

[1] An evolutionary perspective highlights social stressors as key antecedents of low birth weight

D A Coall, J S Chisholm (The University of Western Australia)

An evolutionary analysis of low birth weight predicts that an individual's childhood psychosocial environment can influence his/her subsequent reproduction. According to life history theory, it may be adaptive for individuals whose childhood environment is high in psychosocial stress to reproduce earlier and more often. In females, a common correlate of early reproduction is early menarche. Early reproduction tends to maximise the number of offspring an individual produces. However, any increase in offspring quantity is likely to be associated with a reduction in the quality of each offspring. A valuable indicator of offspring quality, due to its association with childhood morbidity and mortality, is low birth weight (LBW). Therefore, life history theory predicts that women who experienced childhood psychosocial stress and had early menarche are more likely to have LBW babies. However, this prediction appears to conflict with an alternative evolutionary perspective, the "deficit model" of age at menarche. This model holds that women who had poor health and nutrition during childhood have delayed menarche and lower birth weight babies. Despite the apparent contradiction, conceptualising these models in terms of a hierarchy allows a more comprehensive understanding of the variability in age at menarche. On this view the effect of deficits in health and nutrition will take precedence over psychosocial stressors. Therefore, individuals would adapt to their psychosocial context once their biological demands have been met. This paper will present evidence of an association between age at menarche and birth weight that is consistent with both the life history and "deficit" model predictions.

[2] The relationship of stress and experience of menopausal symptoms

Jacinta Purnell, Jan Meyer, Kathy Sanders and Neville Bruce (The University of Western Australia)

Menopause is frequently associated with an assortment of symptoms, such as hot flushes, bloating, tiredness and anxiety. The causes, or triggers of these symptoms, however, are poorly understood. This study examined the role of stress, both early and current life, on symptom manifestation. The basic hypothesis was that women who experienced more menopausal symptoms would report more stress, as indicated by psychometric tests and cortisol levels.

Data were collected from 41 premenopausal, perimenopausal, postmenopausal and hysterectomised women from the Perth metropolitan area. Questionnaires were completed to ascertain demographics, psychometrics, life events and menopausal symptom experience. Additionally, a daily diary was completed to determine daily experiences and menopausal symptom occurrence. Saliva samples were collected to measure cortisol and anthropometric measurements taken to establish body fat distribution.

There was no evidence that early life experiences, as indexed by life events inventories, were related to current or the previous year's symptom occurrence. Furthermore, there were no associations revealed between cortisol and menopausal symptoms. Current stress, however, was significantly and positively related to prevalence of symptoms. More symptoms were also reported on work rather than leisure days; the latter were also associated with more sleep and higher alcohol consumption.

This is the first evidence of a positive association between current stress and the complex of menopausal symptoms. Further work is now needed to establish causality and the time sequence of this stress:symptom relationship.

[3] The Influence of Early Stress on Personality, Cortisol and Reproductive Strategies in Secondary School Students

Monique Lewis, Neville Bruce and Jim Chisholm (The University of Western Australia)

Stress is a central experience in the lives of most people and well recognised as contributing to many diseases. Increasing evidence suggests early experiences may influence an individual's vulnerability to later disease and stress. Much of this research focuses on chronic or extreme stress. The present study focuses on a normal adolescent population. Specifically, the effects of early stress on family relationships (attachment) personality, cortisol, age at puberty and age at first sexual intercourse are examined.

One hundred and ten female secondary school students, aged 14-18, completed questionnaires assessing objective life stress, psychometric questionnaires of personality and attachment. Saliva samples were collected to assay cortisol as a biomarker of stress.

Early life events did influence attachment. Less positive attachment relationships were associated with less positive affect, more negative affect, lower self-esteem, lower morning cortisol and earlier first sexual intercourse. Contrary to expectations, early life events were not directly related to personality, cortisol, age at puberty or first sexual intercourse. Females who had experienced sexual intercourse had lower life expectancies and reported more recent life stress.

These results imply that early family experiences can influence later development. The association of attachment with cortisol in adolescence was a new and important finding. Cortisol is a key hormone in the stress response and negative consequences of stress arise from alterations in cortisol secretion. If early stress experienced within a normal population can alter cortisol levels, the implications for identifying individuals vulnerable to stress would help reduce the burden stress places on society.

[4] Effects of early life stress on personality, cortisol and body fat distribution

Emma Dove, Jan Meyer and Neville Bruce (The University of Western Australia)

Stress has psychological, physiological and somatic effects on individuals. Specifically, stress is associated with negative personality profiles, altered cortisol levels and a centralised distribution of body fat. These outcomes predispose individuals to diseases such as type II diabetes, atherosclerosis and osteoporosis. Furthermore, it is possible that stress could have different effects at different stages of life. The present study examines the importance of early life stress on personality, cortisol secretion and body fat distribution in adult life.

Seventy-five women, aged 25-45 years, completed a questionnaire assessing objective and subjective life stress and psychometric questionnaires of personality and social support. Anthropometric measures were made to assess body fat distribution and saliva samples were collected to assess cortisol concentrations.

High levels of both early (0-15 years) and later subjective life stress were significantly related to negative personality traits. Later life stress and low current social support were related to higher average cortisol values, however, there was no relationship between early life stress and cortisol. High levels of early life stress were associated with a centralised distribution of body fat. Participants who had experienced depression, a manifestation of intense or chronic stress, also experienced more early life events and had more negative personality profiles and altered cortisol levels.

Collectively these results provide important new data linking stress with lasting changes in personality, cortisol and body fat distribution. Further studies are now needed to identify the nature, duration and severity of early life stressors that have the major influence on adult health and well-being.

[5] Relationships between energy, stress and social support with testosterone and cortisol levels in normal men

Kleng Brekka, Kathy Sanders and Neville Bruce (The University of Western Australia).

The stress hormone cortisol and the reproductive hormone testosterone affect energy levels in men under clinical situations. But their potential role in relation to energy levels in the general community has not been explored. The present study examines their relationship to perceived energy (physical, mental and emotional), work stress and social support in normal men (full time male university staff).

The 38 participants completed an initial questionnaire on work stress, personality, living conditions, social support. Data were obtained on height, weight, fat disposition, blood pressure and heart rate. Participants then, on each of 2 working and 2 leisure days, collected six saliva samples spread evenly over the day, for hormone analysis. They recorded their energy levels and other activities at the time of sampling.

Values for the 24 sampling times were first pooled to obtain averages for each participant. Neither cortisol nor testosterone was related to perceived energy, work hours, work stress, or personality, (indexed by negative and positive affect). However, social support was related to both hormones: low social integration associated with high testosterone ($r = -0.537$; $P < 0.001$) and cortisol ($r = -0.390$, $P < 0.017$) levels. Cortisol but not testosterone was lower on leisure rather than workdays. Both hormones showed the expected circadian decline over the day and approximated changes in perceived physical, mental and emotional energy scores. Further investigations are now warranted to examine short term, hour-to-hour relationships between the two hormones and general energy levels.

[6] The repressive effect of legislation on reproductive technology in Western Australia

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In 1992, the Human reproductive Technology Act came into force. Despite numerous letters to the government and a very balanced Select Committee Report recommending sensible changes, this legislation is still in place.

In Western Australia, we are not allowed to carry out any research or diagnostic procedure on a human embryo. We are prohibited from commenting upon its morphological appearance and Crown Law Department inform us that it may well be illegal to photograph a human embryo. We thus cannot (legally) examine whether one form of morphological appearance in an embryo produces a better pregnancy rate than another. We cannot change any of our culture media or test any new media. We cannot carry out quality assurance using unwanted embryos. We cannot perform any diagnostic tests on a human embryo but the law does allow us to implant a genetically abnormal embryo in the uterus and then abort that pregnancy if needs be. Genetic selection of embryos prior to implantation however is forbidden. We cannot use IVF and related techniques such as ICSI for the treatment of anything but infertility: the proven value in the use of IVF/ICSI in the prevention of HIV transmission is against the law in WA. Failure to observe these restrictions carries a maximum sentence of 5 years in prison.

The result of this legislation is that the patients in WA are provided with a poor service and treatment that does not measure up to that available in the rest of Australia. We are unable to train our embryologists fully as they are not allowed to manipulate embryos. No research can be carried out and no improvements can therefore be made in any of our techniques. Western Australia has thus fallen behind the rest of the country and will stay that way until this legislation is changed.

[7] Stature Reduction and Developmental Stress as Registered Through Macroscopic Dental Enamel Hypoplasia in Prehistoric West Malaysia

D Bulbeck (The Australian National University)

Stature seems to have steadily dropped by 5-10 cm on the coast and 10-15 cm in the hinterland between about 5,000 years ago and the early twentieth century in West Malaysia. It is hypothesized that this decline relates to the disruption to the hunter-gatherers' network of trails through the forest as coastal groups involved in maritime trade usurped critical segments of the network. At the same time, groups of swidden farmers established isolated enclaves in remote parts of the forest away from the main trails. To test these hypotheses, macroscopic dental enamel hypoplasia was recorded on 55 individuals from eight prehistoric sites, and growth-interruption events recognized based on Simon Hillson's criteria. The results suggest that the critical stages at which growth stalled, affecting about a quarter of all individuals at each stage, were at two to three years (toddlers), five to seven years (delayed weaning?), and eleven to thirteen years (males only). No variation in these patterns related to chronology or material culture was apparent. Notwithstanding the small available sample sizes, it is suggested that the difficulties in obtaining sufficient high-quality food impacted negatively on the adolescent growth spurt, especially in males, and this caused the long-term decline in average stature.

[8] The effects of dietary creatine supplementation on strength changes with exercise training in 60+ year old men

A.P., Lavender (Edith Cowan University), L.M., Murray (Edith Cowan University) & P. Sacco (Edith Cowan University & Centre for Neuromuscular and Neurological Disorders)

Ageing is often associated with reductions in muscle mass, strength and functional capacity. The aim of this study was to ascertain whether Creatine (Cr) supplementation leads to increases in muscle mass, strength and endurance of knee extensors (KE) and flexors (KF) in older males undergoing light resistance training. Eleven sedentary males (61 - 75 yrs) were allocated to a Cr (C, n = 5), or placebo (Pl, n=6) group. Subjects performed training (T) on the dominant limb, the contralateral being untrained (U). Strength was assessed using an isokinetic dynamometer for static, dynamic and endurance strength attained at baseline, weeks 2, 7 and 12. The C group ingested 15 g/day (14 days) followed by 3 g/day (10 weeks) of Cr whilst Pl group ingested dextrose. Pre- and post-measurements consisted of body composition and Cr kinase assessments. Body composition comparisons were performed using paired t-tests and muscle function analysed using a repeated measures ANOVA. Changes to body composition was not significant in any groups. Static strength showed larger increases in the C group compared to Pl group (n.s.). Dynamic strength improved significantly after week 7 for both limbs. Strength showed no significant increases for training without supplementation. Work capacity showed some improvements, significant only when Cr was combined with training for weeks 2 and 7. Overall, Cr supplementation has a positive effect on KE strength, when combined with training, can increase work output during endurance tasks. Therefore, Cr may be a useful supplement for maintaining/improving muscle function in older individuals.

[9] Proprioceptive and reflex responses of triceps surae to submaximal eccentric contractions

C. Nottle and P. Sacco (Edith Cowan University)

This study examined the relationship between proprioceptive and reflex responses of triceps surae in twelve subjects following backward downhill walking (60 minutes @ 1.5 m/hr and – 15%) leading with the left leg (exercised limb). Proprioceptive alterations were examined with the exercised limb acting as reference, and matching conducted with the non-exercised limb. Pre (-48 hours) and post (0.5, 24, 28, 72 and 96 hours) plantarflexion ankle position perception (AP) at 10° from neutral, torque (30% maximal voluntary torque) perception (TP), and Hoffmann and Achilles tendon reflex responses for soleus and gastrocnemius (sH-reflex, sT-tap, gH-reflex, gT-tap) were conducted. A repeated measures ANOVA with simple (baseline) comparisons demonstrated significant ($p < 0.05$) changes in the non-exercised limb for AP at 0.5, 72 and 96 hours, and TP at 0.5 and 24 hours post walk. Significant correlations ($p < 0.05$) were recorded between angle error and changes in sH-reflex, s-T-tap and gH-reflex, and torque error and changes in sT-tap. While no significant changes were observed in the reflex responses of triceps surae following eccentric exercise, the correlations between changes in the reflex responses and proprioceptive alterations indicate that proprioception may be a sensitive indicator of functional change associated with eccentric exercise.

[10] Student Attitudes towards Organ Donation

N Majrouh (St Mary's AGS)

[11] Use of an Interactive CD-ROM to Improve Student Outcomes in Primate Biology

D.A. Coall (School of Anatomy and Human Biology, The University of Western Australia)

Primate biology is recognised as one of the more challenging subjects for students to master in human biology. To address this problem the flexible delivery and graphics capabilities of an interactive CD-ROM were utilised to increase student access to the valuable primate biology resources within the School of Anatomy and Human Biology. This paper presents the results from an evaluation of the Primate Biology CD. In 2001 the Primate Biology CD was incorporated into the School of Anatomy and Human Biology's first year human biology unit. Subsequently, student usage of the CD and its influence on student learning outcomes were assessed. Of the 345 (72%) students who participated in this study, 218 (63%) used the Primate Biology CD at least once. Students who used the CD received higher primate biology exam results compared to those who did not ($t(290) = 3.674, p < 0.001$). The number of features each student accessed on the CD was positively associated with their primate biology exam results ($r = 0.188, p = 0.006, 2$ tailed). This association remained even after removing the variance accounted for by the student's general ability ($\beta = 0.011, p = 0.05$). Further analysis highlighted the "quiz" feature ($F_{(2,339)} = 5.02, p = 0.007$) and the "views of the skull" feature ($F_{(2,339)} = 3.1, p = 0.046$) as significant independent predictors of primate biology exam marks. Overall, these results emphasize the positive impact of both graphical and interactive features of the Primate Biology CD on student learning outcomes.

[12] CT Analysis of Infants with Cleft Lip and Palate

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Epidemiological studies conducted on the incidence of cleft lip and palate show varying occurrences between different ethnic groups, from once in every 600 to 1000 live births. Clinicians rely upon the best quality information available in planning and reviewing patients' treatments and advances in medical imaging have played an important role in these processes, particularly in the management of cleft lip and palate.

The purpose of this study was to analyze the cleft lip and palate anatomical deformity using three-dimensional computerized tomography (3DCT) in a group of 3-month-old infants with complete unilateral cleft lip and palate. A total of 7 affected children, 4 males and 3 females, were scanned prior to any surgical intervention.

CT scans were obtained using the GE Lightspeed CT Scanner housed in Radiology Department, Hospital Universiti Sains Malaysia. The procedure followed the protocol used in the Australian Craniofacial Unit, Women's and Children's Hospital, Adelaide. The data were reformatted and analyzed using volume rendered three-dimensional displays.

Our radiographic analyses demonstrated: deviated nasal septa with marked swing of the vomer to the non-cleft side; narrower nasal passages on the cleft side due to bulging of the nasal septum; flattened alar cartilages with deviation of the tip of the nose from the midline; larger turbinates on the unaffected side compare to the cleft side.

The maxillary segment of the cleft side was smaller than the segment of the non-cleft side. Abnormalities were also noted in the hyoid bone, including its shape and position in relation to the cervical vertebrae. Displaced central and lateral incisors with rotation of the anterior alveolar segments were also observed.

Gross skeletal and soft tissues deficiencies on the cleft side were evident compared to the non-cleft side and involved the bony naso-maxillary complex with malalignment of the central structures.

[13] The role of PAX3 in the metastasis of cutaneous malignant melanoma

J. Blake, M. Ziman (Edith Cowan University)

This research encompasses the developmental control gene, *PAX3*, and the implications of its re-activation in cutaneous malignant melanoma, a neoplasm with high metastatic potential.

The transcription factor encoded by *PAX3* is amongst the first expressed in the embryo, being a principal regulator of neurogenic, neural crest and myogenic progenitor cell migration and specification.

This research is based on the supposition that genetic programs for migration regulated by *PAX3* during embryonic development are used by the metastatic cell. In the highly metastatic cutaneous malignant melanoma (CMM), which arises from cells of neural crest lineage, markedly high expression levels of *PAX3* support this supposition. By contrast, virtually no *PAX3* expression is observed in benign nevus cells.

As *PAX3* is thought to regulate expression of cell surface molecules known to play a role in the migratory events of neuro- and myogenesis, we hypothesise that the metastatic potential of CMM cells is directly linked to migratory properties conferred through *PAX3* expression.

Here we investigate the expression of *PAX3*, Eph receptors and cell adhesion molecules and assess their co-localisation in CMM, relative to their expression profiles (or lack of expression) in benign nevus cells.

[14] Pax7 Transcript Expression In Satellite Cells Of Normal, Dystrophic And Hypertrophic Skeletal Muscle: Implications For Duchenne Muscular Dystrophy

T.M.Lamey, A. Koenders and M.Ziman (Edith Cowan University)

Satellite Cells (SC's) are undifferentiated muscle precursor cells residing beneath the basal lamina of skeletal muscle fibres. Their role is vital in skeletal muscle growth and repair as they provide for the formation myofibres. This has implications for Duchenne Muscular Dystrophy (DMD), a degenerative musculoskeletal disorder characterized by recurrent cycles of muscle degeneration and regeneration, as with each regeneration response SC's are activated to replace damaged myofibres. The abnormally high level of regeneration in DMD muscle requires a degree of SC renewal that cannot be sustained, resulting in an eventual loss of SC's with a subsequent reduction in muscle mass.

The transcription factor *Pax7*, plays an important role in the specification of SC's. In fact, skeletal muscle of *Pax7* knockout mice is completely ablated of SC's, yet embryonic myoblasts are still formed and skeletal muscle develops normally with the exception of a reduced muscle mass. The diminished muscle mass, and the absence of SC's in skeletal muscle establish the essential role for *Pax7* in the ontogeny of the satellite cell lineage and its importance in muscle regeneration.

Alternate *Pax7* transcripts that may be associated with differences in the ability to regenerate muscle have recently been identified. In this study we investigate the role of the alternate transcripts of *Pax7* in the regeneration of normal and dystrophic muscle using normal and mdx mouse models. Firstly, *Pax7* transcript expression was assessed by RTPCR in quiescent and regenerating muscle, using RNA isolated from fresh muscle. Encoded proteins were assessed by immunohistochemistry.

[15] Peroxisome Proliferator –Activated Receptor Gamma and Leptin Receptor in Human Pregnancy

G. H. Gladstones, P. Roberts (Edith Cowan University) and P. Burton (Concept Fertility Centre)

Leptin is a 16kDa peptide hormone that has recently been implicated in human reproductive processes. Like other hormones, leptin exerts its influence through its receptor. Of the three major isoforms of the receptor (OB-Ra, OB-Rb, and OB-Re), OB-Ra (the dominant short form) has been implicated in transport processes within rat and human placentas, suggesting a role for it in implantation and pregnancy maintenance.

The peroxisome proliferator-activated receptors (PPARs) are ligand-dependent transcription factors that are a subfamily of nuclear hormone receptors. PPARs form heterodimers with another nuclear hormone receptor, RXR α , before binding to PPAR response elements (PPREs). Recently PPAR γ /RXR α heterodimers have been implicated in trophoblast differentiation, thus playing a key role in human implantation and placentation.

The present study used Western Blot analysis to quantify the presence of Ob-R and PPAR γ protein in human placental tissue from first and second trimesters, and at term (n=9, n=10, n=12 respectively). PPAR γ and OB-Ra were found at all stages of pregnancy. Levels of OB-Ra were significantly lower in second trimester than in first trimester or at term ($p < 0.01$, one-way ANOVA). Interestingly, two different molecular weight (MW) protein bands of PPAR γ were found, one at ~ 55kDa and another at ~80kDa. The 80kDa PPAR γ protein decreased from first to second trimester and then increased to maximal levels at term ($F=14.437$, $p < 0.0001$, one-way ANOVA), and the 55kDa PPAR γ protein was maximal in first trimester, fell in the second trimester, and remained at this level until term ($F=3.793394$, $p < 0.05$, one-way ANOVA). Furthermore, the 80kDa protein was greater than the 55kDa at all stages of pregnancy (first trimester $p < 0.005$, second trimester $p < 0.0001$, term $p < 0.0001$).

The presence of OB-Ra and PPAR γ over the three stages of human pregnancy demonstrates they are important in implantation and pregnancy maintenance, and this may aid in our understanding pathological conditions such as miscarriage and intrauterine growth retardation (IUGR).

[16] Detection of Trisomy 21 by Quantitative Pcr Using Str Primers in East Java Population

N.S. Indrayana (Airlangga University, Indonesia)

OBJECTIVE: Diagnosis of Down Syndrome - trisomy 21 by means of quantitative polymerase chain reaction (PCR).

METHODS: Down syndrome is one of the most common congenital chromosome disorders, affecting about one in every 1000 newborn babies. Currently, the most common prenatal test for Down's syndrome involves an amniocentesis, in which amniotic fluid is collected. The entire test, a karyotyping technique, requires considerable laboratory expertise and takes about 15 days to complete. Children born with Down's syndrome typically have short stature, undersized heads and mild to severe mental retardation. The disorder occurs when the child inherits three copies of chromosome 21 instead of just two. In this paper we use a technique called quantitative polymerase chain reaction (PCR), which makes it possible to amplify small amounts of DNA extracted from peripheral blood (enough to analyse very quickly), and detected using a set of genetic markers (short segments of DNA that appear only in chromosome 21). In normal cells, with the normal complement of two copies of chromosome 21, the test should detect only two sets of the marker segments, one from each of the chromosomes. But in cells from fetuses/babies with trisomy 21, the test should detect the presence of three sets of the markers from the three copies of chromosome 21 present. Results showed that using STR primer D21S11 will make the test informative fast, cheap and simple.

[17] Asymmetry Analysis of the Craniofacial Skeleton for Acfu Patients with Plagiocephaly

D.J. Netherway (Institute of Craniofacial Studies), A.H. Abbott (Australian Craniofacial Unit), N. Gulamhuseinwala (visiting United Kingdom medical student), J.J. Cole (Institute of Craniofacial Studies), D. J. David (Australian Craniofacial Unit).

Plagiocephaly is a descriptive term that connotes an asymmetrically oblique or twisted head. The most frequently encountered forms of plagiocephaly are deformational plagiocephaly (without synostosis) and unicoronal synostosis (premature fusion of the coronal suture). Over the last 10 years, children in each of these groups have had computer tomography (CT) scans using the same protocols for clinical evaluation of their distorted head shapes. The management of patients with synostotic plagiocephaly tends to be more invasive, involving release of cranial sutures, reshaping and expansion of the cranial vault, whereas management of patients with deformational plagiocephaly tends to be conservative (non-surgical).

For each group we sought to quantify their asymmetry utilizing 3D cephalometric osseous landmarks. Double determination of some 84 landmarks indicated landmark relocation errors in the range 0.2mm to 1.7mm with mean 0.9 and median 0.7mms. The 3D landmark positions were determined from the CT data manually using visualization software developed at The Australian Craniofacial Unit. The groups consisted of 21 patients with deformational plagiocephaly and 20 patients with unicoronal synostosis.

For the unicoronal synostosis group significant asymmetries were found in the posterior face height, orbital widths, height and index, mandibular lengths, lateral base the parietal bone and the zygomatic arch lengths. For the deformational plagiocephaly group significant asymmetries were similarly found for the affected orbital index, posterior face height, mandibular lengths, lateral base length of the parietal bone and zygomatic arch lengths. Simply listing the statistically significant asymmetries indicates similarities but the quantitative detail reveals the distinctly different craniofacial conditions.

[18] Intracranial volume of ACFU patients with craniosynostosis

D J Netherway (Institute of Craniofacial Studies), A H Abbott (Australian Craniofacial Unit), J J Cole (Institute of Craniofacial Studies), D J David (Australian Craniofacial Unit)

Surgical management of patients with craniosynostosis (premature fusion of cranial sutures) often involves reshaping and expansion of the cranial vault altering the intracranial volume. We have determined the intracranial volumes of 297 Australian Craniofacial Unit (ACFU) patients with either craniosynostosis or deformational plagiocephaly for comparison with our recently published normal intracranial volume curves. These normal curves for females and males were based on CT determined intracranial volumes for a normal population of white European descent [Abbott et al, J Craniofac Surg, 11:211-223, 2000].

The patients in the current study had had no surgical intervention that would impact on their intracranial capacity and comprise 38 Apert, 24 Crouzon, 9 Pfeiffer, 8 Saethre-Chotzen, 25 uni-coronal, 54 metopic, 64 sagittal, 2 uni-lambdoid, 3 bi-lambdoid, 3 bi-coronal, 67 deformational plagiocephaly. Intracranial volumes were measured from CT data using software developed at the Australian Craniofacial Unit. Volume determination was based on measuring area in each CT slice [Netherway et al, Asian J Surg 20:68-78, 1997].

To facilitate comparison, the intracranial volume measurements for each patient were standardised by determining a "standard deviation score". The most significant result was that the intracranial volume for the Apert group was larger than normal. Determination of the intracranial volume ranges for patients with craniosynostosis has provided baseline information for clinical evaluation of patients with craniosynostosis.

[19] Amino-Acid Variations in the Tail Region of the Beta Cardiac Myosin Heavy Chain Gene (*MYH7*) Associated with Childhood Onset Distal Myopathy (MPD1)

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The distal myopathies are a heterogeneous group of disorders, with multiple phenotypes and multiple genetic loci. We linked a childhood onset distal myopathy (MPD1, OMIM 160500) in a West Australian family to chromosome 14 in 1995. Three smaller European families with similar clinical phenotypes, compatible with linkage to the same region of chromosome 14 were described in 2001. One candidate gene in the linkage region is the gene for the beta cardiac myosin heavy chain (*MYH7*) which is expressed in type I skeletal muscle fibres in addition to the heart (OMIM 160760). Mutations of the head and S2 regions of *MYH7* have been associated with hypertrophic cardiomyopathy and a central core-like phenotype in skeletal muscle. The entire coding region of *MYH7* was screened for mutations in the West Australian family by sequencing cDNA from a muscle biopsy of one affected individual. A single heterozygous alanine 1663 to proline missense mutation was identified in exon 35, coding for part of the myosin tail. The *MYH7* tail region was analysed from genomic DNA from the three European families and heterozygous deletion of lysine 1617 in exon 34 in two of these families was identified. The two variations segregated with the diseases in these three families and were not seen in more than 200 control chromosomes. These variations are significant alterations. Both the 1663 proline residue and the 1617 lysine deletion will disrupt the ability of the myosin tail to form a coiled-coil, an essential step in muscle thick filament formation.

[20] Individual Identification of a Woman Bali Bomb Accident Victim

Soekry Erfan Kusuma (Medical School Forensic Department, Airlangga University)

A woman, Bali BOM accident victim with totally burned body was unable to be identified using conventional methods such as physical anthropology, fingerprints, and unusual markings, among others. Her husband (a North American male) suspected that she was his wife. The woman victim's teeth had on her first and second molar of the right mandible a gold crown and a gold crown on premolars 1 and 2 as well as gold crowns on the first molar and second molar of the left mandible. The dental record from a dentist who made the gold crown on the right mandible didn't show any gold crown on the right part molar, but this may be because it was made after the right part. Her father was also unsure about the deceased, being unsure if the victim was his daughter. This paper reports an identification of the deceased by paternity test with VNTR and STR polymorphism examination. For the DNA profiling a sample was extracted from the liver of the deceased and blood from the suspected father. Results of STR; THO1, TPOX, VWA, and F13A01 and VNTR D17S5, D17S766, D16S83 were all matched.

[21] Race – is it time for even forensic anthropologists (and other scientists) to let go?

C.N. Stephan (The University of Adelaide)

Physical anthropology has traditionally been based on the construction, description, and study of human racial typologies. However, there is much evidence that indicates human races do not exist. Although many anthropologists are now of the collective opinion that modern human races are theoretical fantasy many other scientists continue to categorize individuals according to race. Even in the sub-discipline of anthropology applied to forensics (forensic anthropology) are racial taxonomies still frequently used to help identify human remains. In this paper I review race, particularly with respect to forensic anthropology since this is one discipline where racial classifications appear to have significant meaning. I use a cross-disciplinary approach to argue the arbitrary nature of racial groupings, and provide some evidence for why forensic anthropologists should abandon race prediction methods even though they offer some benefits to identification processes.

[22] A solution for the permanent storage of historical skeletal remains for research purposes: a South Australian precedent that keeps most people happy

T.J. Anson and M.Henneberg (The University of Adelaide)

Seventy human burials dating from 1847 have been excavated from the St. Mary's Church, St. Marys South Australia. Permit requirements stipulated that the remains be returned to the church for reburial. During osteological examinations, it resulted that the material is extremely valuable and should remain available for future studies and the emergence of new methods. Negotiations with the church were entered into and agreement was reached to place skeletons in individual ossuary boxes and placed within a subterranean concrete tank with an access hole. Boxes containing skeletons are deposited on simple shelves made of brick and wooden planks. All stakeholders in the exercise (Church, University, bureaucrats) were satisfied with the solution and the skeletons are now permanently available for future studies.

[23] Secular Trend in Stature Among Indonesians

J. Glinka (Airlangga University)

Do Indonesians become taller? In the cities we can see that often sons and daughters are a little taller than their fathers or mothers. How far does stature of the Indonesians change during the last decennials? I was able to collect data from 1908 till 1992 of males and from 1929 to 1992 of females. Except for the last year (1992), all data are from rural areas. The 1992 data are students. The regression line shows that males become 0.75 cm (± 0.158) and females 0.82 cm (± 0.09) taller per 10 years. It means that in the respective period males grow 8.3 cm and females 5.1 cm. But the regional variations in stature are very big, as are the differences between rural and urban population. Besides better nutrition, interbreeding between different populations has to be seen as causes of the acceleration in growth.

[24] National Size and Shape Survey of Australia: A Work in Progress

M. Henneberg (University of Adelaide), & D. Veitch (SHARP Dummies Pty, Ltd)

Knowledge of sizes and shapes of bodies of citizens of a country is needed for a number of reasons: public health, production of garments, footwear and headwear, industrial ergonomics, workplace design, armed forces supplies and equipment, school furniture etc. Most industrialised nations have run such surveys, but an anthropometric survey of the entire population has never been done in Australia. We have designed a survey collecting over sixty dimensions of a human body from head circumference to the outline of the big toe. Many dimensions are standard anthropometric characteristics such as body height, upper and lower extremity length, shoulder width and chest depth. Others are specific for apparel industry (eg sleeve length or underbust circumference) and footwear design (eg instep height). We have hitherto collected full sets of measurements on over 1400 individuals of both sexes and age ranging from one year to over 80 years. The majority of participants who volunteered to be measured are adult women due to the acute need for the improvement of garment sizing. Preliminary results indicate that Australians increased in height over the last 75 years by only about 1.5%, much less than people in the UK and the US, but that our weight increased by well over 10%.

We acknowledge collaboration of Dr Jan Meyer, Dr Robert Kidd, Dr Alan Thorne, Dr Vaughan Kippers, Anna Milanowicz, and numerous other colleagues and postgraduate and undergraduate students from universities and TAFE colleges in Adelaide, Perth, Melbourne, Sydney, Canberra, and Brisbane.

[25] Are numbers of deciduous caries and dental fillings related to growth among Taiwanese primary school children?

B. Floyd (Department of Anthropology, University of Auckland)

Both steamed and boiled rice have traditionally been a staple of Han Chinese diet in Taiwan. Consumed from an early age onward, such a diet along with added sweets have tended to result in relatively high rates of caries, particularly in deciduous dentition. Until very recently any dental expenses incurred were borne by families without governmental assistance. The present study examined whether or not indicators of dental health and prior dental care were related to patterns of height and weight variation of first grade children in a “working class” area within Taipei. Two hypotheses were tested. The first is that the number of caries a child has should be negatively associated with measures of growth. Deciduous caries reflect a variety of interacting factors including diet, oral health, parental concerns and family economics. Limited ethnographic evidence also suggests that caries may lead to discomfort that, in turn, influences dietary intake. The second is that children with fillings are anticipated to be larger than those without once the total number of untreated caries has been statistically controlled for. These hypotheses were tested using data from 282 males and females in a primary school in the Shinyi district all born in 1977 and 1978. A single dental exam by the same dentist was used to assess dental health. Results of multivariate regression analyses controlling for measurement age, sex, and housing supported the first hypothesis, indicating that the number of deciduous caries was significantly negatively associated with height and weight within individuals ($P = 0.001$). Contrary to initial expectations, however, numbers of fillings, thought to be indicative of past dental care, were not associated with children’s weights and appeared to be negatively associated with their heights; the 193 individuals without fillings were about one centimeter taller than the 89 with one or more ($P = 0.063$) with other factors statistically controlled.

[26] The Archaeology and Biological Anthropology of the Anzac Gallipoli Battlefields of 1915

D.W. Cameron and D. Donlon (Department of Anatomy & Histology, The University of Sydney)

Our project will for the first time undertake a detailed survey of the Anzac battlefields in the Gallipoli Peninsula and document the archaeological remains in detail. In one specific region, archaeological excavations, including ballistic studies of spent cartridge cases, will reconstruct the movement of Anzac and Turkish troops through the landscape of Baby 700 and Battleship Hill during the first day (25th April, 1915). It will also undertake a biological anthropological study of the condition of the Ottoman Army in 1915, by an examination of human skeletal remains. This is important, as unlike the Anzac troops, we have no documentary evidence relating to the health of the soldiers within the Ottoman Army, not only during the Gallipoli Campaign, but the First World War in general. Isotope studies will also be used to identify the nationalities of the human remains. It will involve an Australian and Turkish multidisciplinary team consisting of archaeologists, biological anthropologists, and historians.

[27] **Facial Flatness: a characteristic of East Asian population?**

Toetik Koesbardiati (Airlangga University)

Facial flatness is one of important characteristics of the East Asian population, which are also called as *regional continuity feature*. The proponents of the Multiregional Evolution Model argue that this character can be identified on the fossils from *Homo erectus pekinensis*, *archaic Homo sapiens*, *anatomically Homo sapiens* and recent population. Furthermore, they argue that facial flatness occurs in high frequencies in this population. The aim of this current paper is to prove whether facial flatness occurs in other populations outside East Asian. 256 crania from nine populations worldwide were measured. The selection of crania were based on geographic not racial. The result shows that facial flatness does not only occur in East Asian population but also in other populations such as Inuit, Sub Saharan African, North African, European and South American.

[28] **A Three-dimensional Multivariate Morphometric Study of Crania from Indigenous Populations of South Africa and Australia**

D. Franklin, N. Milne and L. Freedman (School of Anatomy and Human Biology, The University of Western Australia)

This study examines regional morphological patterning and sexual dimorphism between and within the crania of modern human populations from South Africa, Australia and other African, Pacific and Southeast Asian regions. The primary skeletal sample for this study is the R.A. Dart collection of human skeletons, comprising dissection hall subjects of known sex, age and ethnic background. This study aims to establish whether it is possible to demarcate morphological differences in the cranial form of a number of indigenous South African populations. This study will also investigate the viability of using a three-dimensional shape analysis and a multivariate morphometric technique to provide an improved quantifiable and reliable method of analysing morphological sex traits in the adult *Homo sapiens* cranium. Similar analyses of other population samples will also be made.

Traditional anthropological metrical cranial techniques involve linear (two-dimensional) distances between cranial landmarks. The methodology of the present study employs an extended series of cranial landmarks, which are digitised, allowing a rendered three-dimensional image of the cranium to be created. The increased series of landmarks introduced permits detailed shape comparisons of regions and/or of the whole cranium. This study uses the shape analysis software *Morphologika* to analyse the three-dimensional descriptions and patterns of shape variation in the crania. The sexual dimorphism and regional population differences in South African populations (Khoisan and Bantu) will be discussed.

[29] A Bioarchaeological Investigation of Beacon Island Land Sites and the Victims of the *Batavia* Mutiny

D. Franklin and L. Freedman (School of Anatomy and Human Biology, The University of Western Australia)

On the 4th of June 1629, the Vereenigde Oost-Indische Compagnie (VOC) ship *Batavia* ran aground onto Morning Reef in the Houtman's Abrolhos. The survivors' situation was dire, water was scarce and the available food was not being rationed. The ships Commanduer (Francisco Pelsaert) resolved to attempt the hazardous voyage of more than 1,900 kilometers to Batavia (modern day Jakarta), leaving behind approximately 268 survivors. In Pelsaert's absence of some three months, the second-highest ranking officer of the *Batavia* (Jeronimus Cornelisz) managed to establish his own 'ruling council', and with the aid of his followers began to murder all those who opposed him. Before Pelsaert's return, Cornelisz and accomplices had already murdered at least 125 men, women and children.

The Houtman's Abrolhos is approximately 65 kilometers off the coast of Western Australia, between 28° and 29° south latitude. Human skeletal material has been recovered from excavations of *Batavia* land sites since the 1960s. Between 1994 and 2001 six individuals were recovered from a mass burial. Characteristics of material from the mass burial such as the age, sex, numbers and positioning of individuals interred, evidence of trauma and the nature of the burial itself were analysed and compared for any similarity or dissimilarity to individuals listed and events outlined and chronologically recorded in Pelsaert's journal. The results of this analysis suggest that the interred were probably sick individuals who were amongst the early victims of the massacre.

[30] Syphilis and the West Australian Lock Hospital system at the turn of the twentieth century

J. Stingemore, J. Meyer and S. Bowdler (The University of Western Australia)

Public measures to control the spread of disease can impact on the workings of society just as significantly as the biological effects of the disease. This study looks at the demographics of forced removal to Lock Hospitals of Indigenous Australians judged to be 'syphilitic' in early twentieth century Western Australia. Historical records pertaining to reports of syphilitic people in the north west of Australia, the Lock Hospital records and general correspondence on syphilis and venereal disease were used to determine the demographics of people sent to Lock Hospitals.

It is very unlikely that even the majority of the people taken with 'syphilis' or 'venereal disease' were syphilitic. Diagnoses varied from predominately 'venereal' before 1908 to predominantly 'granuloma' at the Lock Hospitals. Older females were collected more frequently than males and retained at the Lock Hospitals longer despite similar types of diagnosis and recorded 'cure' rates. Excess collection of females was particularly notable in the Pilbara from which most people were taken. More than forty percent of people sent to the Lock Hospitals had no record of release or cure. Seventy percent of deaths at the Lock Hospitals were unrelated to the condition for which people had been incarcerated. These patterns reflect advances in medical knowledge, economic factors, the mindset of the Europeans towards Aboriginal people and general attitudes towards venereal diseases.

Further research needs to be conducted into the potential impact of these health policies on cultural continuity, resource earning capacity and reproductive potential of the Aboriginal people affected.

[31] Why human evolutionary ecology and psychology need human biology

J Chisholm (The University of Western Australia)

As our only scientific theory of life evolutionary theory must be relevant for understanding and improving the human condition. This important goal may be compromised, however, by some versions of evolutionary psychology that risk alienating the public by trivialising or misrepresenting what modern evolutionary theory is really about. To illustrate, I contrast the assumptions and methods of evolutionary psychology and human evolutionary ecology. I use (1) the differences between biology's adaptationist and mechanist perspectives and (2) evolutionary ecology's rationale for expecting tradeoffs among the components of fitness to argue that evolutionary psychology's view of adaptations as modules is lacking. On the other hand, while supporting human evolutionary ecology's emphasis on measuring the fitness effects of adaptations, I argue that its contribution to the overall goal of understanding and improving the human condition is limited by its inattention to modules. One way forward, I conclude, is for human biologists to enter the fray, describing the anatomical, physiological and developmental mechanisms - the modules - that actually do adaptive work.

[32] Risk, uncertainty, and attachment: Evolutionary perspectives on the relationship between early stress, theory of mind, and reproductive strategies

Cindy Schomaker, Jim Chisholm (The University of Western Australia)

A myriad of psychosocial stressors have been shown to influence reproductive strategy traits such as age at menarche, age at first sexual intercourse, and number of sex partners. However, not a great deal is known about the factors influencing the development of an individual's theory of mind (ToM) – the psychological mechanism encompassing the necessary skills for competent social interaction. This project enlisted evolutionary theory in order to gain a greater understanding of the interplay between society and human development, examining the association between childhood environment and subsequent reproductive and ToM functioning. Specifically, this project examined the effect of early stressful life events, family environment, and parent-infant attachment on an individual's reproductive traits and ToM competency in adulthood. Parent-infant attachment was proposed to be an important determinant of the alternative reproductive strategy adopted, not only mediating the effects of psychosocial stress but also being the primary factor influencing the acquisition of ToM skills. Results from a self-report analysis of 140 Western Australian females provided support for the predicted relationships. While early stress was related to early menarche, the majority of associations between psychosocial stressors and number of sex partners/year were in the direction opposite to that predicted. Stress variables, particularly those concerning family relations, were implicated in ToM ability, however, ToM competency was not substantially related to adult reproductive traits. Parent-infant attachment did not influence either ToM ability or reproductive characteristics. Overall, this study demonstrated the influence of psychosocial stress on both reproductive and psychological development.

[33] A new method for identifying cognitive indices of male mating strategies

F Gemmiti (The University of Western Australia)

According to evolutionary theory, human mating is strategic. At one extreme is a strategy that maximises offspring quality. At the other is a strategy that maximises offspring quantity. As with other mammals, human mating strategies are expected to depend on context, including perceived attractiveness of mates or available resources for parental investment. Evolutionary psychologists have investigated human mating strategies through controlled experiments, forced-choice questionnaires, public documents, psychophysiological measurements and behavioural observations. These methods have inherent limitations, such as the imposition of theoretically biased concepts in forced-choice questionnaires or the context-independence of public documents. This paper describes a new method that I am using to investigate male mating strategies. The method is divided into three steps. First, I conduct exploratory interviews with adult, English-speaking men residing in Australia. These men are interviewed on the subject of intimate relationships with women. Next, I identify subtexts from systematic analysis of the transcribed interviews. Last, I apply elements of life history theory, parental investment theory and sexual selection theory to the subtexts. I aim to investigate whether the subtexts can provide cognitive indices of male mating strategies. Two advantages of the method I am using are that participants determine the types of responses and analysis of those responses incorporates context.

[34] The misapprehension of good-genes mechanisms in humans: A review of specific theoretical issues and overlooked biological evidence

C.N. Stephan & M. Henneberg (The University of Adelaide)

Human evolution by sexual selection has received considerable attention in the international literature principally as a result of research into good-genes mechanisms, that is, directional choice of mates displaying environmentally adaptive traits (those that increase survival and/or fecundity). However, there appears to be some misapprehension of the basic principles underlying good-genes theories. For example, it appears that: (a) assuming good-genes are valid, they are natural selection not sexual selection; (b) Zahavian good-genes mechanisms are no different to Fisherian Sexual Selection when fecundity variance (or heritability of human fertility variance) is negligible; (c) measures of health are not critical natural selective factors as implicated in some good-genes theories; and (d) good-genes mechanisms are unlikely to operate in humans from first world/Western societies because survival and fecundity/fertility variance are negligible. This suggests that in many instances good-genes theories have been over implicated in modern microevolution of humans and that when evolution has occurred by good-gene processes it has actually done so via Fisherian sexual selection. These findings indicate that the theory of good-genes evolution may need to be refined to accurately describe truly novel evolutionary events that are not already addressed by other mechanisms. It also suggests that the majority of any recent microevolution in humans is likely to be the result of Fisherian sexual selection, not good-genes.

[35] Litter size, longevity and parental investment

D S Judge (University of Western Australia)

With very few exceptions, the reproductive pattern of long-lived species is characterized by production of litters of one separated by prolonged intervals. Life history theory has generally explained small litter sizes as a response to low ratios of adult to juvenile mortality. In this case, reduced litter sizes are presumed to indicate reduced parental effort (energy allocated to reproduction) and increased energy allocated to somatic maintenance and repair of the parent. Carey and Judge (2001) presented a model proposing that patterns of per capita intergenerational transfer are key to the evolution of prolonged adult life spans through a self-reinforcing mechanism. In this case, small reductions in juvenile mortality through either environmental change or adaptation can result in disproportionately large effects on survival (longevity) of both young and adults and thus in even greater parental investment (energy allocation to offspring that costs the parent and has a fitness return to individual offspring). Decreasing litter size is one mechanism for increasing parental investment that requires no change in reproductive effort per breeding attempt. In this paper, I develop this aspect of the model using comparative life history data and focus on the role of parental investment in contrast to parental effort in the evolution of life histories of humans and other long-lived taxa. This may help explain the extremely rapid increase in human life span observed over the preceding century.

[36] Formation of the Trefoil Configuration of the L5 Vertebral Canal in Humans

X.M Chen, N. Milne (School of Anatomy and Human Biology, The University of Western Australia)

Different hypotheses have been proposed to explain the trefoil shape of the last lumbar vertebral canal in humans. The purpose of the present study was to investigate the vertebral shape variation related to the formation of this trefoil configuration. A comparative approach was taken and the methods of geometric morphometrics were used for analysis. Twenty normal adult human lumbar columns were selected to examine the inter-segmental variation. Twenty degenerate human, 4 juvenile human and 73 ape last lumbar vertebrae were compared with the normal last lumbar vertebrae of humans. Compared to the upper vertebrae, the last human lumbar vertebra tends to have more coronally orientated superior articular facets, relatively larger inter-facet and inter-pedicular distances, and a convex posterior border of the vertebral body. The adult human superior articular processes tend to encroach into the vertebral canal, causing the trefoil canal shape, but this is not the case in children or apes. The degenerate vertebrae show a relatively bigger vertebral body and superior articular facets, but no significant changes in the general shape of the vertebral canal. The comparison of the human and great apes last lumbar vertebrae again reveals difference in the orientation of the superior articular facets. Therefore, the results of this study clearly indicate that the trefoil shape of the human lumbar vertebral canal is not due to pathological changes or anatomical variation, but suggests that formation of the trefoil shape is an intrinsic tendency of the vertebra, probably related to the adaptation for the human bipedal posture.

[37] Craniofacial asymmetry in Malaysian Malays based on 3-D CT analysis

A. Yusof (The University of Adelaide), A.H. Abbott (Australian Craniofacial Unit, Adelaide), D.J. Netherway (Institute of Craniofacial Studies, Adelaide), G. Townsend (The University of Adelaide), I.L. Shuaib (School of Medical Sciences, University Sains Malaysia)

Asymmetry in the craniofacial structures of humans, while often minor in extent, is a common feature in individuals of all ages. This asymmetry may be directional in nature, with one side being consistently larger than the other, or of the fluctuating type, with small random differences in size between sides. Most previous studies of craniofacial asymmetry in humans have focused on individuals with developmental abnormalities and have been restricted to analyses in two dimensions.

This report presents preliminary findings on the nature and extent of asymmetry in the craniofacial structures of Malays with normal morphology, aged from 3 months to adulthood. The software program PERSONA developed at the Adelaide Women's and Children's Hospital was used to locate 22 landmarks on reconstructed 3-D images of helical CT scans for 10 individuals, five in the age range 3 to 11 months and five adults. A midline was constructed using selected reference points, then 3-D distances calculated on both sides for 12 craniofacial variables. Directional asymmetry was quantified according to the formula, $(L-R)/((L+R)/2)$ while fluctuating asymmetry was defined as $|L-R|/((L+R)/2)$.

There was little evidence of directional asymmetry in the sample, although the number of individuals was small. There was evidence of fluctuating asymmetry above that attributable to error, reflecting the influence of environmental factors from early during postnatal development through to adulthood. It is planned to carry out 3-D asymmetry analyses on a sample of 200 individuals to provide standards against which individuals with craniofacial abnormalities can be compared.

[38] Pax7 Expression is Altered in the Superior Colliculus of Pax6 Mutant (Sey) P21 mice

J. Thompson, M. Ziman (Edith Cowan University)

The *Pax* genes are a family of transcriptional regulators highly conserved during evolution. They are crucial regulators of vertebrate embryogenesis, and correct gene dosage is critical for normal regionalisation of the brain. *Pax6* and *Pax7* are involved in both early and late stages of central nervous system development; they initially afford ventral (*Pax6*) and dorsal (*Pax7*) identity to the developing neural tube, and later, restricted expression is involved in brain patterning and neuron specification within the visual system. Here we investigate whether the graded expression of *Pax7* within the retinorecipient layers of the superior colliculus is pivotal for topographic map formation. Superior colliculi formation, from the dorsal mesencephalon, has previously been correlated with increased levels of *Pax7* and suppression of *Pax6*. In the absence of *Pax7* the mesencephalon adopts a tegmental identity (ventral mesencephalon), whereas *Pax6* haploinsufficiency in *Sey* mice has been shown to result in defective formation of the diencephalic-mesencephalic boundary. In this study we have examined the graded expression profile of *Pax7* in the superior colliculus of *Sey* mice as compared to that of wild type in order to assess whether *Pax6* levels affect the *Pax7* expression profile and thus retinotopic map formation. This expression was characterised using immunohistochemistry on cryosectioned mouse brain tissue, and subsequent signal detection was explored using Optimus Digital Analysis. Results in *Sey* mice indicate *Pax7* expression (normally dorso-caudal) was expanded both ventrally and rostrally, with concomitant increase in signal intensity, as compared to wild type littermates.

[39] Postnatal growth of the posterior cranial base

Russell Chapman, Nick Milne Jan Meyer (School of Anatomy and Human Biology, The University of Western Australia)

This study examines changes in the size of the cranial base, as a unit of the craniofacial complex, in children from 2 – 17 years of age, using cross-sectional data. The nature of cranial base growth is investigated by comparing differences in its anterior and posterior segments with age. Age-related differences in cranial base length are compared to other age related differences in the craniofacial complex, in particular vault size and cranial base angle. Analysis involves the use of coordinate landmark data obtained from lateral radiographic images. Shape analysis is applied to the landmark data using geometric morphometrics and cranial measures of interest are derived using simple geometry.

The results of this study support previous findings of the cessation of anterior cranial base growth earlier than posterior cranial base growth, and the continued growth of the posterior cranial base until about the end of the pubertal growth spurt. Additionally, there is provision of support for a phenotypic plastic model of cranial base growth, based on associations between the size of the cranial base and its angulation, and vault size and cranial base angle, using basal length as a mediator for both. Shape analysis and derived measures are used as ageing criterion to test the reliability of age prediction based on craniofacial metric variables predominantly weighted by cranial base morphology. The results show average reliability of age prediction based on these criteria when sex is not known. Sex established based on the same criteria can be used to yield predictions of age with a high degree of accuracy.

The findings suggestive of a phenotypic plastic model of growth for the cranial base have important implications for the timing of orthopaedic treatment in disorders involving the craniofacial complex. This study highlights the need for detailed experimental data to test the causality of these associations. The findings of the possibility for accurate determination of sex and age has important implications for developing discriminant functions which would be of value in forensic and anthropological applications.

[40] Hand and Forearm Musculature of the Brachiating Apes: with Particular Reference to the Structure and Function of the Orang Utan (*Pongo pygmaeus*). Implications for Hominid Evolution

M.M. Brennan, R. Norris and M. Henneberg (University of Adelaide)

Great ape musculature is frequently referred to in relation to theories of hominid evolution, particularly the evolution of upright bipedalism. For these theories to have validity it is important for ape musculature to be well documented. This is currently not the case. Information, especially on orang utans, is scarce and from dissection of only a few individuals. In this study three adult, one infant and two foetal orang utans, and an assortment of hylobatid cadavers were studied. The muscles of the three adult and one infant orang utans were measured and origins and insertions recorded. From this the function of the muscles and possible relations with locomotory and manipulatory activities were discussed. In conclusion brachiating apes were found to have forearm musculature specialised for locomotion and hand musculature specialised for manipulation. This information can be used in relation to theories regarding the development of precision manipulation and upright bipedalism in hominids.

[41] **Pax7 Regulates Expression of the Axonal Guidance Cue Ephrin-A2**

M. Ziman (Edith Cowan University), M. Thomas, L. Beazley (University of Western Australia)

During embryonic development, expression of *Pax7* amongst other transcription factors, defines the polarity of the midbrain region, the optic tectum. In later stages of tectal development, restricted expression of *Pax7* within retinorecipient layers of the stratum griseum superficiale (SGFS), suggest it may be involved in formation of a retinotopic map. A precise topographic map is formed as a result of retinotectal connections that are mediated by complementary retinal and tectal gradients of Eph receptors and ephrin ligands.

Here we explore the possibility that within tectal laminae, *Pax7* controls expression of one such ligand, *ephrin-A2*. Mice were terminally anaesthetised and perfused with 4% paraformaldehyde. Using immunohistochemistry, we quantified spatial and temporal expression patterns of *Pax7* within the tectum and found *Pax7* to be expressed in rostral^{low} to caudal^{high} and ventral^{low} to dorsal^{high} gradients as previously shown for *ephrin-A2*. Moreover, double-labelling immunofluorescent experiments performed at a time of retinotopic map formation in young mice, demonstrated that *Pax7* and *ephrin-A2* were co-expressed in SGFS neurons.

The ability of *Pax7* to regulate ephrin-A2 expression was further assessed *in vitro* by stably transfecting undifferentiated P19 mouse embryonal cells with *PAX7-pHM6* cDNA. Using immunohistochemistry and RT-PCR we found that transfected cells differentiated along a neurogenic lineage and up-regulated *ephrin-A2*. This result was confirmed using antisense oligonucleotides to down-regulate *PAX7* with concomitant down-regulation of *ephrin-A2*. We conclude that *in vivo* and *in vitro*, *Pax7* plays a role in regulation of *ephrin-A2* expression.

Matsunaga et al., (2001) *Development* 128: 4069-4077

Marin et al., (2001) *Developmental Biology*, 234: 289-303

[42] **Fast Movements Distort The "Proportional Duration Model" of Movement**

P. Yilder, B.Gutnik, D. Nash, (School of Health and Environmental Sciences, UNITEC), Auckland, New Zealand (Information Technology, UNITEC), Auckland, New Zealand, J. Millar (School of Health and Environmental Sciences, UNITEC), Auckland, New Zealand

The proportional duration model [PDM] (Smidt & Lee, 1999) maintains that the relative timing of elements of movement remain constant within the same motor program. Constant temporal ratio is independent of the total and absolute prolongation of the motion. Subsequently the model does not discriminate the influence of visco-elastic components of muscles.

This study aimed to clarify this influence. We used two models of fast repetitive movement (abduction-adduction of the total arm and flexion-extension of the forearm with an experimental interval of 20 seconds). During each interval our young participants drew numerous cyclic traces using the "WACAM" graphic design system linked to associated software.

Each cyclic trace was then categorised into temporal compartments of a) Reversal time, b) Periods of acceleration, and c) Deceleration.

Nine cycles (with minimal, maximal and closest to the average velocities) were systematically correlated. We then measured contextually the different forces and stiffness of muscles in performance of the cyclic sequences (related to the same periodic performance).

Our resultant analysis did not support the theoretical foundation of PDM. We suggest that our results may be due to the involvement of viscoelastic elements of muscles intruding upon the initiating motor program (which remains the same in the different phases of the same task). PDM as a key element of motor control is subject to the speed of muscle contraction. We contend that speed in turn is not only governed by contractile muscle components. Our findings have significance with regard to motor learning of fast movements in sport.

Reference: Schmidt, R.A. & Lee, T.D. (1999) Motor control and learning: A behavioral emphasis, 3rd Edition. Champaign, IL: Human Kinetics.

[43] Osteopathic Treatment Changes in Behaviour and Bimanual Coordination

D. Gale, B. Gutnik, C. Standen (School of Health Science, UNITEC), Auckland, New Zealand, J. Nicholson (School of Animal Welfare, UNITEC), Auckland, New Zealand, J. Miller (Information Technology, UNITEC), Auckland, New Zealand, G. Hudson (School of Civil Engineering, UNITEC), Auckland, New Zealand, Wei Gúo (Data Technology), Auckland, New Zealand

The aim of our work was to check some spatial and temporal kinematic characteristics of unilateral and bilateral movements before and after osteopathic crossfibre massage of the proximal (experiment 1) and distal (experiment 2) muscles.

In experiment 1 (investigation of the proximal muscles in the uni-manual task) 6-15 young participants using horizontal abduction-adduction and flexion of the stretched arm created a number of Zigzag lines with an electronic stylus on the frontal plane (10 -12 experiments for each person). Each Zig-zag was represented as a combination of the big and small angles, and presented as synchronic alternation of the X and Y vectors.

In experiment 2 (investigation of the distal muscles in bi-manual task) participants pushed handles on the electronic hardware with both thumbs, utilising the left and right first dorsal interosseous muscles simultaneously (25 individual experiments). Four temporal landmarks were identified on the each kinematic curve and unilateral temporal differences (± 1 ms) were calculated.

Each person was primarily tested (in both experiments) and retested after 4 minutes crossfibre massage.

The results have shown the essential difference of kinematic structures for the both tests: other distributions of X and Y vectors and improve synchronization between landmarks of both hands. The traditional mass - spring biomechanical model was applied to describe these alterations.

Osteopathic treatment may alter stiffness in the elastic elements of muscles that in turn caused these bi-side effects. Also we did not exclude and influence of this massage on the central mechanisms of motor control.

[44] Lateralisation in Behaviour of Upper Limbs During Human Bipedal Locomotion

B Gutnik, C. Standen, D. Gale (School of Health Science, UNITEC), Auckland, New Zealand, G. Hudson (School of Engineering, UNITEC), Auckland, New Zealand, H. Mackie (School of Sport Science, UNITEC), Auckland, New Zealand.

Lateral differences in kinematic parameters of the movements of the upper limbs during natural treadmill locomotion were investigated. 24 healthy, young, right-handed subjects (14 females, 10 males) were videotaped while walking at a constant velocity of 4 km.hr⁻¹. Two opposing video cameras were focussed on the saggital projection of the walking subject. The spatial and temporal kinematic parameters (shoulder and forearm flexion-extension angles, and total period of fluctuation) were recorded for 6 – 10 cycles and analysed using “Video-Expert II” software on a PC.

Five key positions, relative to the shoulder, were defined in each flexion/extension cycle. Angular positions of the shoulder and forearm were measured relative to the vertical. Locations of the combined centre of gravity for the forearm and shoulder were computed, respectively, and compared to pendulum motion. Damped pendulum motion was considered to explain differences between virtual and physical periods. Accordingly, a damping factor (proportion of a critically damped system) was calculated.

Experimental data demonstrated the same damping factor for both arms, but dominant arms displayed greater amplitude of movement, faster angular motion and higher kinetic energy. Damping factors were observed to be significantly different between individuals.

The explanation of our findings appears unrelated to amplitude of rotation of the pelvis and trunk in clockwise and counter-clockwise directions (the same magnitudes were observed). We suppose that elasticity of the more trained dominant shoulder muscles may be greater than those on the non dominant side enabling a more energetically charged pendulum movement. We have plans to investigate these suggestions.

[45] **The Evolutionary Significance of the Middle Pleistocene Narmada Hominin Cranium from Central India**

R. Patnaik (Vertebrate Palaeontology Laboratory, Centre of Advanced Studies in Geology, Panjab University), D.W. Cameron (Department of Anatomy & Histology, The University of Sydney).

Traditionally the Narmada fossil hominin has been allocated as a member of a late *Homo erectus* grade. This paper re-examines the status of the Narmada hominin. We concluded that the Narmada hominin is a member of archaic *H. sapiens* deme (prehistoric lineage), closely related to the deme defined by the European Steinheim and Petralona specimens. The only features that it shares with early and late *H. erectus* demes are primitive hominin characters, while it shares a number of derived features with archaic *H. sapiens*. The derived hominin condition of the Narmada cranium can be explained as a result of developmental processes associated with neuro-orbital convergence and frontal lobe development/repositioning. Many of the primitive features, however, are related to musculature attachment sites, which are directly influenced by *in vivo* responses. While of interest from a functional perspective, they are of no phylogenetic significance. A multivariate analysis also concludes that the Narmada hominin is a representative of a European archaic hominin deme. Preliminary dating of bovid remains found in association with the hominin cranium by the gamma spectrometric U-series dating technique suggests a tentative minimum age of not less than 236,000 years. This is in agreement with evidence from biostratigraphical studies of the Boulder Conglomerate (Sankhyan, 1997), which place these deposits in the Middle Pleistocene.

[46] **New *Indopithecus* (= ‘*Gigantopithecus*’) and *Sivaladapis* Specimens From The Late Miocene, Hari-Talyangar Region, Siwaliks, Himichal Pradesh, Northern India**

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A new primate fossil locality, Hari Devi I, containing a hominoid right M² and left I¹ have been discovered about 100 metres north of the recently reported Dangar I locality, Himichal Pradesh, northern India. The incisor is believed to represent a specimen of *Sivapithecus*. This specimen is worn but broad and fits within the size range of known *Sivapithecus* incisors. The large size of the M² and the relatively bunodont nature of its occlusal morphology are distinctive from both *S. sivalensis* and *S. indicus*. A correlation between upper and lower molar breadth of extant hominids and species of *Sivapithecus* suggests that this upper molar fits within the projected range of the *Indopithecus* (‘*Gigantopithecus*’) M² relative to the M₂ in the *Indopithecus* mandible from the same region. While this new molar also falls within the range of *S. parvada*, geological and temporal evidence indicates that this tooth is more likely to represent an M² of *Indopithecus*. Another locality designated as Hari I (within the Hari-Talyangar area) produced a number of *Sivaladapis* specimens in the 1980s that are reported here for the first time. Current radiometric and geological studies by the Siwalik Hominid Project will provide absolute dates for these localities.

[47] The Fossil Ape from Chad, *Sahelanthropus*, is Hominin

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Early hominid phylogeny is reconstructed by generating a number of parsimony analyses. The main focus of this research is to examine the phylogenetic status of the hominid *Sahelanthropus* from Chad relative to Miocene hominids and Pliocene hominins. A secondary aim is to examine the phylogenetic significance of *Kenyanthropus*. A number of analyses were generated some based on craniofacial features alone, while others a combination of craniofacial and postcranial features. Characters were also analysed as ordered and unordered. Two phylogenetic schemes were consistently generated, according to whether characters were ordered or unordered. The inclusion or exclusion of postcranial features had little or no impact on the phylogenies generated. In all analyses *Sahelanthropus* is defined as belonging to the Pliocene hominin clade, as opposed to the Miocene hominids and extant great apes. This is not in agreement with current molecular dates for hominin-chimpanzee divergence dates. *Kenyanthropus* is shown to consistently share a sister group relationship with members of the '1470 group' to the exclusion of all other hominins, suggesting a longer history for each of the lineages of *Paranthropus* and *Homo*.

[48] Shape variation in new world monkey crania

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Cranial variation among the new world monkeys was examined using geometric morphometrics. Three dimensional coordinates were obtained for 63 cranial landmarks on 174 new world monkey crania from 16 species representing all the major groups of the platyrrhines. The data were analysed using morphologika software that first uses Procrustes analysis to scale and fit the landmark data. This removes differences that may arise due to size, position and orientation of the crania and leaves only the shape differences in the landmark configurations. Then principle components analysis is used to analyse the shape variation. Principle components can be considered as shape variables and the shape variation represented by each PC can be visualised in the morphologika program. In addition associations between each PC and other variables such as body size, brain weight, diet and locomotion can be explored. The results confirm the basic phylogenetic relationships among the new world monkeys. Certain patterns of shape variation seem to relate to diet, body and brain size. However others are related to the special adaptations of particular species.