BONE DEVELOPMENT

Observations On A Study of 567 Ceylonese School Children Of The Ages 9–16 Years

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During a period of seven years (1944–1950), 325 judicial cases were referred to the Department of Forensic Medicine of the University of Ceylon, for the determination of age by radiological examination. These 325 cases consisted of 111 males and 214 females. Almost all of them were juveniles whose birth-certificates were not available, and therefore whose exact ages were not known. Only a very small proportion of them were offenders while the majority consisted of complainants in cases of kidnapping, rape, and other assaults. The necessity to determine the ages of these individuals was purely for the purpose of assisting the Law in the administration of Justice.

The Law as it exists in Ceylon is as follows.

PENAL CODE SECTIONS

- (a) "75. Nothing is an offence which is done by a child under seven years of age."
- "76. Nothing is an offence which is done by a child above seven years of age and under twelve, who has not attained sufficient maturity of understanding to judge of the nature and consequence of his conduct on that occasion." (1).
- (b) "352. Whoever takes or entices any minor under fourteen years of age if a male, or under sixteen years of age if a female, or any person of unsound mind, out of the keeping of the lawful guardian of such minor or person of unsound mind, without the consent of such guardian, is said to "kidnap such minor or person from lawful guardianship." (2)
- (c) "364A (1) Whoever has carnal intercourse or attempts to have carnal intercourse with any girl of or above the age of twelve years and under the age of fourteen years shall be guilty of an offence, and shall be punished with imprisonment of either description for a term not exceeding two years, and may in addition be punished with whipping.
(2) It shall be a sufficient defence to any charge under this section if it should be made to appear to the court or jury before whom the charge shall be brought that the person so charged had reasonable cause to believe that the girl was of or above the age of fourteen years.
(3) Sexual intercourse by a man with his own wife, or between a man and girl who are living together as husband and wife with the consent of the parents or guardians of the girl, shall not be an offence under this section if the girl is of or above the age of twelve years." (3)

Our reports on the ages of the 325 individuals under reference (irrespective of whether the individual was a male or female), were based entirely on the figures in

regard to the appearance of ossification and the union of epiphyses with shafts given by Sir Sydney Smith. (4) Our experience in the course of our work, however, led us to believe that the figures on which we based our reports did not seem to be applicable to local conditions. The reasons which led us to this belief were twofold, namely,

1. The ages given by the individuals or their parents were always lower than that indicated by the skiagram.
2. The ages indicated by the skiagram appeared to be incompatible with the stature and general appearance of the individuals.

With a view to throwing some light on this problem the present survey was undertaken. Being an initial survey the age-groups investigated were restricted to 9 years plus to 16 years plus.

By arrangement with the Principals of 9 primary and secondary schools in and around Colombo, we examined 297 boys and 270 girls. The date of birth of each child as recorded in the birth-certificate was supplied to us by the principal of the school. And the actual age on the date of our examination was estimated in years, months, and days.

Although we have not detailed against each individual what his or her antecedent or background was, the children examined in this survey showed no physical abnormality, hormonal, or dietetic influence. They comprise a reasonably fair representation of the various grades of society, religion and communities, and standards of living in and around the city of Colombo.

In this survey, as well as in the 325 judicial cases referred to earlier, the parts x-rayed were the wrist, elbow, knee, and ankle in each case.

Table 1 is an analysis of the number of boys x-rayed, their age groups, and the particular ossific centres and epiphyseal unions investigated.

Table 2 refers to the girls.

Table 3 is a summary of the ages of early appearance and complete ossification of the pisiform and lateral epicondyle of humerus, and also of the ages at which early and complete epiphyseal union was seen in our survey.

On examining the tables the following facts are evident:

1. *Appearance of Ossific Centres.* The pisiform and lateral epicondyle of the humerus were seen approximately 5 and 6 months, and complete ossification approximately 39 and 47 months respectively *earlier* in the girls.
2. *Union of Epiphyses with Shafts.* There is a definite tendency for epiphyseal union to occur *earlier* in the girls.

Epiphyseal union in the girls precedes that of boys by approximately 15-45 months in the bones examined.

The early appearance of ossific centres in the females has been noted by many medical investigators.

Pryor (5) states "The bones of the female ossify in advance of the male. This is measured at first by days, then months, then years."

Todd (6) refers to a co-worker Stevenson (7) who while working under his direction, pointed out that the accelerated rate of growth in the female "could not be invoked beyond the entrance to adulthood, namely the years eighteen to twenty-two".

TABLE I - BOYS

NO. OF CASES IN EACH AGE GROUP	AGE GROUP	APPEARANCE OF OSSIFIC CENTRES				UNION OF EPIPHYSES WITH SHAFTS																																			
		Abent	Early Appearance	Incomplete Ossification	Complete Ossification	Abent	Early Appearance	Abent	Lower End of Humerus	OLECRANON OF ULNA	Upper End of Radius	Medial Epicondyle of Humerus	Lateral Epicondyle of Humerus	Lower End of Radius	Lower End of Ulna																										
32	9 - 10	30	2	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0	0												
32	10 - 11	26	3	3	0	29	3	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0	0								
32	11 - 12	21	2	9	0	23	8	1	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0	0								
45	12 - 13	19	5	19	2	20	9	16	0	45	0	0	0	45	0	0	0	45	0	0	0	45	0	0	0	45	0	0	0	45	0	0	0								
39	13 - 14	10	0	15	14	7	9	18	5	39	0	0	0	39	0	0	0	39	0	0	0	39	0	0	0	39	0	0	0	39	0	0	0								
48	14 - 15	5	1	8	34	5	2	11	30	40	2	3	3	22	11	9	6	21	2	6	19	43	2	1	2	44	2	1	1	20	1	20	7	48	0	0	47	1	0	0	
39	15 - 16	0	0	2	37	0	0	3	36	12	4	6	17	3	3	6	27	3	0	5	31	18	5	2	14	15	7	12	5	3	1	10	25	36	2	0	1	35	3	1	0
30	16 - 17	0	0	0	30	0	0	0	30	1	3	4	22	1	1	1	27	0	0	0	30	4	2	2	22	5	3	5	17	0	0	5	25	12	10	8	0	8	12	7	3

TABLE II - GIRLS

NO. OF CASES IN EACH AGE GROUP	AGE GROUP	APPEARANCE OF OSSIFIC CENTRES				UNION OF EPIPHYSES WITH SHAFTS																																			
		PISIFORM		LATERAL EPICONDYLE OF HUMERUS		CALCANEAL EPIPHYSEAL CALCANEUM		LOWER END OF HUMERUS		OLECRANON OF ULNA		UPPER END OF RADIUS		MEDIAL EPICONDYLE OF HUMERUS		LATERAL EPICONDYLE OF HUMERUS		LOWER END OF RADIUS		LOWER END OF ULNA																					
		Absent	Early Appearance	Incomplete Ossification	Complete Ossification	Absent	Early Fusion	Partial Fusion	Complete Fusion	Absent	Early Fusion	Partial Fusion	Complete Fusion	Absent	Early Fusion	Partial Fusion	Complete Fusion	Absent	Early Fusion	Partial Fusion	Complete Fusion	Absent	Early Fusion	Partial Fusion	Complete Fusion																
29	9-10	13	5	9	2	22	2	4	1	29	0	0	0	28	1	0	0	29	0	0	0	29	0	0	0	29	0	0	0	29	0	0	0	29	0	0	0	29	0	0	0
26	10-11	8	2	15	1	8	3	14	1	26	0	0	0	23	3	0	0	24	1	1	0	26	0	0	0	26	0	0	0	26	0	0	0	26	0	0	0	26	0	0	0
37	11-12	1	1	12	23	5	2	6	24	35	2	0	0	24	6	5	2	21	3	11	2	37	0	0	0	21	1	15	0	37	0	0	0	37	0	0	0	37	0	0	0
46	12-13	0	0	3	43	0	0	44	23	5	12	6	10	2	2	32	7	1	4	34	25	3	5	13	35	3	4	4	9	4	10	23	46	0	0	0	45	1	0	0	
34	13-14	0	0	0	34	0	0	0	34	5	6	16	7	0	1	32	0	0	0	34	7	6	7	14	15	6	5	8	0	0	9	25	34	0	0	0	28	5	1	0	
35	14-15	0	0	0	35	0	0	0	35	0	1	13	21	0	0	0	35	0	0	35	0	2	1	32	1	6	7	21	0	0	0	35	18	15	1	1	15	11	7	2	
34	15-16	0	0	0	34	0	0	0	34	0	0	2	32	0	0	0	34	0	0	34	0	0	2	32	0	2	1	31	0	0	0	34	9	13	10	2	4	11	15	4	
29	16-17	0	0	0	29	0	0	0	29	0	1	1	27	0	0	0	29	0	0	29	0	1	0	28	2	0	1	26	0	0	1	28	3	3	16	7	3	1	15	10	

TABLE III

			Boys			Girls		
			Yrs.	Mos.	Dys.	Yrs.	Mos.	Dys.
Appearance of ossific centres	Pisiform	Early appearance at	9	10	16	9	5	2*
		Completely ossified at	12	9	21	9	6	16
Union of epiphyses with shafts	Lateral epicondyle of humerus	Early appearance at	10	0	7	9	5	14
		Completely ossified at	13	5	26	9	6	23
	Calcaneal epiphysis with calcaneum	Early fusion at	14	6	21	11	0	7
		Completed fusion at	14	8	27	12	2	14
	Lower end of humerus	Early fusion at	14	3	18	10	5	21
		Completed fusion at	14	6	21	11	0	7
	Olecranon of ulna	Early fusion at	14	2	8	10	5	21
		Completed fusion at	14	2	12	11	4	13
	Upper end of radius	Early fusion at	14	6	21	12	2	1
		Completed fusion at	14	8	27	12	2	14
	Medial epicondyle of humerus	Early fusion at	14	6	21	12	2	29
		Completed fusion at	14	8	27	12	6	29
	Lateral epicondyle of humerus	Early fusion at	14	6	9	11	10	29
		Completed fusion at	14	6	21	12	0	24
Lower end of radius	Early fusion at	15	4	15	14	1	1	
	Completed fusion at	15	11	25	14	9	15	
Lower end of ulna	Early fusion at	14	11	28	12	11	3	
	Completed fusion at	16	0	23	14	4	23	

* Since this paper was submitted for publication, the authors conducted another survey of children of the age groups 4-8 and found that the earliest age of appearance of the Pisiform in the girls was 8 Yrs. 0 Mos. 6 Dys. The results of the second survey will appear in this Journal in due course.

Todd's own investigation on the relation of sex to skeletal maturation is interesting. He observes:

"Until the age of six years the sex differences are negligible apart from actual inception of ossification in secondary centers. From six to eight years the female forges ahead of the male and her acceleration reaches a maximum at about the latter date. There then ensues a slowing up in the female so that from the ninth to the tenth birthday the sexes are approximately equal in skeletal differentiation. After the tenth birthday the girls again undergo a period of acceleration which rapidly attains its maximum of two years and is failing when, after twelve and a half years, the criteria are changed through the introduction of a new feature, namely epiphysial union. From this date onwards the acceleration of female skeletal maturation over male diminishes until by the seventeenth birthday there is no sexual distinction which we have been able to prove to our satisfaction. In general therefore, and bearing in mind the reservations presented above, boys and girls may be said to punch the time-clock together."

We have also the work of Appleton, Hamilton, and Simon (8) who point out that postnatal bony changes occur approximately one year earlier in the female than in the male.

Hepworth, (9) after examining 83 Indians, has concluded that the union of the epiphyses with their shafts takes place $2\frac{1}{2}$ to 3 years earlier than in the case of English and American peoples.

Pillai (10) reports a study of the epiphysal union in one hundred South Indians of the ages of 10 to 23 and concludes that average age of fusion of the epiphyses is about 2 to 3 years in advance of the age incidence in temperate climates.

Cameron, (11) in Penang, studied the ossification in 27 girls of Chinese, Indian, and Malay descent and concluded that 2 years on an average should be subtracted from the European standards of ossification in the case of Asiatic girls.

CONCLUSIONS

1. Our findings to a great extent corroborate those of the previous workers cited.
2. From our past experience and the evidence available from the present survey, we are satisfied that the appearance of ossific centres and epiphyseal union takes place earlier in Ceylon than in temperate countries.
3. We are also convinced that the appearance of the ossific centres and the epiphyseal unions under investigation takes place earlier in the females.
4. We are of the opinion that the appearance of ossific centres and the epiphyseal unions in the age groups investigated by us occur at least 2 years earlier in the males and $3\frac{1}{2}$ years earlier in the females in this country, as compared with standards recognised in temperate climates.
5. Although the patella was examined in all the 567 cases under study, we were not able to draw any conclusive deductions from the skiagrams.
6. We consider that our findings on the assessment of age in respect of the age groups studied, in this survey, would reasonably apply to the whole Island.

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REFERENCES

1. LEGISLATIVE ENACTMENTS OF CEYLON, 1938, Vol. I, Chap. 15, Sects. 75 & 76, p. 204.
2. LEGISLATIVE ENACTMENTS OF CEYLON, 1938, Vol. I, Chap. 15, Sect. 352, p. 285.
3. LEGISLATIVE ENACTMENTS OF CEYLON, 1938, Vol. I, Chap. 15, Sect. 364A, p. 289.
4. SMITH, SIR SYDNEY, FORENSIC MEDICINE, ninth edition, 1949, p. 76.
5. PRYOR, J. W., ANAT. REC., Vol. 25, (1923) p. 257.
6. TODD, T. WINGATE, CHILD DEVELOPMENT, Vol. 2, No. 1, (1931) p. 49.
7. STEVENSON, P. H., AM. JOURN. PHYS. ANTHROPOL., Vol. 7, (1924) p. 53.
8. APPLETON, A. B., HAMILTON, W. J., SIMON, G., SURFACE & RADIOLOGICAL ANATOMY, 3rd Edition, 1949, p. 316.
9. HEPWORTH, S. M., THE INDIAN MEDICAL GAZETTE, Vol. LXIV, (1929) p. 128.
10. PILLAI, M. J. S., IND. JOUR. MED. RESEARCH, Vol. 23, (1936) p. 1015.
11. CAMERON, J. A. P., JOUR. OF THE MALAYA BRANCH B. M. A. Vol. 2, No. 1, (1938) p. 19.