Aboriginal stature in South Australia: 
A 10,000-year history

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ABSTRACT
Aboriginal stature across a range of South Australian environments is investigated. Comparison is made between ancient, historical and modern populations. Stature of skeletal remains from the ancient Swanport burial ground was compared against published results for the Roonka site. Stature was reconstructed using Pretty et al. [1998] and the Trotter-Gleser [1952, 1977] method for Blacks. The Swanport sample provided statures of 1,707mm (n = 45) and 1,691mm for males and 1,582 mm (n = 58) and 1,585 mm for females. Roonka statures were 1,652 mm (n = 55) and 1,665 mm for males and 1,527 mm (n = 40) and 1,549 mm for females. An on-going anthropometric study (1996 to 2002) in the Lower Murray Aboriginal communities at Raukkan and Gerard (South Australia) showed the average male stature of 1,715 mm (n = 45) and the average female stature of 1,562mm (n = 47). In 1879 the Reverend George Taplin (‘Missionary to the Aborigines’) measured the stature of 14 adults living at Raukkan. His results indicate that males averaged 1,678 mm (n = 6) and females averaged 1,547 mm (n = 8). Historical data for South Australian Aboriginal stature in the arid north of the state show the average male stature of 1,662 mm (n = 35) and the average female stature of 1,557 mm (n = 36). Comparison between these data sets suggests that there has been little alteration in South Australian Aboriginal stature covering a period of approximately 8,000 years. This contrasts with a noticeable recent increase in European stature and has significant implications for our understanding of historical and modern Aboriginal living conditions and nutritional status.

KEY WORDS Swanport, Roonka, River Murray, secular trends
Stature in humans is a direct reflection of both long-term and short-term adaptations. Long-term stature trends in all human populations are governed by many different factors. Long-term body size and shape are a manifestation of natural selection and genetic effects, thus variability in individual stature is primarily governed by genetic material (Henneberg 2001b). In addition stature heritability can be described as fairly high [Cavalli-Sforza and Bodmer 1971, Susanne 1971, Mueller 1976, Roberts et al. 1978].

Short-term variability in stature is the result of ontogenetic adjustments [Lasker 1969] which, in addition to genetics, further influences an individual’s stature. Many environmental influences can alter final stature; including the effects of nutrition, disease and social status [Birdsell 1993]. These factors are believed to have a predominant influence during infancy and childhood and may reflect a broad socioeconomic picture of society [Scheuer and Black 2000].

This paper explores South Australian Aboriginal stature over a 10,000-year period in comparison to that of European stature. It is believed that Western stature has been increasing steadily since ‘modernisation’, a factor regularly attributed to improved environmental, diet and living conditions [Roche 1979, Prokopec 1984, Bogin 1988, Sobral 1990, Weber et al. 1995]. The absence of a secular increase in stature may be related to poor nutrition and low socioeconomic development [Tobias 1985, 1990; Leatherman et al. 1995; Prince 1995], although Australians and South Africans of European extraction have shown very little secular stature increase over the last 100 years [Henneberg and Van der Berg 1990; Henneberg 2001a,b].

It is not clear whether Australian Aboriginal stature has followed an increase similar to Western stature or remained static [Birdsell 1993, Pretty et al. 1998]. This question is difficult to address due to the diversification between Aboriginal groups, a limited body of documentary evidence pertaining to Aboriginal health and stature and the small number of large burial samples available for anthropometric study. This paper will use data collected from historical sources, two large well-documented South Australian skeletal collections, in addition to ongoing anthropometric studies in two South Australian Aboriginal communities. The data collected and presented herein on Aboriginal stature in South Australia, sample a number of environmental zones from rich coastal habitats, through riverine environments to desert populations in the extreme north of the state. They present a microcosm of the Aboriginal situation in a single state.

Materials and methods

Data from the ancient Aboriginal burial grounds excavated at Swanport and Roonka (approximately 90 km and 200 km north of the River Murray mouth, respectively) and from anthropometric studies of living people in the Aboriginal reserves of Gerard and Raukkan (located near Roonka and at the Murray mouth, respectively) were used (Fig. 1). These were supplemented
Aboriginal stature in South Australia

by data concerning South Australian Aboriginal stature from publications by TAPLIN [1879], WOOD JONES and CAMPBELL [1924], CAMPBELL and LEWIS [1926] and FENNER [1936]. Data from ABBIE’s [1975] study of Central Australian Aborigines were used to calculate age/stature regression equations.

As there are few complete Australian skeletal collections from the historic period or historical records related to living Aboriginal populations there are no recognised methods for reconstruction of stature in Aboriginal remains. Height reconstruction should therefore be conducted with some care. PRETTY et al. [1998] compared the TROTTER and GLESER [1952, 1977] formulae for ‘Blacks’ against height reconstruction from relative lengths of the humerus, femur and tibia of living Aborigines. Using data on maximum length of bones and statures of living Central Australian Aborigines measured by ABBIE [1975], PRETTY et al. [1998: 508] determined that the male femur constitutes 26.5% of the stature and the female femur constitutes 26.4% of stature. The comparison indicated that both approaches produced similar results. Stature reconstructed from the length of limb bones seems to represent stature of young adults (maximum living stature) since the loss of stature with age results mostly from changing shape of the trunk. Both methods were employed for reconstruction of stature in the ancient Swanport and Roonka samples.

Although there is no known reduction in long bone length with age, an overall stature decline with age is present in all individuals once growth is complete [CHANDLER and BOCK 1991, BIRDSELL 1993]. In 1975 Abbie published results

Fig. 1. Map showing location of Swanport and Roonka Aboriginal burial grounds and Gerard and Raukkan Aboriginal communities.
from a study of Aboriginal people living in Central to North Australia. His data provided age related stature for 204 adult males and 150 adult females [ABBIE 1975: Tables IV and V]. These data were used for the calculation of stature on age regressions in both adult males and females. From regression equations it was discovered that male stature decreases by 21.6 mm/century, whilst female stature decreases by 16.0 mm/century. Stature measurements for all living Aborigines used in the present study were age corrected for individuals over 25 years according to our calculations to attain maximum living stature comparable with that reconstructed from skeletal samples. Corrections resulted in average statures of separate samples increasing by 1-4 mm, a small alteration chiefly because most people measured were of rather young age.

In 1911 skeletal remains of around 136 individuals were excavated from the Aboriginal burial ground at Swanport [STIRLING 1911]. During reclamation of low-lying swamplands, workmen constructing a series of levy banks took soil from a small embankment which contained the skeletal remains. The South Australian Museum was notified and the museum Director, Professor E. Stirling, and a colleague Mr. R. Zietz, removed the mixed skeletal remains from a hole at the site where they had been gathered together [STIRLING 1911, OWEN 2004]. The indiscriminate manner of exhumation meant that unfortunately all stratigraphy and provenance pertaining to the skeletal material was lost. Fortunately Zietz was able to remain on site and supervise the removal of an additional 16 complete skeletons.

For some time academic speculation has surrounded the antiquity of the Swanport skeletal remains, where many thought the burial ground to be related to a smallpox epidemic during the early 19th century [e.g., HOWELLS 1973, HOBSON and COLLIER 1984, MOLNAR et al. 1989, WEBB 1995]. This matter has now been resolved by radiocarbon determinations which indicate that the skeletal material dates to between 3027 and 480 BP [PATE et al. 2003].

In 2002, T. Owen, conducted an osteological examination of the Swanport femora, which included taking measurements of maximum length (the Ngarrindjeri Heritage Committee and the Flinders University Social and Behavioral Research Ethics Committee provided permission for analysis of the Swanport skeletal collection.). These measurements were cross-checked against previous measurements [WEBB 1991] to assure accuracy. Sex determination was established for each femur [OWEN 2004] and stature of the Swanport sample was calculated for males and females using the PRETTY et al. [1998] technique and the Trotter-Gleser formulae for Blacks. This provided stature estimates for 45 males and 58 females.

Roonka was excavated between 1968 and 1977 by Graeme Pretty and 216 individual skeletons were removed from the burial site [PRETTY and KRICUN 1989, PATE et al. 1998, PATE 2006]. M. Prokopec, D. Ellicot and K. Cotton conducted an osteological examination in 1974. The results of stature determination were published [PRETTY et al. 1998] and have been used in this research. They provided stature estimates for 55 males and 40 females.
Since 1996 M.H. has conducted studies into the health status of individuals living in the Aboriginal communities of Raukkan and Gerard. At the written request of both communities and following approval by the University of Adelaide Human Ethics Committee, measurements were taken of volunteers following Martin’s methods. The techniques used during the study are described in Henneberg et al. [2001]. To date the ongoing research at Gerard and Raukkan has collected stature data from 45 males and 47 females. Stature decline with age was corrected for as described above.

In 1874, at the request of His Excellency Sir A. Musgrave, the Governor of South Australia, an inquiry was made into the manners and customs of Aborigines in South Australia. The Rev. George Taplin was charged with compilation of the results from numerous questionnaires [Taplin 1879]. Data collected included information regarding ‘measurements of adults of the Narrinyeri’ [1879: 53-56]. This name pertains to the coastal tribe around Raukkan. Taplin reported the statures of the 6 males and 8 females, which have been corrected for stature decline and used in our analysis.

Data from three different studies have been used for comparison of stature relating to inland Aborigines. Wood Jones and Campbell [1924] collected data on body heights of Aborigines living in the Sturt Ranges (mid-South Australia). Their data presented age and stature for 6 males and 4 females. Campbell and Lewis [1926] published anthropometric data on Aborigines living in Ooldea (northern South Australia). Their measurements included age/stature data for 9 males and 16 females. Fenner [1936] provided anthropometric analysis of Aborigines living in the Diamantina and Cooper Creek regions (extreme northern South Australia). His data presented age/stature information for 20 males and 16 females.

The current study has compiled the data from these three studies and corrected them for age related stature decline. These three studies represent a total of 35 males and 36 females who may be described as living in inland arid locations.

To provide a comparison we have used data for the current general Australian population, which is of predominantly European origin [Australian Bureau of Statistics 1995]. These represented 502 males aged 18-24 years and 549 females of the same age group. To provide time depth to comparative data, the results of stature reconstruction for the sample of victims of the 79 AD eruption of Vesuvius in Pompeii was used [Henneberg and Henneberg 2002]. Sixty-six male and 100 female femora from the Pompeian sample were used to reconstruct statures using the Trotter-Gleser formulae for Whites. These statures are similar to those reconstructed for other samples from classical antiquity [Henneberg and Henneberg 2002, Fig. 15:184] and thus representative of the ancient situation.

**Results**

Table 1 presents statures of Aboriginal samples and comparative European series. Statures reconstructed for each skeletal series by the use of two methods.
do not differ significantly, though there is a significant difference between the two samples. It can be seen that in general terms statures of Aborigines located closer to the coast are taller than further inland (Fig. 2), where individuals from Roonka are shorter than those from Swanport. It was observed that some differences between statures of living males from Gerard and Raukkan and from northern South Australia are significant.

**Table 1.** Average body heights of South Australian Aborigines and comparative series (mm)^1

<table>
<thead>
<tr>
<th>Series</th>
<th>n</th>
<th>Male mean</th>
<th>Male sd</th>
<th>Female n</th>
<th>Mean</th>
<th>Female sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swanport – P^2 (2830-380 BP)</td>
<td>45</td>
<td>1707</td>
<td>60</td>
<td>58</td>
<td>1582</td>
<td>58</td>
</tr>
<tr>
<td>Swanport – TG^3 (2830-380 BP)</td>
<td>45</td>
<td>1691</td>
<td>38</td>
<td>58</td>
<td>1585</td>
<td>32</td>
</tr>
<tr>
<td>Roonka – P^2 (9800-100 BP)</td>
<td>55</td>
<td>1652</td>
<td>101</td>
<td>40</td>
<td>1527</td>
<td>84</td>
</tr>
<tr>
<td>Roonka – TG^3 (9800-100 BP)</td>
<td>55</td>
<td>1665</td>
<td>52</td>
<td>40</td>
<td>1549</td>
<td>50</td>
</tr>
<tr>
<td>Taplin (1879)</td>
<td>6</td>
<td>1678</td>
<td>37</td>
<td>8</td>
<td>1547</td>
<td>67</td>
</tr>
<tr>
<td>Mid-South Australia (1924)</td>
<td>6</td>
<td>1656</td>
<td>74</td>
<td>4</td>
<td>1545</td>
<td>71</td>
</tr>
<tr>
<td>N-South Australia (1926)</td>
<td>9</td>
<td>1665</td>
<td>58</td>
<td>16</td>
<td>1556</td>
<td>44</td>
</tr>
<tr>
<td>v. N-South Australia (1936)</td>
<td>20</td>
<td>1661</td>
<td>49</td>
<td>16</td>
<td>1562</td>
<td>47</td>
</tr>
<tr>
<td>Raukkan (1996-2002 AD)</td>
<td>18</td>
<td>1722</td>
<td>45</td>
<td>19</td>
<td>1565</td>
<td>44</td>
</tr>
<tr>
<td>Gerard (1996-2002 AD)</td>
<td>27</td>
<td>1710</td>
<td>62</td>
<td>28</td>
<td>1561</td>
<td>53</td>
</tr>
<tr>
<td>Pompeii (79 AD)</td>
<td>66</td>
<td>1673</td>
<td>54</td>
<td>100</td>
<td>1549</td>
<td>54</td>
</tr>
<tr>
<td>Australians (1995)</td>
<td>502</td>
<td>1784</td>
<td>66</td>
<td>549</td>
<td>1639</td>
<td>66</td>
</tr>
</tbody>
</table>

^1 All individual heights of living people were adjusted to represent statures of young adults.

^2 PRETTY et al. [1998] method.


Fig. 2. Male and female mean stature in South Australia
In order to obtain a clearer picture resulting from larger sample sizes we have grouped the inland samples and the recently measured samples from Raukkan and Gerard for the final analysis (Figs. 3a, 3b). This clearer picture visibly indicates the lack of difference between Ngarrindjeri measured in the 1870s, the Swanport skeletal series, present day inhabitants of Gerard and Raukkan, and

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**Fig. 3a. Comparison of male stature**

**Fig. 3b. Comparison of female stature**
early 20th century Aborigines from northern South Australia. The stature of ancient Pompeians does not differ significantly from any of the Aboriginal series, except the present-day Gerard and Raukkan males who are taller. All Aboriginal samples have statures much shorter than present-day mainstream Australians.

The apparent small differences in stature between these samples were subject to a Student t-test. It was discerned that the differences between all the Aboriginal series, both ancient and modern, and the stature of ancient Pompeians are not statistically significant (p > 0.05).

**Discussion**

The averages of stature we obtained for South Australian samples are not much different from the general stature range for the continent [BIRDSELL 1993, Fig E-2:311].

Despite relatively small sample sizes, characteristic of Aboriginal data, some trends emerge. The most striking is the lack of change in stature from early to modern times. The Swanport series especially stands out among Aboriginal samples as one of the tallest despite its antiquity (average date 2500 BP). This, combined with the gradient of decreasing stature away from the coast leads to the following interpretation: Richer coastal and lower riverine environments provided populations with more abundant and stable sources of food. Traditional, long-term cultural adaptations to harvesting this abundance resulted in the tall stature of people buried at Swanport. Shortening of stature of post-contact Ngarrindjeri may be a result of the disruption of their environment and culture by European settlers. In comparison to Swanport, the ancient inland riverine area of Roonka seemingly provided less abundant or less reliable food sources as evidenced by the shorter stature of people buried there. Roonka is 200 km from the coast and the beneficial effects of the coastal environment were not available. Stable isotope analyses of bone collagen [PATE 1995, 1997, 1998] indicate that the Roonka inhabitants were relatively sedentary and had limited access to foods from the coastal region to the south. Further inland populations lived in semi-arid and arid environments poorer from the point of view of human diet.

Although the stature of present-day inhabitants of Aboriginal communities is somewhat taller than the Aboriginal samples studied here, it is very much shorter than that of mainstream Australians. Stature in present-day Aboriginal communities does not differ significantly (t-test) from that of past aboriginal samples. This occurs despite the fact of obvious European admixture in these communities [HENNEBERG et al. 2001]. This disparity in stature between Aboriginal communities and mainstream Australian population is especially significant taking into account two centuries of the interaction between native and immigrant Australians.

The increase in stature that occurred in Europe was not repeated among Aboriginal Australians. Assuming that stature, at least to a certain extent, reflects living conditions, it may be suggested that for Australian Aborigines these conditions did not improve with the arrival of Europeans, though they have certainly changed.
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Streszczenie

Przeprowadzono badania wysokości ciała Aborygenów ze stanu Południowa Australia żyjących w zróżnicowanych warunkach środowiskowych. Porównano wysokość ciała przedhistorycznych, historycznych i współczesnych populacji. Ze szczątków szkieletowych pochodzących z cmentarzyska Swanport, użytkowana 3000–500 lat temu, odtworzono wysokość ciała i porównano ją z wysokością ciała uprzednio odtworzoną dla cmentarzyska z Roonka, użytkowanego 9800–200 lat temu [PRETTY i in. 1998]. Oba te cmentarzyska położone są nad rzeką Murray, odpowiednio 90 km i 200 km od jej ujścia. W obydwu przypadkach wzrost obliczano metodą specjalnie opracowaną dla odtwarzania wysokości ciała Aborygenów [PRETTY i in. 1998] oraz metodą TROTTER-GLESER [1952, 1977] dla amerykańskich Murzynów. Wysokość ciała odtworzona tymi dwiema metodami dla ludności pochowanej w Swanport wynosiła odpowiednio 1707 mm i 1691 mm dla mężczyzn (n = 45), a 1582 mm i 1585 mm dla kobiet (n = 58). Porównywalne dane dla Roonka wynosiły 1652 mm i 1665 mm dla mężczyzn (n = 55) oraz 1527 mm i 1549 mm dla kobiet (n = 40). Wszystkie te dane odnoszą się do maksymalnej wysokości przyjęciowej u osób młodych i nie biorą pod uwagę zmniejszania się wysokości ciała z wiekiem.

W trakcie ciągłych badań antropometrycznych (1996–2002) zmierziliśmy wysokość ciała współczesnych dorosłych osób mieszkających w dwóch Aborygeńskich osiedlach – Raukkan i Gerard, nad rzeką Murray, w pobliżu Swanport i Roonka. Po wprowadzeniu poprawek na zmniejszanie się wysokości ciała z wiekiem, średnie wysokości ciała współczesnych Aborygenów porównywalne z odtworzonymi z serii szkieletowych wynosiły 1715 mm u mężczyzn (n = 45) i 1562 u kobiet (n = 47).

W 1879 roku George Taplin, misjonarz działający w Raukkan, opublikował wysokość ciała pomierzonej przez niego dorosłej Aborygenów. Wysokość ówczesna wynosiła 1678 mm dla mężczyzn (n = 6) i 1547 mm dla kobiet (n = 8). Dane zebrane w latach międzywojennych na pustynnej północy stanu Południowa Australia przez WOOD-JONESA i CAMPELLA [1924], CAMPELLA i LEWISA [1926] i FENNEITA [1936], po wprowadzeniu poprawek na zmniejszanie się wysokości ciała z wiekiem wynosiły 1662 mm dla mężczyzn (n = 35) i 1557 dla kobiet (n = 36).

Wysokość ciała Aborygenów jest podobna do odtworzonej z kości udowych, metodą Trotter-Gleser, dla ludności Pompejów (mężczyźni – 1673 mm; kobiety – 1549 mm) i innych historycznych populacji europejskich, ale znacznie mniejsza niż współczesnych Południowych Australijczyków pochodzenia europejskiego, badanych w 1995 roku (mężczyźni – 1784 mm (n = 502), kobiety – 1639 mm (n = 549). Porównanie przytoczonych danych wskazuje, że w ciągu ostatnich 10 tysięcy lat nie wystąpiły istotne zmiany w wysokości ciała Aborygenów żyjących w Południowej Australii. Kontrastuje to ze znacznym zwiększeniem się wysokości ciała Europejczyków i jest prawdopodobnie wynikiem różnic w warunkach życia obu populacji.