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Age estimation using radiographic Staging of Medial Clavicular Epiphysis

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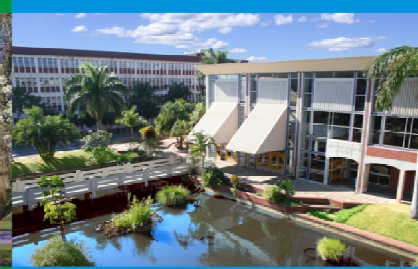
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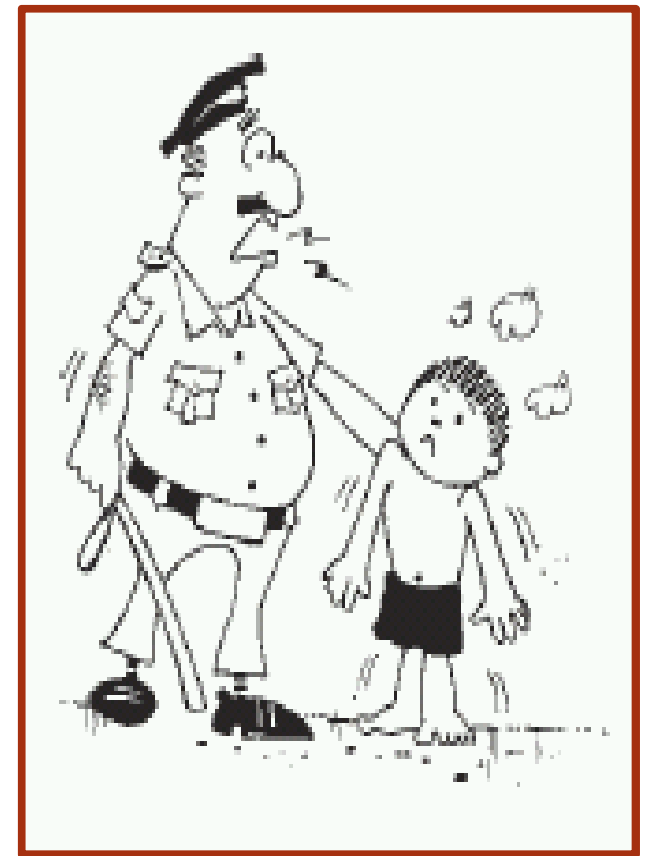
Forensic Age Estimation

Why age estimation ?

1. Juvenile status for criminal responsibility
2. Sports categorization
3. Voting rights, driving license
4. Immigration and Asylum proceedings

Hillewig et al., 2011

Kreitner et al., 1998

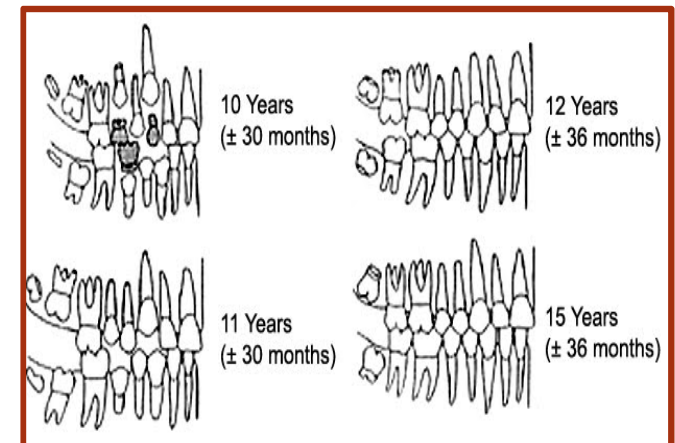
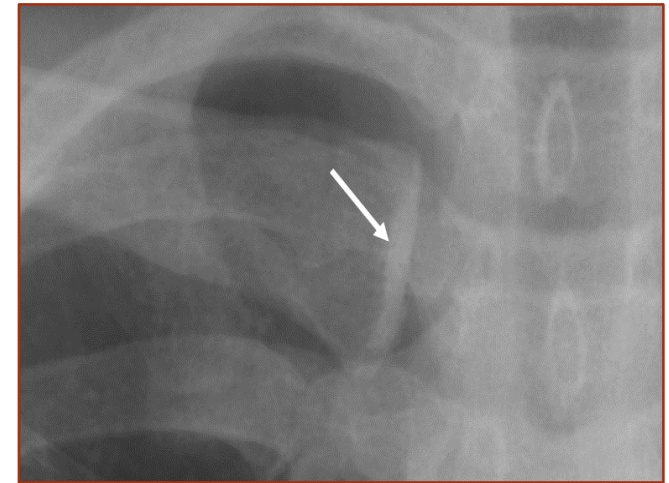


Techniques of age estimation

1. Bone/skeletal age assessments
2. Physical examination
3. Teeth assessment
4. Psychological evaluation

Schmeling et al., 2007

Dewitte et al., 2002



The use of clavicle

- More interest = young subjects below 30 years
- Fusion of epiphysis = Onset @ puberty
= Complete 13 years later
- Other bones ossify = ≤ 20 years

Kellinghaus et al., 2010
Schmeling et al., 2007



Problem statement

- The current reference data = Northern Hemisphere
= High socio-economic status
- Presented as a series of **'atlases'**

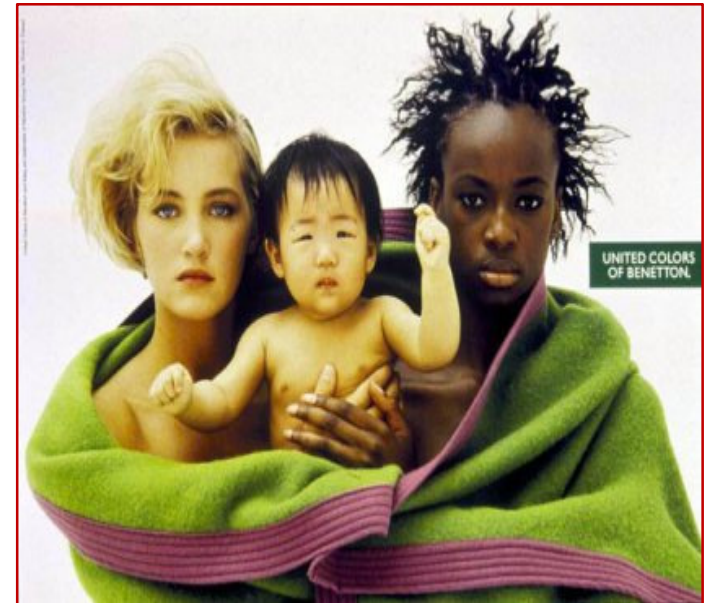
➤ Paucity of information -**African population**

Meijerman et al., 2007
Schmidt et al., 2008



Problem statement

- Can the results of previous studies act as reference to subjects of different
 - i. Racial origin
 - ii. sexes
 - iii. socio-economic status
 - iv. Current generation



Aims

Influence

➤ Sex

➤ Race

➤ Laterality

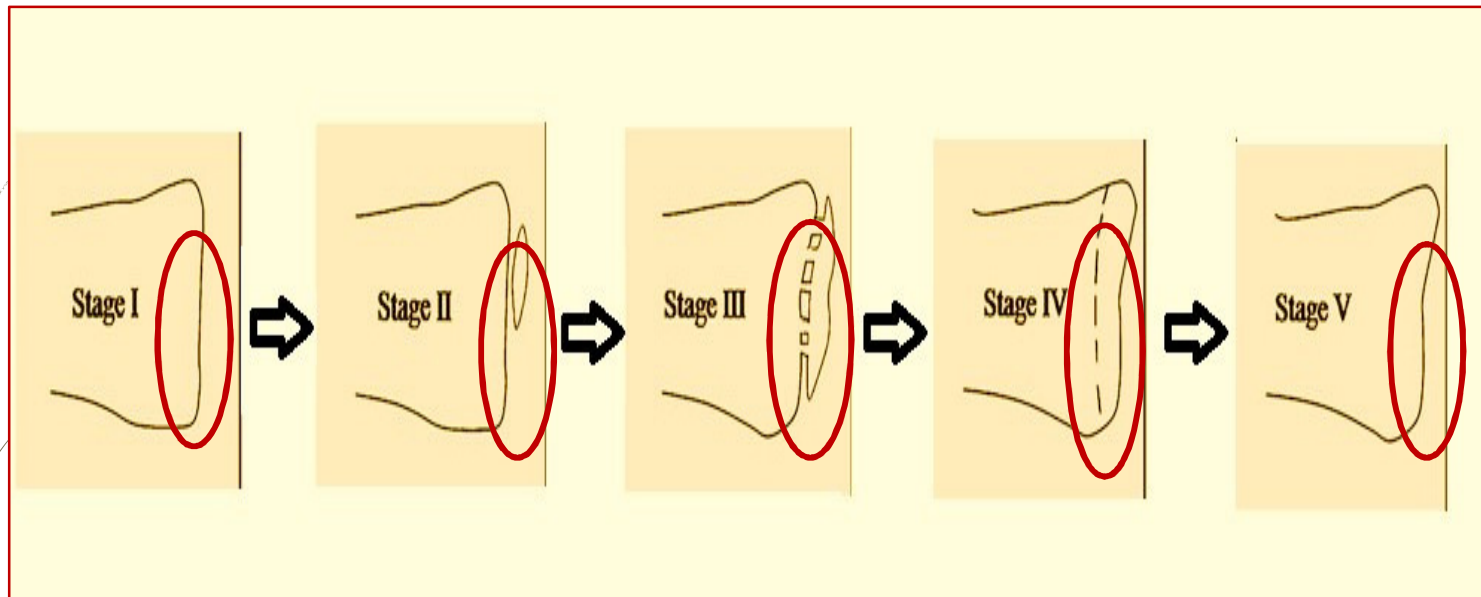


Materials and methods

- N = 210
- PA chest X-rays
- Black, white and Indian SA populations (14-30 years)
- Schmelings scoring system
- The difference in Chronological age (CA) and Estimated age (EA) = Bland-Altman plot CI= 95%
- BREC 267/14



Materials and methods... Scoring/Staging system



1. OC not ossified
2. OC ossified. Epiphyseal cartilage not ossified
3. Epiphyseal cartilage partially ossified
4. Epiphyseal cartilage completely ossified. Epiphyseal scar visible
5. Epiphyseal cartilage completely ossified, no visible scar

Schmeling et al., 2011

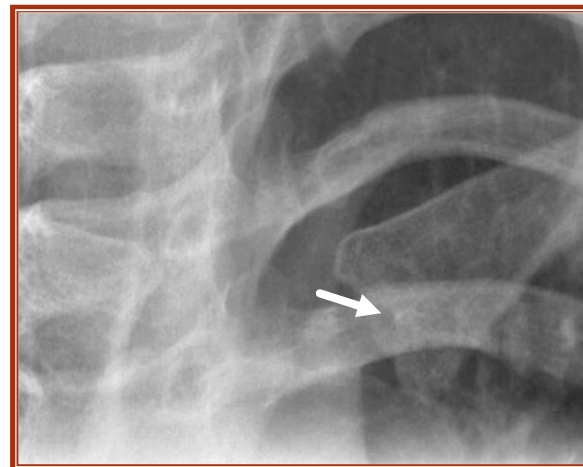
Results

- ✓ Laterality-Asymmetry 12.9% of all cases. ($p = 0.0731$).
- ✓ Gender dimorphism

Mean ages \pm standard deviation							
Race	Sex	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	p value
Average mean	Males	16.2 \pm 1.2	19.5 \pm 1.5	22.9 \pm 1.3	24.5 \pm 1.2	27.3 \pm 2.0	0.0373
	Females	14.4 \pm 1.5	18.7 \pm 2.1	21.6 \pm 1.9	24.6 \pm 1.3	27.5 \pm 1.9	

Racial variations at stage 1; onset of fusion

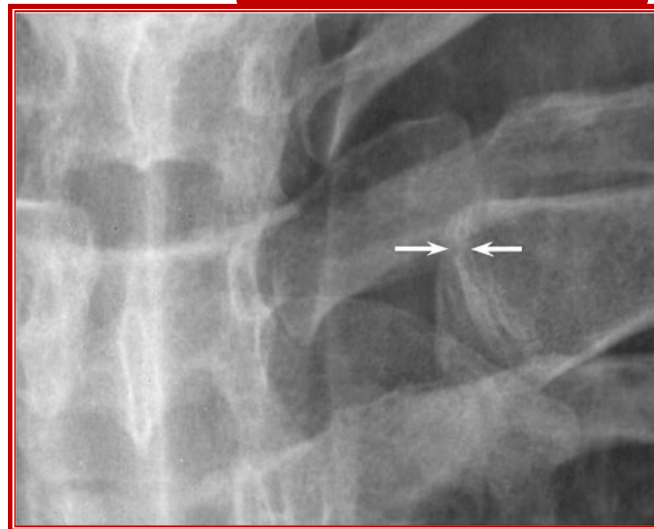
Stage	Group	Mean± Std. Deviation	Range
Stage 1 Onset of fusion	Whites	14.81±0.91	14-16
	Indians	15.74±1.45	14-18
	Blacks	15.92±1.81	14-19



Stage 1. ossification center not yet ossified

Racial variation at stage 3; partial fusion

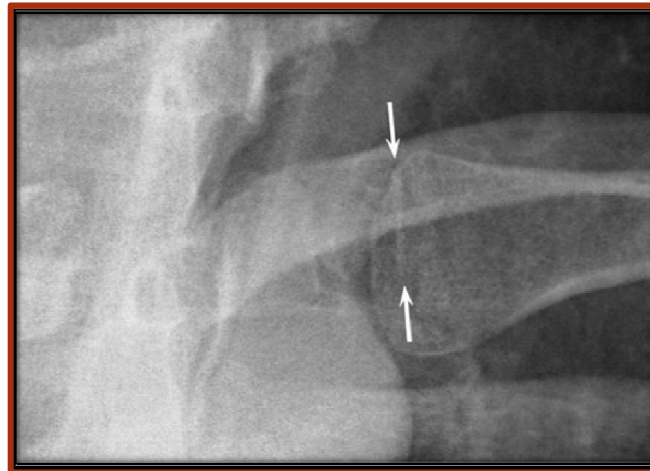
Stage	Group	Mean± Std. Deviation	Range
Stage 3 Partial fusion	Whites	21.30±1.02	19-22
	Indians	23.01±1.00	22-25
	Blacks	23.11±2.31	19-25



Stage 3 Epiphyseal cartilage has partially ossified

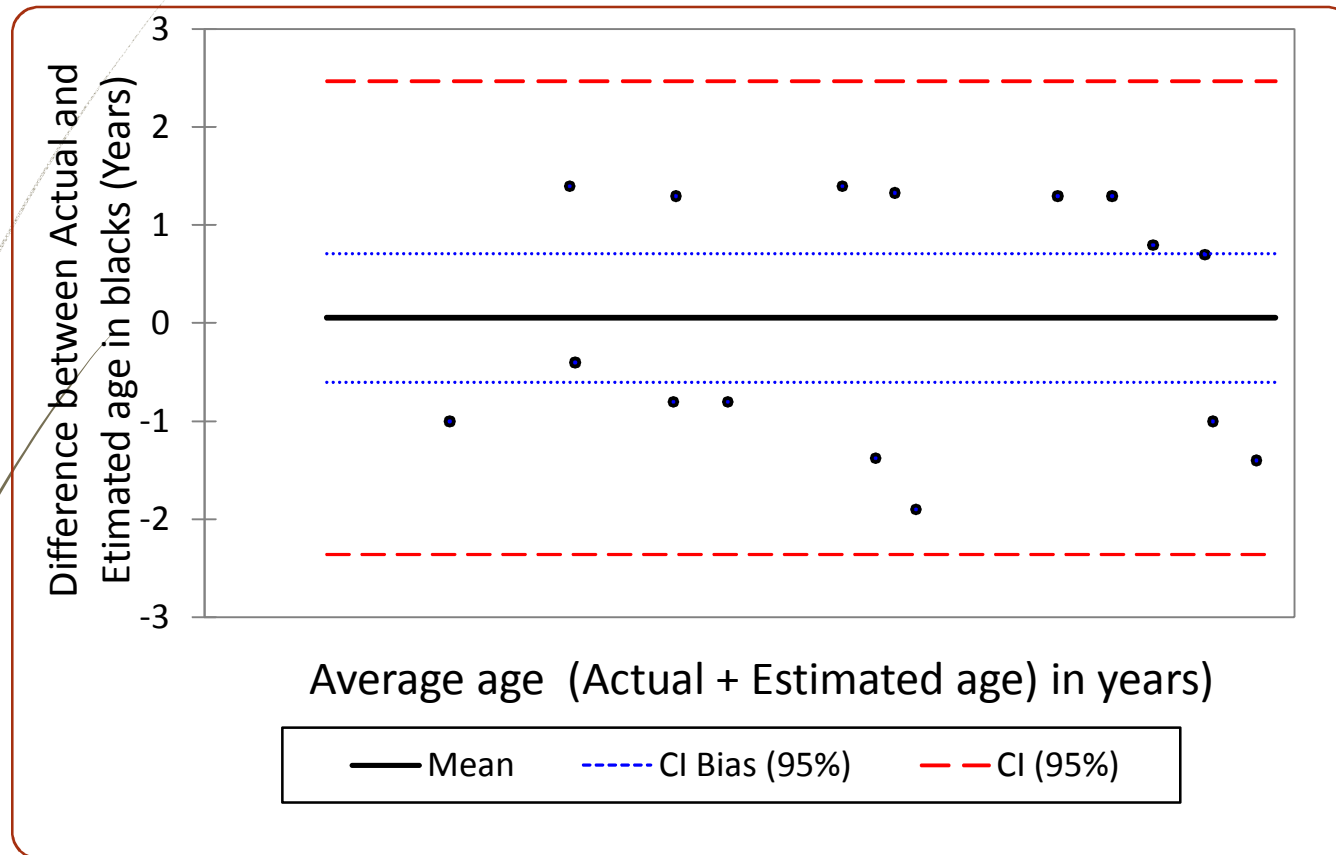
Racial variation at stage 4; Complete fusion

Stage	Group	Mean± Std. Deviation	Range
Stage 4 Complete fusion	Whites	23.32±1.03	22-25
	Indians	25.06±0.70	24-26
	Blacks	25.13±1.80	21-27

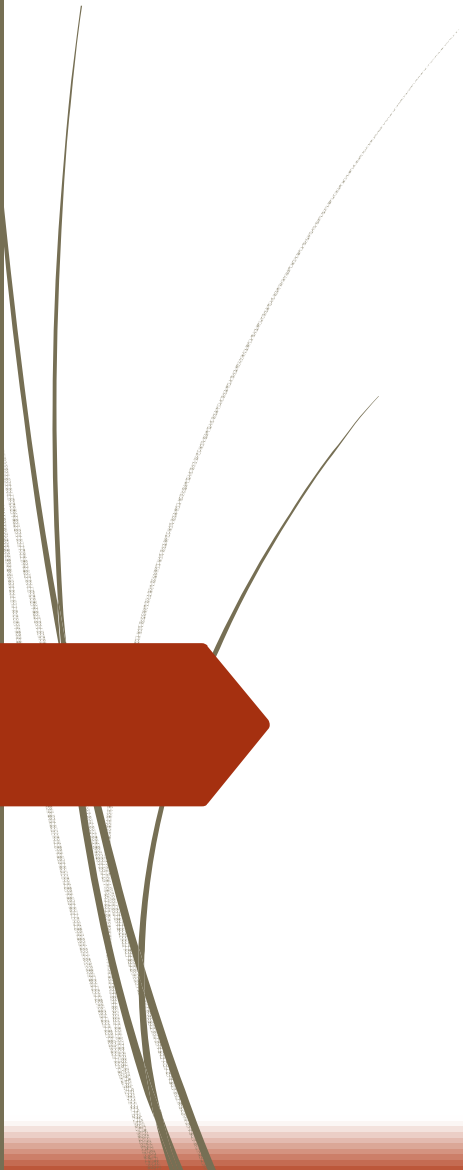


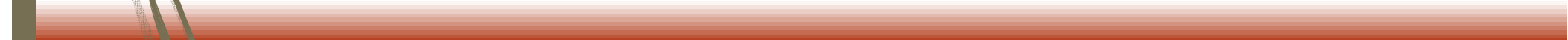
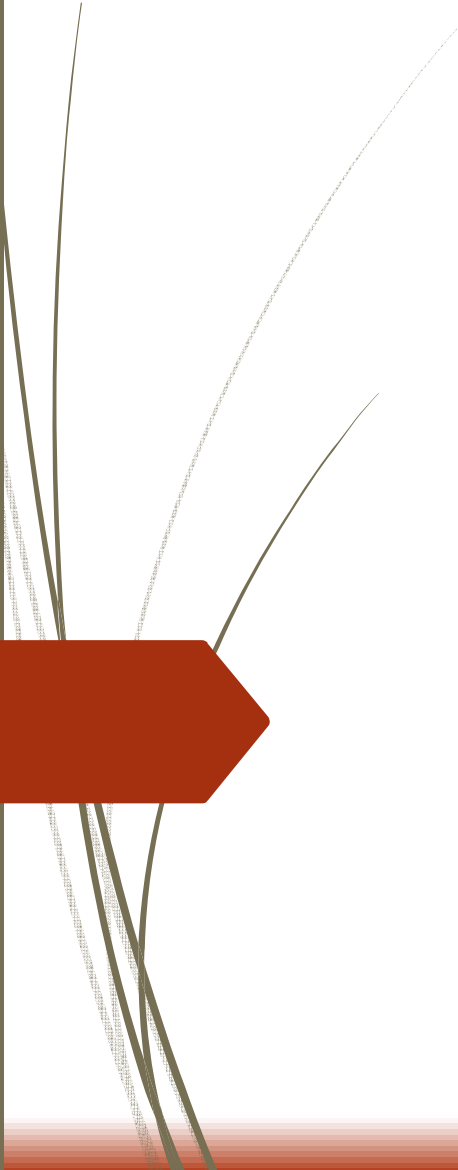
Stage 4. Epiphyseal cartilage ossified, scar visible

Chronological age vs Actual age-Black population



The Bland-Altman plot for CA and EA in the Black population. The limits of agreement were -2.3 to 2.5 years

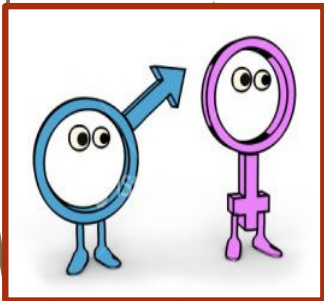




Discussion

➤ Gender dimorphism

Females achieved maturity earlier



- 1.8 years - Bassed *et al.* (2011) Australia
- 2.5 years - Wittschieber *et al.* (2013) Germany
- 1 years - Brown *et al.* (2013) Ghana
- 2 years - Marera & Satyapal (2014) RSA

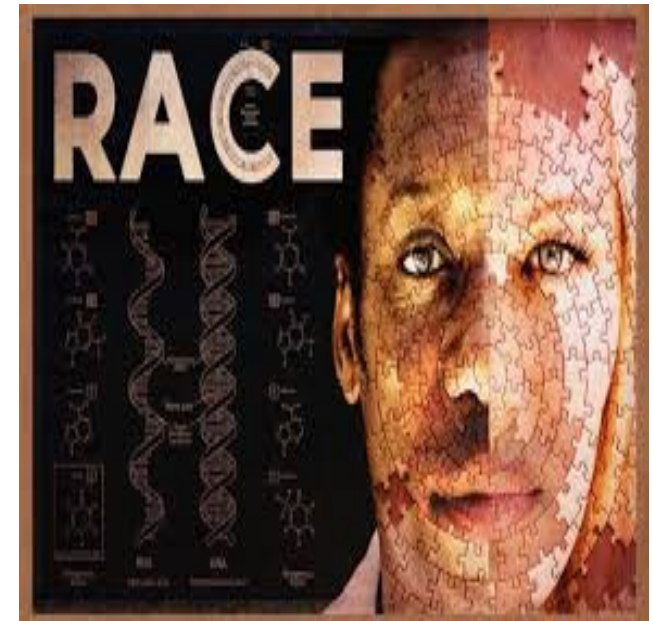


Discussion

➤ Racial difference

White population mature 1-1.5 years earlier

- i. 2.5 years - Wittschieber *et al.* 2013
- ii. 0.6 years - Mansourvar *et al.* 2013
- iii. 1.5 years - Schmeling *et al.* 2004



Conclusion

- I. References from one group should **not** be applied across different racial origin
- II. Gender variations
- III. Laterality



Reference

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The end

Thank you

