

New estimates of change in the welfare of Chinese during the nineteenth century

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Abstract

South China had the earliest encounter with modern capitalism as Europeans from the 16th century tried to open trade with the Middle Kingdom via the port of Guangzhou (Canton), in Guangdong Province. Increasingly from the late 18th century foreign influence disrupted the economy and social fabric of southern China. Many scholars believe these developments reduced the standard of living, while others stress positive gains from increased integration with the world economy. The aim of the paper is to examine the well-being of the southern Chinese from the start of the 19th century based on the secular trend in average height. Data are drawn from disparate sources. The primary records are prison registers from 1853-1927 for Victoria, Australia, and the immigration control records used in Australia in the first half of the 20th century. The results are compared with those previously obtained from the personnel files of Chinese government agencies in the 1920s-40s and various anthropometric surveys conducted in China since the 1950s. The earliest born individual in the data set was born in 1798. From these sources we compile time series for average height. The focus of the paper is on the 19th and early 20th centuries, and includes comparisons with more recent anthropometric survey data.

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1. Introduction

China experienced huge social and economic upheaval during the 19th century that is believed to have severely reduced per capita income (Maddison 1998, 2001, 2003), though conventional economic data to construct historical times series for the standard of living are at present far inferior for China than other large countries. Height data has often helped fill the data gap for many studies of pre-20th century economies. Surprisingly few sources of height data have been discovered for China before the 20th century compared with Europe and North America, where military, prison and other institutions have yield large quantities of data. The only height data reported for Chinese born in the 19th century are for ethnic Chinese in Taiwan from Japanese colonial surveys (Olds, 2003), a note on 150 Chinese immigrants leaving the United States (Murray, 1994), and the health examination records of Chinese railways and other modern organizations (Morgan, 2004). The height data presented in this paper are the earliest so far analyzed based on the records of individual Chinese that enable reliable estimates of height trends from 1810 onwards.

Our data are compiled from the holdings of the National Archive of Australia (NAA) and the Public Records Office of Victoria (PROV). The NAA records are the documents that governed the entry and residency of Chinese in Australia after 1901, such as the Certificate of Domicile, the Certificate of Exemption from Dictation Test, and the Alien Registration Form. The PROV data comes from the prisoners registers that recorded all who were sentenced to custodial terms in the Colony (later State) of Victoria. The Australian immigration files for the Chinese, and similar records in Canada and the United States, along with the prison records that have also survived, are a huge untapped resource for the anthropometric history of the Chinese.¹

Not only are the archives of the former settler economies more easily accessible than the Chinese archives, the records of individual heights extend back in time further than any found in China. The earliest-born individual in our data set was a flute player called Ah Ching from Canton, who was born in 1798 and arrived in Melbourne in 1862 to join his son Ah Fook, a “digger” (gold miner) at Blackwood on the Victorian gold fields, who had arrived in 1855. They were both convicted on

¹ The United States Immigration and Naturalization Service, San Francisco, holds many thousands of records for Chinese admitted to the USA from the mid-19th century. About 100,000 records also exist in the Canadian national archives. Personal communication from Professor John Komlos, University of Munich, 2003, and Professor Peter Ward, University of British Columbia, 2004.

charges of larceny (petty theft) and sentenced to three months hard labor (VPRS 515/12/211-212, October 1868). These height and other data give historians an opportunity to re-write not only the history of Chinese immigration to Australia, to distance ourselves from a story focused on the exclusionist policies and more focused on the lives of these Chinese (Cushman, 1984), but also enable us to re-write the history of human welfare in China for the decades before the First Opium War (1839-42) that opened China to increased trade, commercialization and investment through to the mid-20th century. In particular, we can contribute to the debate about the nature of modern economic growth in China over the past two centuries and its impact on human welfare. That debate turns on whether increased trade and commercialization after China's opening improved or impaired the livelihood of farmers in particular. The secular shifts in average stature enable us to examine the impact of these changes.

Our estimates show average height during the 19th century was more or less static, with troughs occurring in the 1850s and the 1890s, and a rise in average stature from the end of the century through to the end of the 1920s. While these results can be interpreted cautiously to lend support to the optimist view that economic change on balance improved living standards, or at least did not impair welfare, they contradict the view that the standard of living collapsed during the 19th century. The paper is organized in the following manner. The next section will discuss Chinese migration to Australia and the anthropometric approach. Section 3 will describe the data, followed by presentation of statistical results. Section 5 will present comparative findings, and the conclusion will summarize the results and outline the future research.

2. Background and Methods

Early Chinese migration to Australia is a well-known story (Palfreeman, 1967; Choi, 1975; Yong, 1977; Jones, 2005; among others). The Chinese first arrived in the 1820 and 1830s. They were employed in the pastoral industry that was unable to recruit shepherds from among the freed former convicts transported to Australia. Some pastoralists petitioned the colonial authorities to allow large-scale recruitment of Chinese workers, but without favor among officials. The discovery of gold in the 1850s saw many thousands of Chinese arrive in Victoria. It also resulted in early conflict between European miners and the "celestials", as the Chinese were sometimes then called, and the introduction of regulatory measures to restrict Chinese

entry in the form of a landing or poll tax. These early restrictions soon lapsed in part because the rich and easily worked alluvial gold petered out and many of the Chinese miners returned home.

Some Chinese remained in Australia and engaged in a wide range of activities. Still others arrived to work in a variety of new industries in the growing colonies. Besides market gardening and petty retail, many Chinese labored in clearing land for farming and worked the tailings of abandoned gold mines. In the 1880s, most of the colonies again introduced restriction on the entry of Chinese workers. In Melbourne, for example, the growth of Chinese furniture manufacturing alarmed white urban tradesmen. During the 1890s depression, claims of unfair competition from Chinese resulted in discriminatory legislation such as the Factories and Shop Act (1896) that required Chinese-made furniture to carry a stamp 'Made by non-European labor'. By that time few of the Chinese who were in Australia had originally arrived as gold diggers. Those from the gold rush who remained were old, and the prison records show them jailed for crimes of destitution, such as vagrancy. Many of these elderly died in prison or the benevolent asylums to which they were transferred. Only two of the CEDTs from the early 1900s were for Chinese who had arrived in the 1850s.

At the founding of the Federation of the Commonwealth of Australia in 1901 there were about 30,000 Chinese in Australia (Palfreeman, 1967: 5). The first legislation passed by the Parliament of the federated colonies was the Immigration Restriction Act (1901) that sought to exclude colored immigrants from permanent settlement. It was specifically focused on the Chinese. Exclusion was enforced using the "language test", which was a dictation test in a European language of the choosing of the administering officer (Palfreeman, 1967: Chapter 8). The test was an adaptation of the "education qualification" test that Natal in South Africa imposed on immigrants.² Any Chinese who visited their ancestral home and wished to re-enter Australia required an exemption from the test, the CEDT, or they risked exclusion and repatriation when they returned to Australia. The test would remain in force as the basic exclusionary device until 1958 (Palfreeman, 1958, 1967; Yarwood, 1958; York, various).

² The British Government prevented its colonies and dependencies from adopting explicit racial exclusion legislation, but allowed so-called education or language tests, to overcome the objections of the better educated colored colonial subjects and diplomatic difficulties with Japan with which Britain was aligned in East Asia from the 1890s to the 1930s (Palfreeman, 1958, 1967; Yarwood, 1958).

The Anthropometric Method: Final adult height is a sensitive indicator of the net nutrition of adults during their growing years, and indirectly the impact of the economic and ecological environment on the development of the human organism (Steckel 1995, Steckel and Floud 1997).³ Attained stature reflects the trade off between the amount and quality of nutrients available for growth from childhood to maturity against the demands of body maintenance, disease and physical exertion. The secular change in the average height of a human population reflects broadly the change in their biological well being as a consequence of fluctuations in the available inputs to human growth, such as food nutrients and access to health care services.

We can view height as a net output measure for human growth, whereas income is an input measure that indicates potential for acquiring the necessities of a better life rather than their acquisition and consumption. Within a population group, such as the Han Chinese, the environment rather than genetics explain the differences in average height of the population over time or across regions or among social classes (Schmitt and Harrison 1988, Eleventh and Tanner 1990, Bogin 1999). Ultimately, other things being equal, the secular trend in height is a measure of the change in the nutritional welfare of the population. The differences in average height correspond closely with fluctuations in the economy, the incidence of disease, access to public goods such as health services and education, or other environmental factors that affect available nutrition (Steckel 1995, Komlos 1994, Komlos and Baten 1998). While most anthropometric history has focused on Europe and North America (Komlos 1994, Steckel and Floud 1997, Komlos and Cuff 1998), there is a small body of literature on Asia, including Shay (1994), Mosk (1996) and Honda (1997) for Japan; van der Eng (1995) for Indonesia; Gill (1998) for Korea; Brennan, MacDonald and Shlomowitz (1994) for India, several historical studies of Taiwan and China (Morgan 1998, 2004; Olds 2003; Wang and Lee 1999).

3. Data Sources

The height data used in this paper are drawn from two sources. The earliest data are from the Register of Male Prisoners at the PROV, Melbourne (Series VPRS 515), which comprises a register of names, particulars and personal descriptions of male prisoners from 1853 onward. These registers are large leather-bound volumes of about

³ One of the best introductions is Cuff's (2005) Chapter 2, "Historical Anthropometrics".

400-500 prisoners each on average, each prisoner record reporting the name and prisoner number, year of birth, native place, occupation, ship and date of arrival, religion, height (and sometimes build and weight), education (read or write), marks, when received, from where, the offence and the date of conviction. Later volumes include photographs. A total of 1268 valid records were obtained for male subjects born between 1798 and 1902, and aged from 15 to 86 years. Other Australian state archives have similar prisoner registers that contain Chinese subjects.⁴

The other source is the collection of documents that governed the entry and residency of Chinese in Australia that are held at the NAA, such as the Certificate of Domicile (CoD), the Certificate of Exemption from the Dictation Test (CEDT) and the associated Statutory Declaration, and the Alien Registration Form (ARF). Every state office of the NAA has holdings of these certificates for Chinese, some of which are digitized and can be viewed via the NAA's web catalogue (RecordSearch at www.naa.gov.au). Three set of CEDTs have been collected: the Melbourne B13/0 series, the Darwin E752/0 series and the Brisbane J2482 series (the later two series were accessed using the digitized online document). These were combined with the Alien Registration B78/1 series that date from c.1939 to create a combined CEDT-AR immigration set. An example of a CEDT form is reproduced as Fig 1.

INSERT FIG 1 ABOUT HERE

The CEDT records the name, nationality, place of birth, complexion, eye color, height in feet and inches and date issued, carries a photograph, and contains hand prints (not just finger prints, but the whole hand). A Statutory Declaration (SD) also accompanies most CEDT. The SD was required as part of the application for a CEDT, and contains invaluable information about the person, but is not always included in the surviving records. It was usually issued by a police station or local magistrate. Information in the SD includes birth date, birth place, current and previous occupations in Australia, current and past place of residence in Australia, marital status, first arrival in Australia, vessel and date of arrival, and past absences from

⁴ The author has identified a series of convict and prison registers at the Queensland State Archives that contain several hundred records of Chinese prisoners from the 1850s to 1900.

Australia. Accompanying the SD were also letters and testimonials from referees such as European shopkeepers as well as police reports on any known criminal activity.

The records are overwhelmingly of men, and the Chinese population was largely male after 1901 because the legislation restricted the men from bringing back to Australia their Chinese wives. Only a few women are found in the CEDT files, but the Alien Registration files contain relatively more. Most of these women were students studying in Australia between the late-1940s and 1960s, but there are also elderly Chinese women who had arrived before 1900 or who later were allowed to join their elderly husbands on compassionate grounds. Table 1 summarizes the total records that were collected, comprising 5344 men and 157 women after excluding children and upper extreme outliers. The earliest born subject was from 1798 and the latest 1954, while the earliest arrivals came to Australia in 1831 and the latest arrival in 1966, the last year of the White Australia Policy.

INSERT TABLE 1 ABOUT HERE

Any person of Chinese descent or part Chinese born in Australia is excluded from the database – the Darwin series contains quite a few children and young adults who were born in Australia to Chinese parents. Similarly, for the analysis of height trends, any Chinese who arrived in Australia as a child up to the age of 12 was also excluded, and teenagers and the very old were additionally excluded from the adult subset that was used to estimate height trends (see discussion of age factors below).

Most subjects in the Victorian prison records were born between 1815 and 1845, arrived in Australia during the early gold rush years between the mid-1850 and 1870, and their occupation was mostly recorded as laborer or miner. These were analyzed separately from the CEDT records because of the different providence of the data and that the majority of the subjects were from a generation earlier than most in the CEDT series. Some of the later arrivals among the prisoners overlap with the birth years of the CEDT subjects (see Fig 3a), but only two subjects in the CEDT series arrived during the 1850s gold rush. The birth years of the CEDT series for Melbourne, Brisbane and Darwin were centred on the period 1860-80, with record density dropping off sharply on either side. Most of them arrived in Australia between the

early 1880s and 1901, and their social status in terms of occupation was higher than the prisoners. Very few were classified as laborers. The Alien Registration series B78/1 from Melbourne comprise two distinct groups by year of birth, the birth year of the earliest group centred on the 1860-80s (the same as the CEDT series), and a later group whose birth year is centred on 1930-50s. The earlier group were from the same cohort groups as the CEDT subjects. They mostly arrived in Australia from South China before Federation. The later group was mostly students who came to Australia after World War Two as high school and university students, and who were from a wider range of provinces and we believe a more privileged social background. Fig 2a and Fig 2b presents a box-and-whisker height distribution by archive source for the subjects aged from teenagers to the elderly, while Fig 3a and Fig 3b are scatter diagrams that show the density of distribution of heights according to the year of birth of the subjects. The distribution histograms (not reproduced) revealed some heaping or rounding on whole inches and half inches, but past research shows such effects tend to cancel out and do not bias the analysis (Steckel, 1995).

INSERT FIG 2a AND FIG 2b ABOUT HERE

INSERT FIG 3a AND FIG 3b ABOUT HERE

Table 2 summarizes the mean height by decade for both men and women, but without any control for age or social heterogeneity within any decade. For some decades the data was insufficient for calculation of genuine population means. Our data for women was also insufficient for any further analysis.⁵ The remainder of the paper will focus on the male population.

INSERT TABLE 2 ABOUT HERE

⁵ Data for women are frustrating scarce in not only sources for Chinese heights, but for all countries. Fairly large sets of heights have been compiled for convict women transported to Australia in the late 18th and early 19th centuries (Oxley 2004; Nicholas and Oxley, 1993) and those incarcerated in Bavaria (Baten and Murray, 2000).

The characteristics of the prisoner and the male immigration data are summarized in Table 3. South China accounted for 96 percent of the CEDT subjects, comprising people drawn from Guangdong, Hong Kong, Macau and Fujian provinces. Most were Cantonese (from Guangdong). Only a few files recorded the actual county of birth.⁶ Native place was not nearly so accurately recorded in the prisoner data. The native place was simply listed as China for 61.5 percent of the entries. When native place was not China it was usually the port of embarkation. These were listed as Whampoa (Guangzhou), Canton (Guangzhou), Hong Kong and Macau, which accounted for 37 percent of the subjects. An ANOVA test showed no significant statistical difference in mean height at the 0.01 level between those whose native place was listed as China and those whose native place was South China, so we can assume that at least 99 percent of the population classed as China actually came from South China. Therefore the whole population of prisoners is assumed to have been born in South China.

INSERT TABLE 3 ABOUT HERE

The Chinese were concentrated in a small range of industries based on the industry classifications used in Australian census of the early 20th century (Keating, 1973).⁷ Rural-based industry engaged slightly more than half of all the prisoners, mostly employed as laborers of various kinds, and one-third of the CEDT-AR immigration-file subjects. Nearly a quarter of the prisoners were also involved in mining, but only 1.2 percent of the immigrants, which reflects the structural shift in industry and opportunities for Chinese in Australia. About one-third of the immigration subjects were in commerce, which included import-export and fruit merchants, greengrocers, shop and restaurant proprietors to hawkers of vegetables and other goods (some

⁶ Most Chinese in Victoria came from 13 counties around Canton, in particular the “four counties” (see yap: Sun Hoi, Toishan, Hoi Ping and Ying Ping) and “three counties” (sam yap: Nam Hoi, Poon Yee and Soon Tak), and the remainder from Chung Shan, Tung Kuan, Chang She, Hock Shan, Gou You and Go Ming (the place names are in Cantonese transliteration rather than pinyin). See Yong, 1977.

⁷ Classification of subjects according to occupation and industry is difficult due to structural changes in the economy – occupations that were skilled may become deskilled or disappear, and new occupations arise. We use the industry classification scheme based on the early Australian census as adapted by Keating (1973). We also adopt a six-class skill/class classification that comprises unskilled, semi-skilled, skilled and lower clerical, intermediate and semi-professional including owner proprietors, professionals, and a final category of retired, invalid or otherwise non-economically engaged. This classification system is informed by the system used by Armstrong (1972), Nicholas and Shergold (1988) and Haines (1989). All such systems are compromises. Full details of which occupations are classified into which industry and skill/class group are available from the author.

market gardeners were also hawkers but were classified primarily as market gardeners). Commerce only involved 15.6 percent of the prisoners. The distribution of major occupations of those in the CEDT-AR sample approximates the population reported for Chinese in the 1901 and 1911 census, which suggest our sample is representative of those who remained in Australia after Federation.⁸

4. Analysis of height data

The analysis of height trends is focused on adult men. A major problem with these data is the age of the subjects. Usually in anthropometric history the problem is that the subjects are young near-adults, such as army conscripts. These data, to the contrary, have many subjects who were quite old when their height was recorded. The problem with younger subjects is that they have not reached final adult height, which in the 19th century may not have been attained until 22-25 years. Older subjects pose two problems for the researcher, which may cancel each other, though this topic is under researched. Firstly, adults begin to shrink during their fifth decade of life, and the rate of shrinkage increases with age, such that men shrink about 6.0 cm from their peak adult height by age 80 (Chandler and Block, 1991). The effect of shrinkage is to bias downward the mean height relative to the original adult height. Secondly, there is a survivor bias that arises from the selection effect of height-related mortality risks. On average taller people have lower mortality than shorter people (Waalder, 1984; Fogel, 1994; Steckel, 1995), and those with greater longevity are likely to have been taller on average than those who had already died, and their inclusion – and statistical adjustment of their height for age-shrinkage effects – may bias the mean height upward.

In the past we have excluded data for subjects older than 50/55 years, but 2150 (52.7 percent) of the CEDT subjects were older than 50 years and 1507 (37.2 percent) were older than 55 years, which represents a huge lost of data. We tested the prisoner and the immigration data for cross-sectional shrinkage rates to determine the age range that might be acceptable. Age dummy variables were used to capture age-related effects, and we assumed that adult height was attained by 25 years of age and there was no shrinkage before 40 years of age. For the prisoner data, the regression

⁸ The occupation distribution for these censuses was 44 percent primary producers, 15 percent industrial occupations, and 29 percent for commercial and independent proprietors (Yong, 1977: 261).

results showed the decline from the height of the reference group 25-39 years (163.9cm) was 0.3 cm by the age 55-59 years and 0.5cm by the age 60-65 years, a height which was still taller than the 22 year-old mean. For the immigration data, the decline from the reference group (166.6) was 0.2 cm by 55-59 years and 0.5cm by 60-64 years. Although 54 years of age is the desirable upper limit for age, from these results our view is that inclusion of subjects up to 59 years will not significantly affect the estimated time series. The inclusion of the 60-64 group might provide additional information about trends to warrant inclusion (with caution), which results in the lost of 422 males in our data set who are older than 65 years.⁹

At the other end of the age spectrum, analysis of young prisoners indicates adult height was attained by the age 22-23 year – there were 51 subjects (4.0 percent) aged 15-21 years – though the data are insufficient for robust estimates. There were few young adults in the CEDT series – only 12 of the CEDT subjects were younger than 22 years. The Alien Registration Forms contain 193 (25.3 percent) teenagers or young adults younger than 22 years, most of whom were students in Australia from the mid-1940s. These students were taller than the earlier generations of arrivals and they attained maximum stature about 19-20 years of age, which was similar to urban males measured in China in the 1980s (Morgan, 2000). Their inclusion is only important for the estimates of those born after 1930.¹⁰ The results of the age-related regression estimates for both data sets are plotted in Fig 4.

INSERT FIG 4 ABOUT HERE

Regression estimates of height trends based on the prisoner data: Removal of a single low-side outlier from the prisoner set left a sample of 1267 subjects aged 18-86 years with a height range 144.8-182.9cm. Several regression models were run, and those reported below include a time-only specification with various degrees of restriction on the age range (Table 4a), from inclusion of all subjects to a set limited to those aged

⁹ The full regression results and the age-profile curves are available from the authors. Our estimates below erred on the side of caution to restrict the upper age to 59 years. In addition, we have a set of duplicates excised from this data set that record the height of about 90 individuals on a second or third occasion that lends themselves to further analysis of shrinkage rates in historical populations.

¹⁰ Only four male students were born before 1930. The sudden upward shift in mean height after 1930 indicates a before and after dummy variable should be included to take account of a 'regime shift' in height, with separate coefficients calculate for heights up to the 1929 and from 1930.

23-59 years. Another set of models included dummy variables for literacy and occupation (Table 4b) with the same age ranges specified. The reference period is 1850-59. For all models the coefficient estimates are unreliable for the periods 1790-1809 and 1890-1909 because of insufficient data in these cells. The coefficients of selected models are plotted in Fig 5 over the range 1810/19-1880/89.

Few of the dummy control variables returned statistically significant results. The literacy variable was significant in all models. Three-quarters of the prisoners were reported to be illiterate, the Read/Write column of the register marked “none”, “nil” or “no”. Prisoners who were recorded in the registers as being able to read and write Chinese (126 men) were about 1.0-1.1cm taller than those who were illiterate ($p < 0.05$ significance for most specifications). Those who could read or write some English (190 men) were not significantly different from the illiterates.¹¹ Only one model specification for the occupation dummy produced significant results. Those classed as tradesmen with some level of skill were 1.0cm taller than laborers ($p < 0.1$), the reference group, in the most restricted model for the age range 23-59 years. Non-manual (commercial) trades and proprietors (mostly shopkeepers) were slightly taller than laborers, 0.1-0.4cm, but not significant. An alternate specification that combined all tradesmen, commercial workers and proprietors reported height up to 0.7cm taller than the reference group, but the result was not statistically significant. Gardeners and hawkers were on average a little taller than laborers, and miners were on average all shorter, but none of the differences were statistically significant.

INSERT Table 4a and Table 4b about here

INSERT Fig 5 about here

Fig 5 plots the coefficients for four of the regression specifications. Average height for 1810/19 decade was 163.0-163.3cm for three of the estimates and 163.9cm for the fourth. On balance average height rose about 1.0cm from the 1810s to the 1840s, which was followed by sharp decline in the 1850s of between 0.7cm and 1.5cm. Three

¹¹ A binary literate/illiterate specification was tried, which found those who had some literacy in either Chinese or English were up to 0.7cm taller than illiterates, but the result was not statistically significant even at the 0.1 level.

of the four models show a slight recovery in average in the 1860s before the downward trend is resumed. The 1850s decline coincides with widespread social unrest in South and East China of which the Taiping Rebellion is the best known, though the wars of the period did not directly affect the areas from which these Chinese came. The decline in average height during the last decades of the 19th century quite clearly point to deterioration in the biological standard of living in South China. Many of the early nationalist leaders, including Sun Yatsen, came from the South and interior provinces that are believed to have fared poorly from the increased commercialization of the Chinese economy after the 1840s.

Regression estimates of height trends based on the immigration data: Exclusion of lower and upper extreme outliers and those younger than 18 years¹² left a final data set of 3960 men with a height range 147.3-184.2cm. Regression models tried ranged from time-only to a model with eight major occupations limited to those aged 23-59years at measurement, a specification that reduces the valid regression sample size to 2486 subjects. The reference period is 1850-59. Coefficient estimates are unreliable for the 1840s because of the small sample size and the estimates for 1890/99-1900/09 should be treated with caution for the same reason. The results are reported in Table 5a and Table 5b, and selected coefficients are plotted in Fig 6a and Fig 6b over the range 1840/49-1940/49.

INSERT Table 5a about here

INSERT Fig 6a about here

All time-only specification produced similar coefficients (Table 5a) after excluding the periods at either end of the period range where there are insufficient subjects in some models for reliable estimates. Fig 6a shows average height rose slightly from 165.5cm in the 1850s to a plateau at 166.3cm 1870/79-1880/89, declined 1.4-1.8cm in

¹² As noted above nearly all subjects younger than 22 were from the post-WWII arrivals who were born in the 1930s-40s and who came to Australia as students. Their height was on average taller than the mean adult height for 25-39 years based on the earlier born cohorts in the CEDT-AR files.

the 1890s, and resumed an upward trend during the early 20th century to 168-168.5cm in the 1930s.

Three separate specifications of occupation or skill were used to identify social differences in height on the presumption that reported occupation reflected past opportunities for the acquisition of human capital from childhood, and therefore point to the social standing of the family in which they were reared. Each occupation specification was tested with an increasingly narrowly defined age range. We also included a variable to control for differences between North and South China. Contrary to expectation, the northern Chinese were 1.0-1.2cm shorter than the southern Chinese, a result statistically significant ($p < 0.05$) in some models (Table 5b). Chinese from the north, however, in the 19th and early 20th centuries were on average several cm taller than southerners (Morgan, 2004; Stevenson, 1925).

Classification of occupation and skill levels of historical populations is fraught with difficulties. We have used three schemes. The first is a 1-6 skill level schema, from unskilled (1) to professional (5) and a retired and economically unengaged category (6) to account for the older subjects that had withdrawn partially or wholly from employment. The second schema adopts four levels of skill, which classed unskilled manual labor including domestic services as low skill (1), merged semiskilled trade and skilled trade into trade skill (2), shop and similar activities into lower commercial (3), and proprietors, merchants and professional occupations into upper commercial and professional (4). The third scheme simply coded for the seven major occupation groups and a miscellaneous other (8). Table 5b reports the results.

For the 1-6 skill scheme we found the unskilled (1) reference group was 0.7-1.1cm taller than the semi-skilled (2) and the skilled and lower commercial (3) groups ($p < 0.01$). They were also 0.5-0.6cm taller than the intermediate skill and proprietor group (4) for the 18-59 years and 23-59 years age-controlled models ($p < 0.1$). Similar results were found for the 1-4 skill schema, with the trade skill (2) and the lower commercial (3) groups 0.9cm shorter than the reference group for the restricted age range ($p < 0.01$). The upper commercial and professional group (4) was 0.4cm shorter, but the result was not statistically significant.

The third schema of eight occupational groups, with the reference group gardeners and hawkers (many hawkers were also gardeners), found these agricultural laborers

and small farmers were taller than all other groups except for the post-WWII student group. Restricting the age group to 23-59 years, we find the gardeners were 1.0cm taller than laundrymen ($p < 0.05$), 0.5cm taller than carpenters, cabinet makers and French polishers in the furniture trades, 1.9cm taller than café and shop employees ($p < 0.01$), 0.6cm taller than merchants and proprietors of cafes, shops and mines, 0.4cm taller than herbalists and other professionals such as accountants and managers, and 1.6cm taller than the miscellaneous group ($p < 0.01$). The students are 1.7cm taller than the gardeners in the most restricted age range, but the result is not significant. All the early 20th century studies found Chinese students taller than other Chinese of the same age indicating a more privileged social origin (Stevenson, 1925; Shirokogoroff, 1923, 195).

INSERT Table 5b about here

INSERT Fig 6b about here

Some of these results are contrary to expectation – we would expect the average height of laborers and those engaged in rural occupations such as market gardening to be shorter than skilled workers, proprietors and the professionals. Tradesmen among the prisoners, however, were about 1.0cm taller ($p < 0.1$) than the laborers, as we might expect, though we can see in those estimates that gardeners were also taller (0.6cm) than the reference group as were commercial trades and proprietors (0.4cm). In the absence of textual information about the origins of the subjects, we can only speculate about the reason for these differences. One explanation is that the market gardeners were from well-off farming families in the villages of Guangdong province, for the most part, whereas those with trades or engaged in upper level commercial activities may have come from market towns and the several large cities of the province. In other words, the “disamenities” of urban living may have reduced their net nutrition during infancy and childhood compared with the gardeners.¹³ In colonial North America the rural born were taller than urban residents, both the native born

¹³ There has been quite a vigorous debate about the extent to which the negative externalities of urbanization – crowding, expensive and adulterated food, poor sanitation and greater propensity for disease communication – affected the standard of living of the population during the industrial revolution. [Add references xxx.](#)

and immigrants, which is attributed to their proximity to the food supply and isolation from crowded settlement that reduced the disease load on the body and slowed transmission of epidemic diseases (add ref).¹⁴

Fig 6b plots the reference coefficients for the 1-6 skill and the 1-8 occupation models, estimated for the age unrestricted above 18 years, the age range 18-59 and the age range 23-59. The time-trend pattern is similar for all models, but with greater diversity in the size of the estimates from 1890/99-1940/49. Before the 1880/89 decade, the difference in the estimated coefficients stem from limiting the upper age of subjects to remove those older than 60 years that raised the estimates 0.4-0.6cm for the 1870-80s from about 166.5cm to 167.0cm, a difference that approximates the expected shrinkage of height from aging. The decline in height for the 1890/90 decade ranged from 1.1cm to 2.1cm, with an average decline of 1.7cm. Over same period the height for the prisoner subjects declined about 1.0cm. During the first three decades of the 20th century height increased above the 19th century peak to 168-169cm, which is tall for South China even in the late 20th century. This height is about the national average of urban men at universities in the mid-1990s (Morgan, 2000), but not as tall as young men in urban Hong Kong measured in 1993 (Leung et al., 1996).

5. Comparative results and discussion

Discussion of 19th century Chinese immigrants to the settler economies of Australasia and North America typically portrays them as the fleeing poverty of their villages in South China. Common opinion is these Chinese were short and perhaps on average less than five feet (152.4cm) tall.¹⁵ The estimates in this paper show the 19th century-born Chinese immigrants to Australia attained a height on average at least 10cm taller. Their average stature was in the range 163cm to 167cm, varying of course with social group and the decade of birth. At this stature these Chinese were not very different in

¹⁴ A rural-born advantage could be expected for 19th century Chinese, but we do not have the data to differentiate place of birth by rural-urban origin. The advantage may have been less than in North America because the countryside of South and East China have long had high population densities, and most farmers in the more developed areas were involved in the periodic markets that would have regularly have taken them to market towns. This means they were easily exposed to communicable disease vectors despite the relative low degree of urbanization in the form of large urban settlements.

¹⁵ The average stature of the Chinese who built the Transcontinental Railway was said to be 4 foot 10 inches (147 cm). National Park Service, "Chinese and the Transcontinental Railroad", www.nps.gov/gosp/research/ (accessed 23 Jul 2004); Robert Chugg, "The Chinese and the Transcontinental Railroad", *Brown Quarterly* 3(1), <http://borwnvboard.org/brwnqurt/01-3/01-3f.htm> (accessed 4 Aug 2004).

average height from the military conscripts of some European armies in the 19th century (Floud, 1994). In fact, they were taller than some. Recruits in the French army averaged 163-164cm over the course of the 19th century (Weir, 1997).

Fig 7 combines the estimated height series for the prisoner and immigrants with previous estimates obtained for South China based on employees of railways and other modern organizations (Morgan 2004). Although these estimates cover different periods, they do overlap at points in time. The prisoner data shows height rising slightly until the 1840s, falling sharply in the 1850s, and rising slightly again before trending down. The immigration data over the period 1840s to 1890s follows almost the identical trend to that of the prisoners from the mid-century onwards, though the reference group for the immigrants (market gardeners) was about 3.0cm taller than the prisoners (reference group laborers). The short time series for South China railway men (reference group skilled workers) from 1900s to the 1920s shows a rise in stature during the first two decades of the 20th century as does the immigration data, though these railway men were about 1.0cm shorter than the gardeners among the immigrants.

INSERT Fig 7 about here

The Southern Chinese immigrants to Australia were much taller than the reported heights for South China recorded in the early 20th century (Table 6). Stevenson (1925) estimated the mean height of South Chinese men was 163.0cm and Shirokogoroff (1925) reported a lower mean of 160.9cm (see Table 6, columns 5 and 6). Murray (1994) calculated a mean of 167.0cm for South Chinese men immigrants who were measured as they left the United States in 1864-65. Described as men in the records, these 150 Chinese would have been born in the 1840s or earlier. Their height corresponds with the mean we found for Chinese immigrants in Australia who were born in the 1870s. Murray observed that the height of the Chinese immigrants was similar to those from North China, rather than the South. Our estimates for Southern Chinese are also similar to estimates of Morgan (2004) for skilled railway employees from East and North China in the early 20th century rather than those reported for employees from South and Central China. Up to 3.0cm shorter than the immigrants, the average height of the prisoners was similar to the average for early 20th century

South China reported by Stevenson (1925) and Morgan (2004). Shirokogoroff's estimate of 160.3cm for Guangdong men is 3.0cm shorter than the other estimates, but he records separately that the Guangdong prisoners were 1.0cm taller at 161.3cm (Shirokogoroff, 1925: 146), which would make the average height of his prisoner population near the average height of the Australia-imprisoned Chinese who were born between 1880/89 and 1890/99 (see Fig 7). Many of the Shirokogoroff prisoner population measured in the 1920s would also have been born during this same period.

INSERT Table 6 about here

The tallness of the Southern Chinese immigrants indicates they were beneficiaries of nutritional advantage in their youth, but that does not explain why they were so tall in the presence of many other reports of significant shorter stature. One explanation could be the method of measurement. We are unclear about whether the height in the CEDT forms was recorded in an equivalent way over time. A small number of records specifically note that a person was measured bare foot, in shoes or in boots (as shown in Fig 1), but most records include no such note and any adjustment is unwarranted. Procedural documentation has not been found in the archives or published regulations to clarify the common practice. Secondly, the difference might arise from immigration selection biases. In general, migrants and sojourners are younger, healthier and better educated than the population in the area from which they are leaving, but less educated and capable than the population into which they are entering (add ref). A family is unlikely to support the foreign adventures of an unhealthy member, therefore they are likely to be taller than most of their stay-at-home cohort.

These considerations are important if we seek a precise measure of the height of the underlying population from which our sample was drawn, but unimportant for the purpose of showing a trend in stature provided we can be confident there was not a shift over time in the method of measurement or the selection of those who left these villages of South China. All historical height samples are subject to some form of selection bias. The issue is whether the bias changes over time, which would render spurious any comparison from one period to another. In a relatively poor economy, therefore, the trend in the height of any social group is indicative of the underlying

trend in the population, and can usefully be analyzed to describe change in human welfare, though the absolute measure of height may not precisely measure the mean height of the population in general.

6. Conclusion

This paper has made an important contribution to anthropometric history in several aspects. Height data for Chinese born before the 20th century is extremely scarce. We have described the earliest time series for the height of Chinese, pushing back in time estimates of the height of Chinese to the 1810s using prison records from the Colony of Victoria, Australia. Using immigration records, the paper secondly showed that the average height of Southern Chinese born from the mid-19th century who came to Australia was taller than was commonly believed. Many of these immigrants to Australia – and also perhaps the United States and Canada – were probably taller than their counterparts who remained at home. While the stature of these Chinese fluctuated, average height varied within a narrow band of 1-1.5cm for most of the 19th century, about 163-164cm for the prisoners and about 166-167cm for the immigrants.

There was neither a strong improvement nor a severe decline in the standard of living as indicated by stature over most of the 19th century. The observed fluctuations, such as the mid-century and the late-century decline, coincide with known social and political disruption that may have reduced the biological standard of living of those born during those decades. Certainly, the deep trough at the end of the 19th century indicates severe impact upon the nutritional wellbeing of those born at the time. The 1890s saw China defeated by Japan in the first Sino-Japanese War (1894), the attempt by the imperialist powers to carve up China into spheres of influence, and in response the emergence of the nationalist movement to overthrow the imperial government that led to numerous revolts.

The paper also showed that from early 20th century through to 1930 there was a recovery in average height from the low of the 1890s, a result that agrees with earlier findings (Morgan, 2004). This rise in stature would support the optimist view (Rawski, 1989, and others) that the growth of the economy brought widespread benefits, contrary to long-held pessimist views (Huang, 1985, and others) that the imperialist opening of the Chinese economy impoverished the rural populace. For most of the

19th century, though, the height data gives little comfort to either the optimist or pessimist argument about the impact of an increasingly open and commercialized economy on the welfare of the Chinese.

Future research has several challenging tasks. Ideally, we would like to push the time series back into the mid-18th century Qing dynasty economic boom. Several scholars have argued the level of development and the standard of living in advanced parts of the Chinese economy were not dissimilar to advanced parts of Europe during the 18th century (Li, 1998, 2005; Pomeranz, 2000, 2005). To do so we would need to find height data from the imperial Chinese armies or the imperial household and government services, but none have come to light so far. More promising, though, is the collection of additional immigration data for the 19th and early 20th centuries from Australia, Canada and the United States that may allow use to explore in more detail the fluctuations in height in over the 19th century and relate these better to specific change in the regional economies from which the Chinese had come.

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Tables and figures for EHB Conference paper

Table 1. Summary of data cases by archive source by type and location of record holdings

	Males	Females	Birth Years	Year height recorded
Certificate of Exemption from Dictation Test (CEDT), Statutory Declaration (SD), Melbourne	2306	15	1840 - 1901	1904 - 1933
Alien Registration, Melbourne	902	129	1855 - 1954	1928 - 1966
Certificate of Domicile (CoD), CEDT and SD, Brisbane	671	4	1843 - 1885	1902 - 1906
CoD, CEDT and SD, Darwin	197	9	1844 - 1888	1905 - 1931
Prisoner Register	1268	0	1798 - 1902	1854 - 1927
	5344	157	1798 - 1954	1854 - 1966

Sources:

National Archives of Australia, Series B13/0 (Melbourne); B78/1 (Melbourne), J2482 (Brisbane, from RecordSearch www.naa.gov.au); E752/0 (Darwin, from RecordSearch www.naa.gov.au); Public Records Office, Victoria, Series VPRS 515 Central Registry of Male Prisoners.

Notes:

The height range is restricted to 140-190cm to exclude children and one outlier >190cm.

Table 2. Summary height of Chinese subjects by decade of birth, cm

Decade	Males			Females		
	Mean	SD	N	Mean	SD	N
1790-99	167.0	0.898	2			
1800-09	159.1	5.084	15			
1810-19	163.3	5.456	84			
1820-29	163.4	5.679	234			
1830-39	163.9	5.635	593			
1840-49	164.2	5.635	223			
1850-59	165.2	5.446	254			
1860-69	165.7	5.453	1204	151.9	6.869	6
1870-79	166.0	5.519	1851	153.5	6.448	14
1880-89	166.0	5.598	463	154.6	8.123	23
1890-99	164.0	6.170	34	155.9	3.575	8
1900-09	164.5	6.198	27	155.4	4.601	8
1910-19	166.0	6.066	37	156.7	4.794	18
1920-29	167.8	5.504	50	155.6	5.690	11
1930-39	167.7	6.815	78	155.2	7.101	23
1940-49	166.2	8.161	182	159.2	5.360	40
1950-59	153.8	7.663	13	148.8	6.546	6
Total	165.4	5.788	5344	155.8	6.503	157

Source: See Table 1.

Note: The range is restricted to 140-190cm to exclude children and extreme upper range outliers, but the mean does not otherwise control for the age of the subjects, the providence of the data drawn from the separate series or occupational and social background.

NOTE: This table conflates the PROV and CEDT-AR series, so the mean seemingly rises markedly in 1850-59 as the CEDT-AR series swamps the PROV series data. I probably should have separate tables or none at all since the means are uncontrolled.

MUST revise and SPLIT into PROV and CEDT-AR summaries.

Table 3. Summary characteristics of early Chinese immigrants to Australia

Province origin	Immigration files		Prison files	
	Number	%	Number	%
China	96	2.4	779	61.4
Beijing	2	0.0	3	0.2
Shanghai	34	0.8	3	0.2
Guangdong	3777	92.7	383	30.2
Hong Kong	123	3.0	82	6.5
Macau	21	0.5	5	0.4
Fujian	4	0.1	13	1.0
Other	9	0.2		0.0
Total	4076	100	1268	100
Industries				
Rural	1378	33.8	666	52.5
Mining, etc	47	1.2	279	22.0
Manufacturing	434	10.6	70	5.5
Commerce	1368	33.6	198	15.6
Community, domestic and business services (incl professionals)	75	1.8	14	1.1
Other	312	7.5	18	1.4
Unknown	466	11.4	23	1.9
Total	4076	100	1268	100
Major Occupations				
Laborers	35	0.9	528	41.7
Miners	47	1.2	279	22.0
Gardeners	1300	31.97	99	7.8
Hawkers	137	3.4	38	3.1
Laundryman	336	8.2	10	0.8
Carpenters	372	9.1	36	2.8
Cooks	156	3.8	52	4.2
Shop/cafe assistants	72	1.8	1	0.1
Merchants, proprietors	157	3.9	57	4.5
Merchants (F&Veg)	370	9.1	16	1.2
Herbalists	55	1.3	2	0.2
Students	261	6.4	0	0.0
Others	312	7.5	127	10.0
Unknown	466	11.4	23	1.9
Total	4076	100	1268	100

Source: See Table 1

Table 4 a: Regression time-only models with controls on the age of the prisoners at measurement

	Model a (age unrestricted)			Model b (age 21-64 years)			Model c (age 23-59 years)		
	coefficient	t-stat		coefficient	t-stat		coefficient	t-stat	
(Constant)	163.2	219.812	***	162.7	215.394	***	162.7	210.669	***
1790-99	3.8	0.959							
1800-09	-4.0	-2.502	**	-3.0	-1.532		-2.4	-1.109	
1810-19	0.1	0.099		1.6	1.565		1.2	1.072	
1820-29	0.4	0.435		0.9	1.054		0.8	0.954	
1830-39	0.7	0.910		1.3	1.589		1.4	1.699	*
1840-49	0.8	0.924		1.5	1.713	*	1.5	1.663	*
1850-59	ref								
1860-69	0.1	0.096		1.4	1.094		1.2	0.953	
1870-79	0.0	0.017		0.5	0.363		0.3	0.237	
1880-89	-0.8	-0.436		0.4	0.238		0.2	0.105	
1890-99	-1.8	-0.744		-0.5	-0.204		-0.6	-0.218	
1900-09	-5.1	-0.902		-4.6	-0.827				
R-square	0.013			0.010			0.008		
D-W	2.019			2.049			2.018		
N	1267			1169			1077		

Source: PROV prison registers, see Table 1.

Note: Significance levels * p<0.1 ** p<0.05 *** p<0.01

Table 4 b: Regression models with various categorical control variables

	Model d (unrestricted age)			Model e (unrestricted age)			Model f (age23-59)			Model g (age23-59)		
	coefficient	t-stat		coefficient	t-stat		coefficient	t-stat		coefficient	t-stat	
(Constant)	163.3	202.137	***	163.2	202.219	***	162.6	191.523	***	162.6	191.556	***
Decade of birth												
1790-99	3.0	0.741		3.1	0.771							
1800-09	-4.2	-2.612	**	-4.2	-2.606	***	-2.7	-1.199		-2.7	-1.204	
1810-19	-0.2	-0.241		-0.2	-0.222		0.5	0.414		0.5	0.412	
1820-29	0.1	0.136		0.1	0.141		0.7	0.798		0.7	0.787	
1830-39	0.4	0.540		0.4	0.560		1.2	1.474		1.2	1.484	
1840-49	0.6	0.651		0.6	0.660		1.4	1.569		1.4	1.572	
1850-59	ref											
1860-69	-0.5	-0.394		-0.4	-0.344		0.5	0.406		0.6	0.462	
1870-79	-0.5	-0.363		-0.4	-0.288		-0.3	-0.176		-0.1	-0.101	
1880-89	-1.4	-0.761		-1.2	-0.681		-0.5	-0.230		-0.3	-0.149	
1890-99	-2.4	-0.979		-2.2	-0.910		-1.3	-0.487		-1.1	-0.423	
1900-09	-5.8	-1.031		-5.5	-0.988							
Occupation group												
Laborers	ref											
Miners	-0.1	-0.350		-0.1	-0.347		-0.2	-0.455		-0.2	-0.449	
Gardeners & related groups	0.2	0.354		0.2	0.338		0.6	1.079		0.6	1.058	
Trades skilled and semiskilled	0.7	1.269					1.0	1.774	*			
Non-manual trades and proprietors	0.1	0.218					0.4	0.625				
All trades and proprietors				0.4	1.000					0.7	1.594	

Recorded literacy

Illiterate	ref									
English read/write	0.0	-0.059	0.0	-0.058	0.0	0.012	0.0	-0.003		
Chinese read/write	1.0	1.930 *	1.1	1.992 **	1.1	1.970 **	1.1	2.026 **		
R-sq	0.019		0.018		0.017		0.017			
DW	2.039		2.037		2.054		2.05			
N	1229		1229		1042		1042			

Source: PROV prison registers, see Table 1.

Note: Significance * p<0.1 ** p<0.05 *** p<0.01

Table 5a. Regression estimates for immigration subjects with controls for age at measurement

	Age > 18 year			Age 18-59 years			Age 21-64			Age 23-59		
	coefficients	t-stat	.	coefficients	t-stat		coefficients	t-stat		coefficients	t-stat	
Constant	165.8	422.324	***	165.6	294.142	***	165.56	349.623	***	165.6	295.489	***
1840-49	1.3	0.892		3.6	0.921		-0.31	-0.111		3.6	0.925	
1850-59	ref											
1860-69	0.0	-0.051		0.1	0.208		0.23	0.461		0.1	0.209	
1870-79	0.3	0.720		0.8	1.291		0.72	1.461		0.8	1.297	
1880-89	0.3	0.617		0.7	1.127		0.71	1.289		0.8	1.218	
1890-99	-1.4	-1.257		-1.3	-1.028		-0.95	-0.792		-0.7	-0.522	
1900-09	-0.5	-0.441		-0.3	-0.264		-0.32	-0.264		-0.3	-0.265	
1910-19	0.3	0.260		0.4	0.417		0.46	0.448		0.5	0.504	
1920-29	2.1	2.388	**	2.3	2.360	**	2.31	2.497	**	2.9	2.821	***
1930-39	2.8	3.580	***	3.0	3.396	***	2.80	3.122	***	2.9	2.736	***
1940-49	3.2	4.728	***	3.4	4.299	***	1.09	0.685		-3.0	-0.766	
R-square	0.014			0.017			0.007			0.009		
D-W	1.945			1.999			1.950			1.992		
N	3960			3082			3434			2938		

Source: NAA immigration records, see Table 1

Note: The age range was first specified before the regression was conducted. There are no controls for social heterogeneity of the sample.

Significance level is * p < 0.1 ** p < 0.05 *** p < 0.01

Table 5b. Regression estimates of height controlled for place of birth and occupational skill levels

	One to six grades occupation skill model			One to four grades occupation skill model			Eight major occupations model		
	Age >18	Age 18-59	Age 23-59	Age >18	Age 18-59	Age 23-59	Age >18	Age 18-59	Age 23-59
(Constant)	166.1 ***	166.0 ***	166.0 ***	166.0 ***	165.9 ***	165.9 ***	166.2 ***	166.1 ***	166.2 ***
1840-49	0.7			0.7			0.7		
1850-59	ref								
1860-69	0.0	0.2	0.2	0.0	0.3	0.2	-0.1	0.2	0.2
1870-79	0.5	1.1	1.0	0.5	1.1	1.1	0.4	1.0	1.0
1880-89	0.5	1.0	1.0	0.5	1.0	1.0	0.4	0.9	0.8
1890-99	-1.3	-1.1	-0.4	-1.3	-1.0	-0.4	-1.4	-1.1	-0.2
1900-09	-0.4	-0.1	-0.1	-0.4	-0.1	-0.1	0.1	0.5	0.5
1910-19	0.1	0.4	0.5	0.2	0.5	0.6	0.6	0.9	1.0
1920-29	2.2 **	2.5 **	3.2 ***	2.3 **	2.6 **	3.2 ***	2.5 ***	2.9 ***	3.5 ***
1930-39	2.8 ***	2.7 **	2.5 *	2.8 ***	3.3 ***	3.1 ***	1.9	2.2	1.5
1940-49	3.3 ***	3.0 **	-3.8	3.4 ***	3.8 ***	-3.0	1.9	2.2	-5.3
Sth China	ref								
Nth China	-1.1 **	-1.0 *	-1.3 *	-1.1 **	-1.0 *	-1.3 *	-1.0 *	-0.9	-1.2 *
1 unskilled	ref								
2 some or semi-skilled	-0.9 ***	-1.1 ***	-1.1 ***						
3 skilled & lower commercial	-0.7 ***	-0.9 ***	-0.9 ***						
4 intermediate & proprietors	-0.1	-0.6 *	-0.5 *						
5 professionals	0.0	0.3	0.3						
6 retired, others	-0.8	-1.2	-1.2						

1 low skills	ref								
2 trade skills		-0.6	**	-0.9	***	-0.9	***		
3 lower commercial		-0.8	***	-0.9	***	-0.9	***		
4 upper commercial & professional		0.0		-0.4		-0.4			
1 gardeners & hawkers	ref								
2 laundrymen						-0.8	**	-1.0	**
3 furniture trades						-0.3		-0.5	
4 cafe and shop trades						-1.6	***	-1.8	***
5 merchants, proprietors						-0.2		-0.6	**
6 herbalists, professionals						-0.6		-0.5	
7 students						1.1		0.9	
8 others						-1.4	***	-1.6	***
R-square	0.020	0.026	0.019	0.019	0.024	0.017	0.024	0.031	0.024
D-W	1.943	2.014	2.005	1.943	2.016	2.007	1.960	2.031	2.023
N	3496	2626	2486	3496	2626	2486	3496	2626	2486

Source: NAA immigration records, see Table 1.

Note:

The age range was first specified before the regression was conducted.

Significance level is * p < 0.1 ** p < 0.05 *** p < 0.01

Table 6 Comparative estimates of Chinese height at various periods.

Region born	Prisoners, born c.1840-49	Immigrants, born c.1870-79	US immigrants, 1864-65	Railways, born c.1915-19	Clinical A ¹ , mid-1920s	Clinical B ² , mid-1920s	Urban surveys, born 1975	Rural surveys, born 1975
North				169.1	169.2	166.6	172.2	170.3
East				168.2	165.1	164.2	172.0	170.3
Central				167.5			169.0	167.6
South	164.0	167.1	167.0	165.8	163.0	160.9	169.0	166.6

Sources: Table 1 for prisoners and immigrants, columns 1 and 2; Murray, 1994, for US Chinese immigrants 1864-65; Morgan, 2004, for railway men; Stevenson, 1925, for Clinical A; Shirokogoroff, 1923, 1925, for Clinical B; Chinese Student Physique and Health Research Group, 1996, for rural and urban Chinese students aged 20 years surveyed in 1995.

Notes:

1. The Stevenson mean was compiled from a numerous small studies conducted by members of the Chinese Medical Missionary Association between 1910 and 1924.
2. Shirokogoroff's regional means were the average of individual province means, and need to be recalculated based on his published data to derive a more reliable regional mean from these data.

PAID WARRANT NO. 1066 OF 3.6.1941
 Bank No. **563** FEE—21. (One Pound.)
 Form No. 21. **N^o 063**
 COMMONWEALTH OF AUSTRALIA.
 Immigration Act 1901-1935 and Regulations.

CERTIFICATE EXEMPTING FROM DICTATION TEST.

I, George Finlay Ashton Mitchell the Collector of Customs for the State of NEW SOUTH WALES in the said Commonwealth, hereby certify that Lee Hong Gook Lee Hong hereinafter described who is leaving the Commonwealth temporarily, will be exempted from the provisions of paragraph (a) of Section 3 of the Act if he returns to the Commonwealth within a period of THREE YEARS from the date of departure shown below.

Date 3.6.1941 Geo. F. A. Mitchell
 Collector of Customs.

DESCRIPTION.

Nationality Chinese Birthplace Canton
 Age 63 years Complexion Dark
 Height 5 ft 6 inches (141) Hair Black
 Build Medium Eyes Brown
 Particular marks Long scar right side neck mole upper lip
 (For thumb prints, see back of this document.)

PHOTOGRAPHS.

Full Face:— Profile:—



Extended for 3 years by C.M.D.
 No. 265/38 Records No. 046/630
 Collector of Customs

Date of Departure 4.6.1941 Port of Embarkation _____
 Ship Taping Destination China
 Date of Return 3 OCT 1946 Ship "NELLORE"
 Port Sydney
 INTERIOR ADVISED OF ARRIVAL
26/10/46
 Customs Officers.

Fig 1, an example of a CEDT form (NAA, Sydney office)

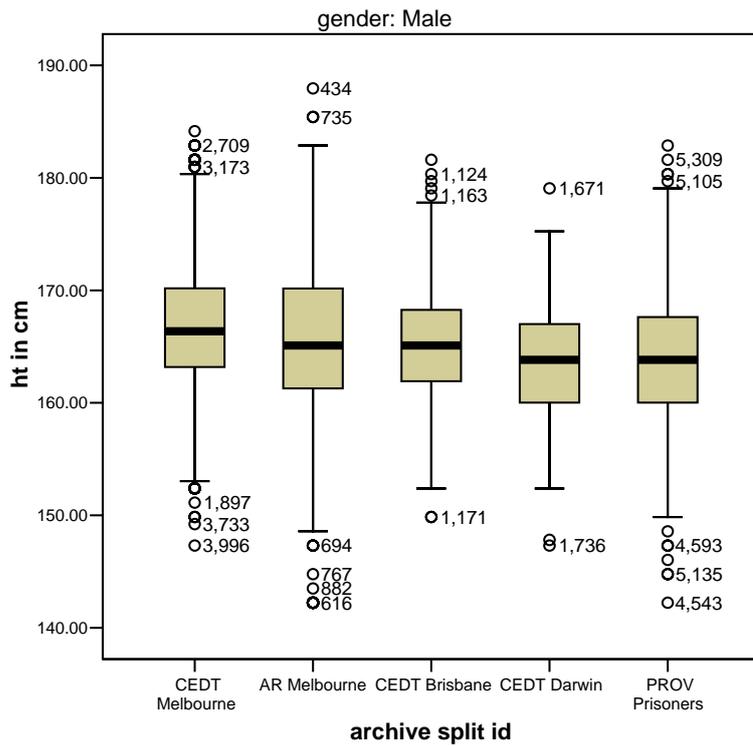


Fig 2a, Crude distribution of height range by archive source for males
 Note: Height range is limited to 140-190cm to exclude children and an extreme outlier

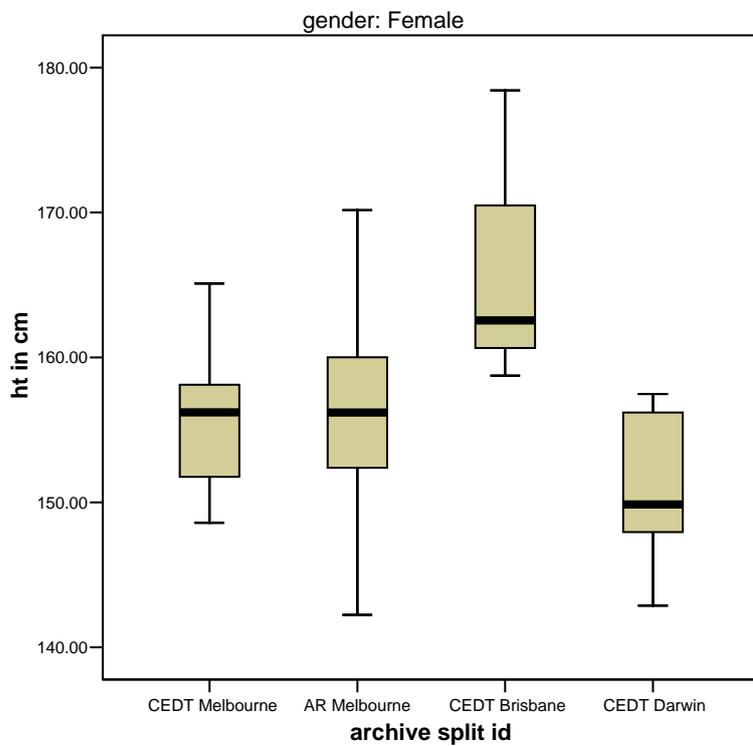


Fig 2b, Crude distribution of height range by archive source for females
 Note: Height range is limited to 140-190cm to exclude children

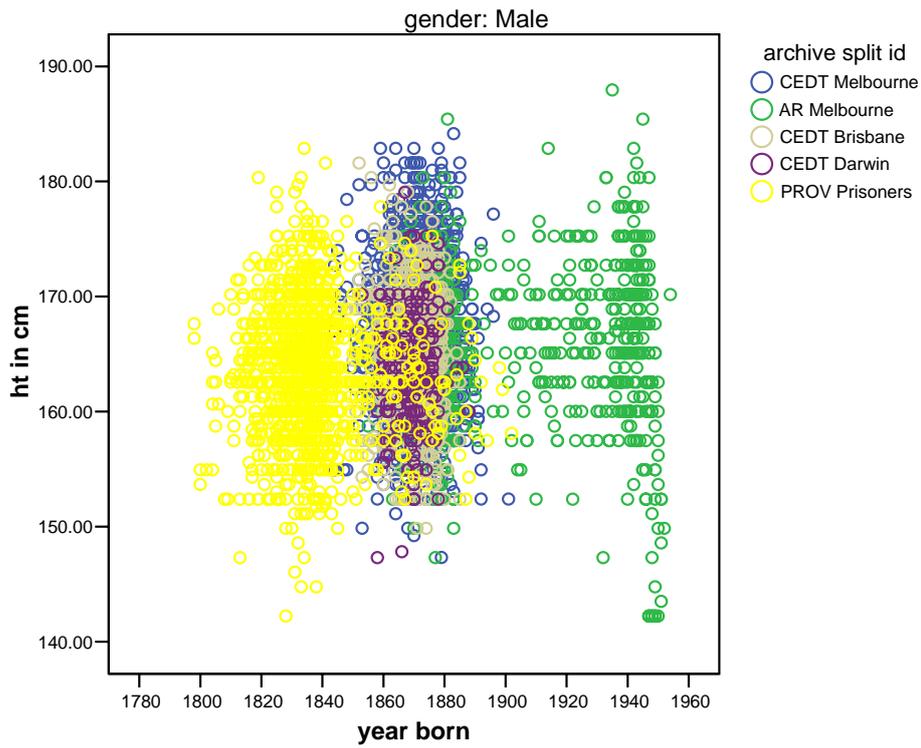


Fig 3a, Scatter plot of heights by archive source by year born for males

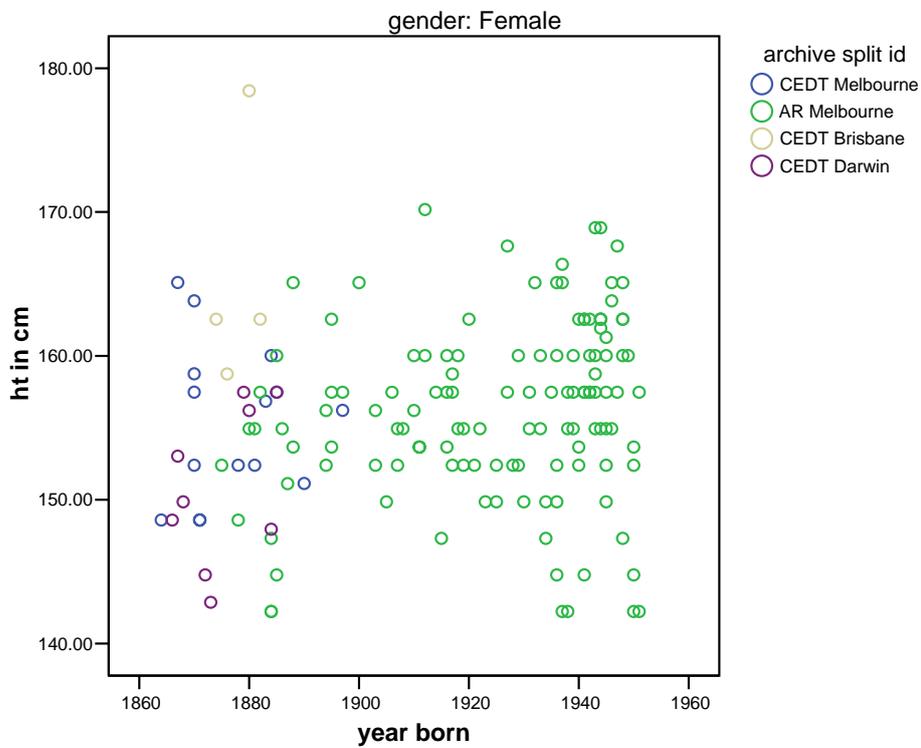


Fig 3b, Scatter plot of heights by archive source by year born for females

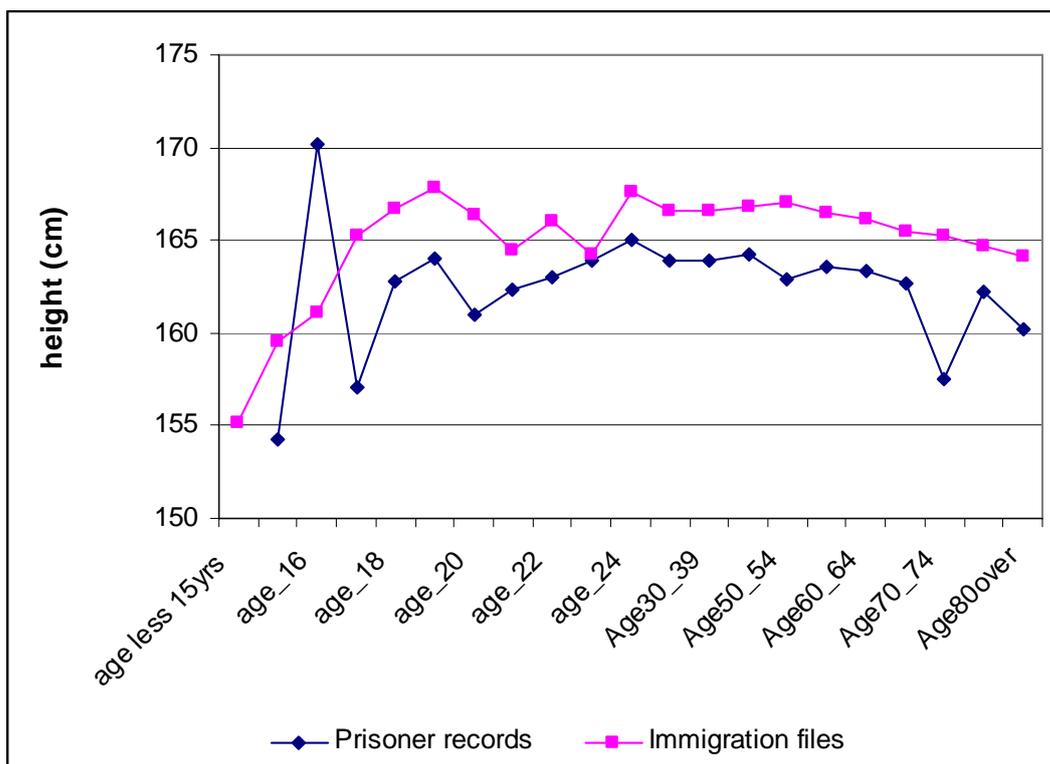


Fig 4. Regression estimates of change in height by the age of subjects.

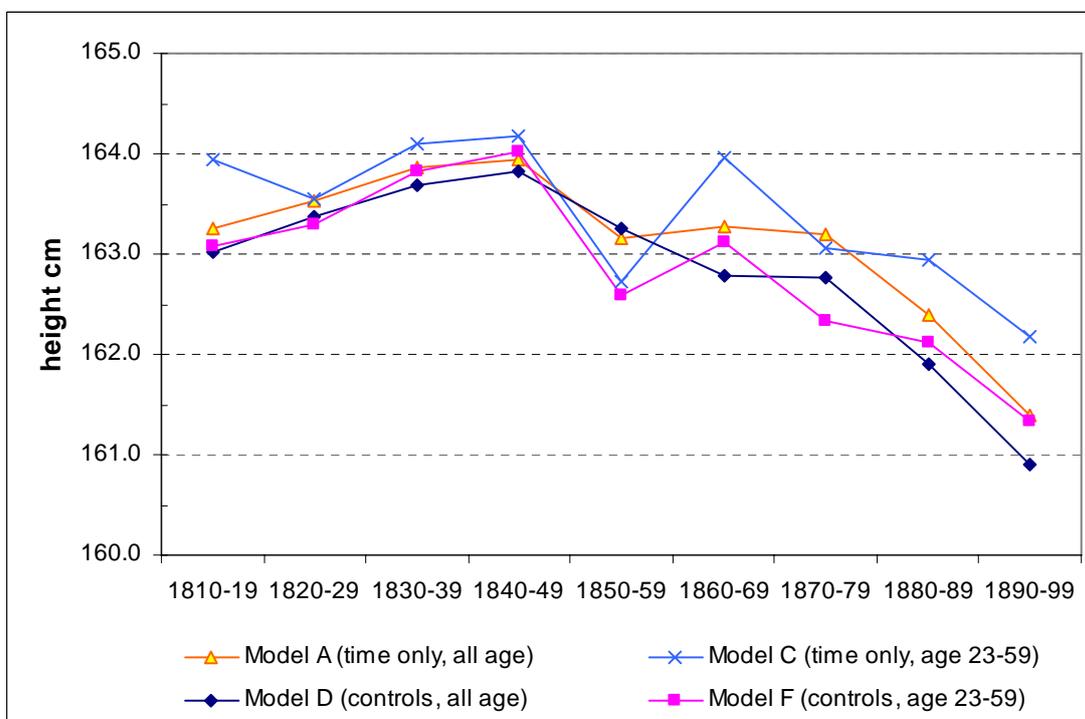


Fig 5. Regression estimates of change in average height by decades, 1810/09-1890/99

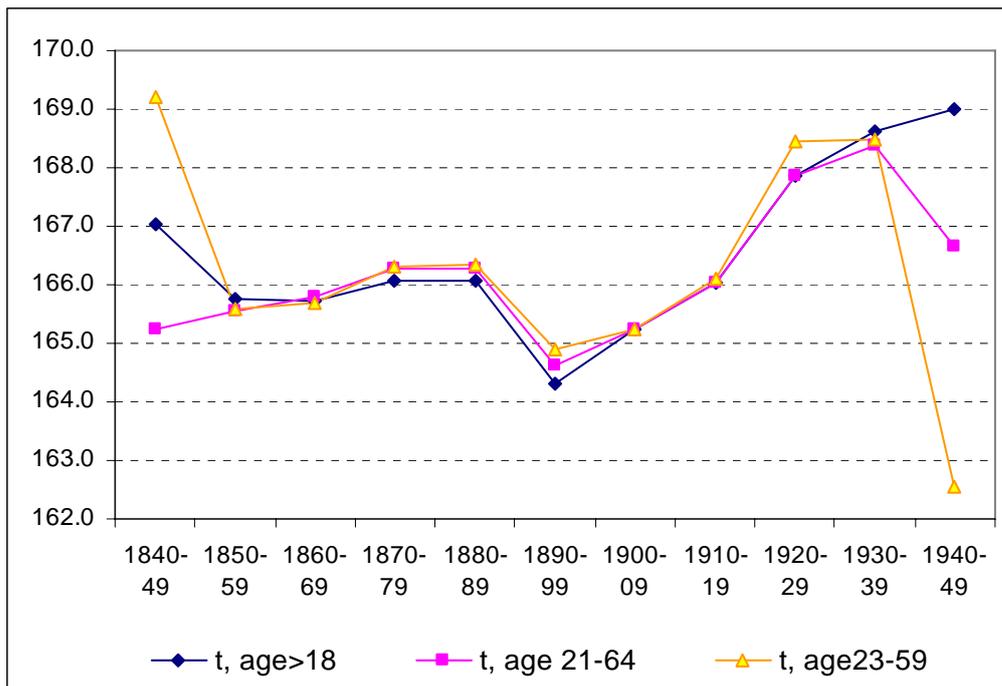


Fig 6a. Time-only and age group-specified estimated of height 1840/49-1940/49

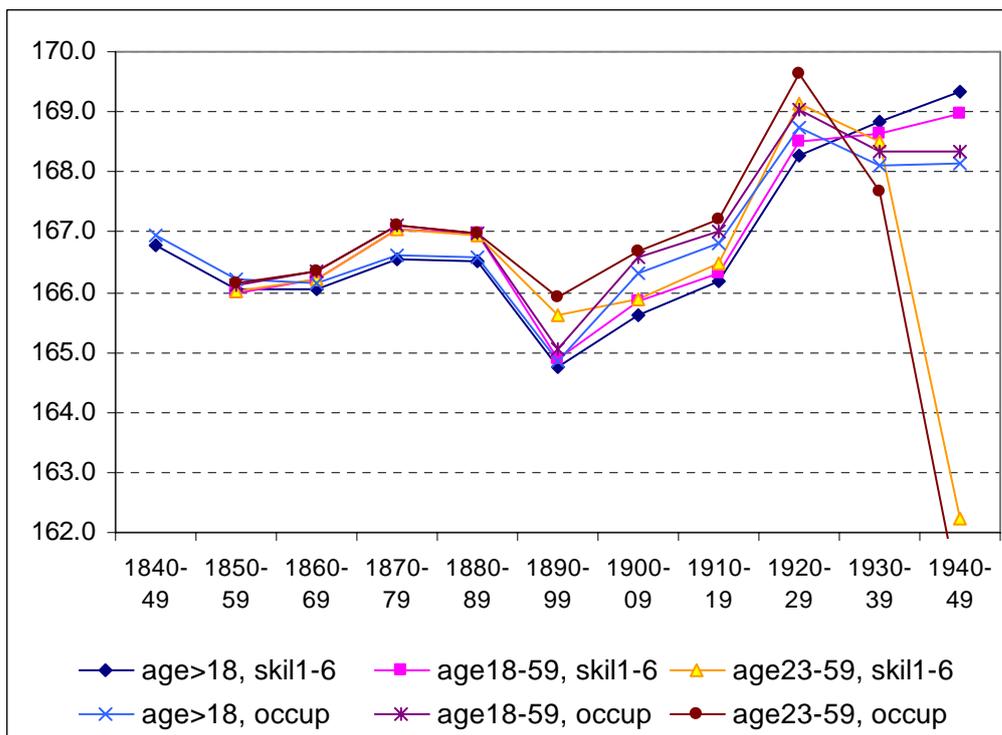


Fig 6b. Estimates of average height with controls for occupation/skills and age

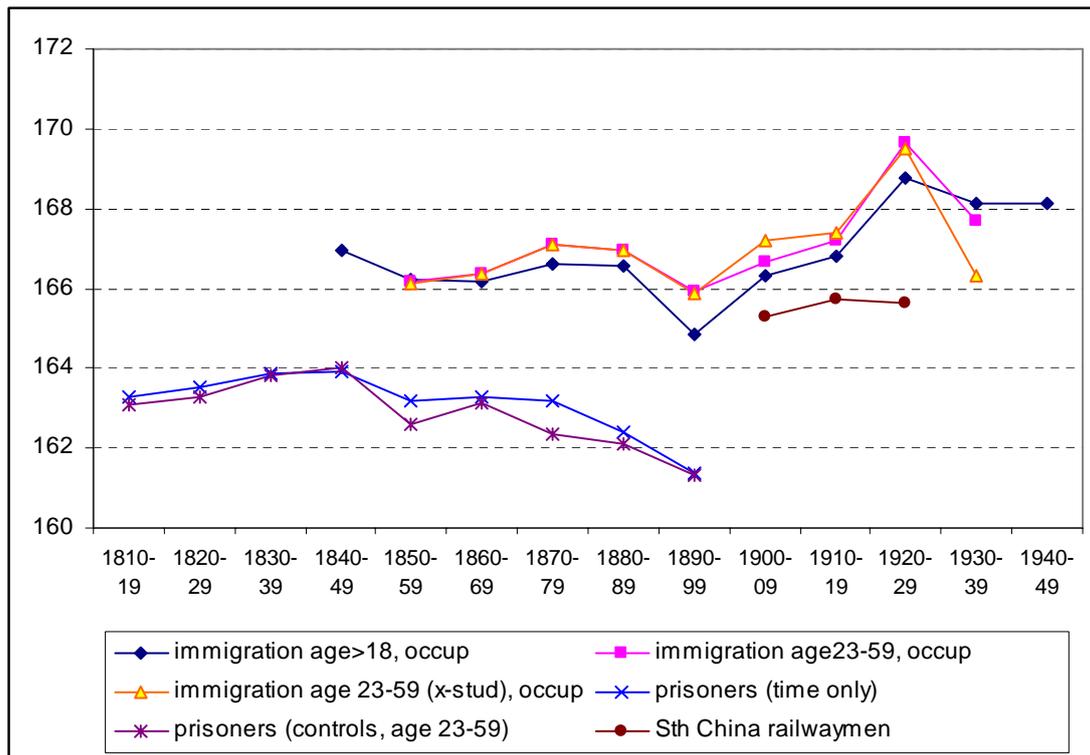


Fig 7 Comparative estimates of the average height of men in South China 1810-1940s

Source: Tables 4 and 5.

Note: The estimates for the group “immigration age 23-59 (x-stud), occup” are not shown in Table 5b. It differs from the “immigration 23-59, occup” estimates only in excluding the student population age, which are concentrated in the 1930-40s.