

DRAFT: NOT FOR QUOTATION WITHOUT PERMISSION

**“Tall, active and well made”
Stature of the New Zealand Māori population, c.1700 - 1976¹**

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Abstract: Nineteenth-century European colonization is commonly understood to have had a deleterious demographic impact on indigenous peoples. The demographic impact of British colonization in New Zealand appears to fit the international pattern, with the indigenous Māori population halving between 1840-1896. However there have been no consistent measurements of the health of living Māori over the long-term. In this paper we fill in the historical record by using stature as a measure of biological standards of living. Our main sources are military recruiting records from the New Zealand wars of the 1860s and 1870s, and the two world wars, and prison records that include men born between the 1830s and 1950s. We find that Māori stature was relatively robust to European colonization. Māori men maintained an average stature of 67-68 inches over several centuries. Cohorts born in the 1850s, and between the two World Wars appear to have receded in stature compared with previous generations and with New Zealand-born Europeans. Notably, the Māori birth cohorts of the 30 years surrounding the population nadir were not shorter than Europeans born at the same time.

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¹ Richard Cruise, *Journal of a Ten Months Residence in New Zealand* (London: Longman, Hurst, Rees, Orme, Brown and Green, 1824), 263.

I. Introduction

This paper arises from our efforts to reconstruct and analyze the evolution of physical well-being in New Zealand, for both Pākehā (European-descendants) and the indigenous Māori, from the 19th century to the late 20th century from anthropometric and related evidence. In this paper we begin the challenge of reconstructing a long-term series of stature for Māori. We review the anthropological evidence on pre-European Māori stature, and then examine a range of data sources that provide evidence on Māori heights after European arrival. Our evidence suggests that Māori height was quite stable in the first generations after European arrival, and regressed in comparison to European stature in the early twentieth century at the same time as population was recovering. Stature gives a different picture of Māori living standards and the impact of European settlement than population aggregates and estimates of life expectancy. Māori population and life expectancy declined in the last half of the nineteenth century, but then began to recover in the early twentieth century. Thus, stature gives a different picture of the welfare of the living than measures based in part on mortality.

Systematic differentiation in adult height between large representative samples is the key indicator in most anthropometric analysis (Fogel; Komlos; Steckel). Since most populations share a common potential for adult stature, systematic differences over large enough samples may then be understood as reflection of differences in ‘net nutrition’ or gross nutrition mediated by disease exposure and work demands during the portions of a life that the body is growing. The military medical exams provide the needed systematic evidence of adult stature, for men at any rate. Relatively large samples are needed because genetic variation within a population makes it uninteresting to examine the height of an individual or a small group. Since adult stature is largely shaped by childhood experience we necessarily think in terms of birth cohorts. Hence the stature of 23 year olds recorded in 1943 may tell us something about the early-life experience of those born in 1920. The stature of 27 year olds recorded in 1917 speaks to the early-life conditions of those born in 1890. And so on.

II. European impressions of Māori physique

From first contact Europeans were impressed with the physical condition of Māori. Abel Janzoon Tasman, the Dutch explorer who discovered New Zealand for Europeans, wrote that Māori were giants, though it seems he mostly met chiefs. Despite his pioneering voyage Tasman did not place New Zealand firmly on the European map, though the Dutch connection survives in the country's name. More than a century passed before the celebrated repeat voyages of James Cook to New Zealand beginning in 1769. Cook, who was reported to stand six feet tall himself, wrote in his journal that

The Natives of this Country are a strong raw boned well made Active people rather above than under the common size especially the men They seem to injoy a good state of hiltth and many of them live to a good old age.

Cook's impressions were amplified, but not always substantiated, by later observers. It must also be noted that as well as being impressed by Māori physique, Europeans from the early contact period were unusually impressed by Māori mental capacity and social organization. Many Europeans—within New Zealand and outside—saw Māori as amongst the highest, if not the highest, class of non-Europeans. Māori were seen as nearly uniquely suited for adapting successfully to European 'civilization'.

The impressions of European explorers and early settlers quickly reached the European and American public. In 1799 the Religious Tract Society told its readers in a pamphlet

“Generally speaking the South Sea islanders are above the middle stature, and in habits of body are rather corpulent than the contrary. The females in most of the islands are taller and stouter than those of Europe. The New Zealander is the most gigantic in stature and muscular in frame, and

may be justly regarded as the most robust and hardy of the oceanic race.”²

Massachusetts school children learned similarly in an 1825 reader that Māori were “generally equal to the tallest Europeans in stature, ... stout and well made, but by the manner of sitting in their canoes, their legs are distorted.”³ The myth persisted into John George Wood’s 1870 magnum opus on the *Uncivilized Races of Men* that described Māori as “a singularly fine race of people—tall, powerful, and well made,” though also noting “There seems to be two castes of men among the New Zealanders. The upper caste is distinguished by the above characteristics; but the lower is shorter in stature.”⁴ The prolific traveler and writer Anthony Trollope put actual numbers to his pleasing take on the Māori, who were an “active people—the men averaging 5 feet 6½ inches in height—and are almost equal in strength and weight to Englishmen.”⁵ A presenter at the American Association for the Advancement of Physical Education took it as common knowledge that Māori were amongst the tallest in the world, ascribing this to “climatic conditions” that make “the Laplander average in stature but 4 feet 11 inches, and the New Zealander 5 feet 9 inches.”⁶ Perhaps most amusingly the myth of great Māori stature persisted into a Charles Atlas-like advertisement in *Popular Mechanics* for a book called *Selling Human Stature*. The book promised to reveal to readers the answer to the question “What made the average New Zealander FIVE AND A HALF INCHES TALLER than the Indian.”⁷ But it is interesting that in 1899 around the point of the Māori population nadir that the prolific American historian John Clark Ridpath dissented from the century-long trend of being impressed by Māori height to write

² *Missionary Records: Tahiti and Society Islands* (London: Religious Tract Society, 1799): 22.

³ Abraham Thompson Rowe, *The Columbian Class Book: Consisting of Geographical, Historical and Extracts* (Worcester: Dorr & Howland, 1825), 155.

⁴ John George Wood, *The Uncivilized Races of Men in All Countries of the World*, 2 vols., vol. 2 (Hartford: J.B. Burr and Company, 1871), 792.

⁵ Anthony Trollope, *New Zealand* (London: Ward, Lock & Co., 1884): 2.

⁶ D.W. Test, “The Physical Test of a Man,” *Proceedings of the American Association for the Advancement of Physical Education*, 5th Annual Meeting, Cambridge and Boston (MA), 4-5 April 1890, p.36.

⁷ “The Taller Person Has the Advantages in Life,” *Popular Mechanics*, January 1946, p.75A.

The Māori are by no means an attractive people ... In the first place, the stature of the Māoris is below the average. The men are rarely more than five feet six inches in height.⁸

Surrounded by tall Americans Ridpath would not have been impressed by men of 66 inches, whereas Trollope (nearly six foot himself) might have seen Māori in relation to the “common size” in England. The two estimates are close and most likely have a single origin in a pioneering, but small, study of the late 1840s we shall return to later.

III. Source and Method

Assembling a time series of Māori stature takes us into multiple sources, not all of which are consistent with each other. Yet by assessing the merits of each and bringing in data we have collected for this research we can begin to make sense of changes in Māori stature from the early nineteenth century onwards, with greater surety from the 1830s birth cohorts. The sources used in the paper are summarized in Table 1.

Table 1. Data sources for Māori stature

Birth cohort	Data source
Pre-European (17 th and 18 th century)	Modern anthropological studies of skeletons
c. 1810 – 1830	147 men described in <i>Journal of the Royal Statistical Society</i> article by A.S. Thomson in 1851.
c. 1830 – 1950	Māori in prison (data collected by authors)
c. 1880 – 1897	Māori serving in World War I (data collected by authors)
c. 1880 - 1897	Māori serving in World War I, and published by Dr. Peter Buck in <i>Journal of the Polynesian Society</i> , 1924.
c. 1900 – 1924	Māori serving in World War II (data collected by authors)

At this stage we are not inclined to make too much of differences in stature observed between the samples. Their biases go in different directions, and how much military, anthropological and correctional samples should differ

⁸ John Clark Ridpath, *Ridpath's Universal History* (New York: 1899), 431.

from each other is not clear. Yet where two sources point to similar trends over time or between different groups we may be in a position to remark more confidently on the trends and differences in Māori stature.

IV. Anthropological studies and Thomson's early estimates

Anthropological evidence indicates that before European contact adult Māori men averaged around 68 inches in height. Despite the interest in early Māori lifestyles since European contact there have been few studies of skeletal remains and their indications about pre-contact stature.⁹ Philip Houghton, Brian Leach, and Douglas Sutton published the one reliable study in 1975.¹⁰ Houghton *et al* had access to 98 skeletons from museum collections around New Zealand. Since first contact Europeans had noted that Māori had different bodily dimensions than European. The surgeon A.S. Thomson—whose work we will review shortly—noted that

Their bodily shape is peculiar, and this peculiarity consists in having longer bodies and longer arms with shorter legs than Englishmen of similar stature. The lengthening of the arms occurs in the forearms, and the shortening of the legs in the bones below the knee; the leg bones of New Zealanders are indeed an inch and a half shorter than these bones are in Englishmen. Their long bodies are produced by the size of the spinal bones and the cartilages between these bones.¹¹

Thus, Māori men of average proportion would have shorter legs than an Englishman of average proportion and the same height. Using the English relationship between body proportions to estimate Māori height would underestimate it. To get around this problem Houghton *et al* used a relatively modern sample of Māori measured on their return from World War I. The eminent Māori doctor, Peter Buck, measured 424 self-identified “full-blooded” Māori in 1919 using instruments obtained from *inter alia* Karl

⁹ Cf. Richard H. Steckel and Jerome Carl Rose, *The Backbone of History : Health and Nutrition in the Western Hemisphere* (Cambridge, U.K. ; New York: Cambridge University Press, 2002).

¹⁰ Philip Houghton, B.F. Leach, and Douglas G. Sutton, "The Estimation of Stature of Prehistoric Polynesians in New Zealand," *Journal of the Polynesian Society* 84, no. 3 (1975).

¹¹ A.S. Thomson, *The Story of New Zealand: Past and Present, Savage and Civilized* (London: Murray, 1859), 69-70.

Pearson.¹² Using the measures of limb length and total stature from Buck's sample Houghton *et al* estimated the stature of pre-historic Māori from skeletal limbs. They estimated the average stature of pre-historic Māori males to be 68½" with a 95% confidence interval of $\pm \frac{1}{2}$ ".

Thus, pre-European Māori men reached an average stature well above the European standards of the day. The attainment of basically modern stature by Māori is unsurprising due to the low population density and disease burden of New Zealand in the seventeenth and eighteenth centuries. While the diet of Māori was not varied, it was sufficient for growth. Protein from the relatively abundant fish and bird life of New Zealand was sufficient for Māori needs.

Following Cook's visit in 1769 European contact with New Zealand increased steadily with further exploration, and the beginning of European settlement in the early nineteenth century for whaling and sealing. British colonization of New South Wales and Van Diemen's Land (Tasmania) for convict settlements led to a growing European presence in New Zealand, along with a numerically small but culturally influential group of missionaries. In the 1820s and 1830s there were significant changes in Māori settlement patterns following the "Musket Wars" that involved iwi (tribes) from around New Zealand. Formal British colonization of New Zealand followed in 1840 with the signing of the Treaty of Waitangi.¹³ In short, there was substantial social and economic change in the late eighteenth and early nineteenth century, and one might wonder if it was reflected in Māori stature.

The only systematic piece of evidence in the colonial period comes from the observation of A.S. Thomson, a Regimental Surgeon with the British army and author of the first general history of New Zealand in 1859.¹⁴ There was impressive ethnology done in late nineteenth century New Zealand by Pākehā such as Elsdon Best and others in the Polynesian Society, and Māori with

¹² Peter Buck, "Māori Somatology," *Journal of the Polynesian Society* 31, no. 1 (1924): 37.

¹³ James Belich, *Making Peoples: A History of the New Zealanders* (Auckland: Penguin, 1996).

¹⁴ Thomson, *The Story of New Zealand: Past and Present, Savage and Civilized*. On Thomson's life, see "Obituary. The Late Arthur S. Thomson," *Medical Times and Gazette*, 26 January 1861, 103.

university education in the early twentieth century. But this anthropological interest from the 1880s was in “habits, history, traditions and language” and “no one as yet has taken up the study of Māori anthropometry.”¹⁵

Thomson noted the history of European observation without measurement of Māori stature, and was proud to contribute the first published evidence on the point. In April 1849 Thomson measured Māori men “above the age of puberty,” who presented for vaccination at the military hospital in Auckland.¹⁶ In the two statistical journals Thomson published in, he appeared more certain of his measurements. But in the *Journal of the Royal Geographical Society* and *Journal of the Ethnological Society of London* Thomson confessed that his results were “interesting if not useful” and that he “took down, indiscriminately, the heights of 147 men.” Perhaps by indiscriminately we should take Thomson to mean that he did not exclude the apparently short or tall, and tried to get a representative selection. Nevertheless, is is the criteria of being “above the age of puberty” that should concern the modern reader. Indeed, 45 of those 147 presenting included men estimated at ages 16-20, and thus yet to reach their adult height. So Thomson’s figures under-estimate Māori height. Thomson’s figures are reproduced in Table 2.

Thomson calculated the average height from this group as “5 feet, 6 inches and nearly three-quarters of an inch.” This is also an underestimate. Thomson’s calculation, which has been accepted by all subsequent authors including Houghton *et al*, comes from multiplying the lower bound of each range by the number in the range, and the exact figure for the solitary man at 6’5½”. It is more accurate to assume that heights within the range are uniformly distributed and that the average height of men in range comes at

¹⁵ Professor Scott, Final Address to the New Zealand Institute, 10 November 1885. Published in the *New Zealand Journal of Science*, 2, no. 12, November 1885, p.585.

¹⁶ A.S. Thomson, "Contribution to the Natural History of the New Zealand Race of Men, Being Observations on Their Stature, Weight, Size of Chest, and Physical Strength " *Journal of the Statistical Society of London* 17, no. 1 (1854): 27-33. The article was also published with minor revisions as ———, "Observations on the Stature, Bodily Weight, Magnitude of Chest, and Physical Strength of the New Zealand Race of Men," *Journal of the Ethnological Society of London* 3 (1854): 123-31. ———, "Observations on the Stature, Bodily Weight, Magnitude of Chest, and Physical Strength of the New Zealand Race of Men," *Journal of the Royal Geographical Society* 23 (1854): 87-92.

the half-inch mark. Averaging using this method gives an adjusted estimate of Māori height of 67.2 inches. While 45 of the 147 men were under 21, Thomson added that they were “Waikato natives or men employed on the government works, both of which classes are usually better fed than the natives generally.” Given the conflicting biases we might note the relatively close agreement between 67.2 and 68 inches as indicating that men born early in the period of European settlement and living through the disruptions to Māori society and economy of the 1820s and 1830s, had not apparently shrunk much if at all from the stature of their pre-historic ancestors.

V. Evidence from military records and comparisons with Pākehā

A key source are the medical examinations of New Zealand soldiers who served in the two world wars. Military enlistment during the two wars was widespread in New Zealand. Although not a perfectly representative sample of the male population, the wartime medical exams are the most comprehensive available source before the advent of nationally representative health and fitness surveys first undertaken in the 1970s. We also examine scattered demographic and health detail from the annual reports of various government departments 1913-1940.

The WWI military service records became available to the public in 2006. Since that time we have been slowly accumulating a database that describes select personal characteristics including birthplace and birth date, occupation and stature or height. Practical limitations on record access and the need for a very large sample dictate an unusual sampling strategy. We examine all personnel records that have come into the public domain because they were needed for other research purposes; most of these requests originated with the work of government departments and genealogists. We also sample all files in stretches of the alphabet that are known to include a high proportion of Māori names.¹⁷ This allows us to acquire a larger number of Māori records than would otherwise be possible. We enter all records, both Māori and Pākehā, in the relevant sections of the alphabet.

¹⁷ We select microfilm reels with names beginning or ending with Ar, Ha, He, Hi, Ho, Hu, Ka, Ko, Ku, Ma, Mo, Nu, Pa, Pe, Pi, Po, Pu, Ra, Re, Ri, Ta, Te, To, Tu, Wa, We and Wh.

We gained access to WWII records in early 2008; this work has not yet caught up with the WWI data entry. Sampling for WWII also comprises two elements. The first selection is to enter all files on a random selection of microfilms which are organized alphabetically by surnames. The second sampling principle is to enter data for soldiers whose names appear in Māori-intensive sections of the alphabet. The second principle ensures a minimum number of Māori soldiers and also adds Pākehā observations.

We employ a maximum likelihood truncated regression model that assesses the contribution of birth cohort, occupation and ethnicity to stature. Analysis is restricted to those born in New Zealand and those aged 21-49 at the time of medical examination. Ages are restricted because some people are still growing in their late adolescent years, and most people begin to lose stature in their 40s (although not noticeably until their 50s). We only look at people born in New Zealand in order to maximize the probability that socio-economic influences on stature formation reflect New Zealand realities.

The estimation ignores men less than 64 inches tall because WWI fitness requirements excluded a disproportionate number of the shorter men. The maximum-likelihood truncated regression model relies on the assumption of a normal distribution of heights in order to ‘replace’ the under-represented heights at the lower end. WWII norms were more flexible and explicitly permitted enlistment above 62 inches, however for comparability we use the same truncation standard for both estimations.¹⁸ A histogram showing the frequency distribution of heights in both wars is illustrated in Figure 1 and 2. The distribution approximates normality with very little sign of truncation at either end in either war, although a modestly disproportionate decline for WWI is visible at 64 inches.

¹⁸ The fact that most men classed as unfit were rejected for reasons other than their stature reduces concern about the selection effects of fitness assessment.

We examine change over time through a comparison of co-efficients estimated for different birth cohorts. Māori identity is inferred from the use of a Māori first and/or last name. The influence of socio-economic status is examined through occupations organized into five classes: (i) professional, managerial and clerical, (ii) farmers, (iii) farm labourer, (iv) other labourers and servants and (v) all other. The 'other' category is made up of men working in manufacturing, transport and utilities. The soldier's occupational class is assumed to correlate with his father's occupational class. Admittedly this is an indirect measure of the nutritional circumstances in which the soldier grew up. Occupation is a very rough socio-economic indicator. The presumption of intergenerational persistence further reduces precision. Nevertheless, in the absence of other indicators we rely on these occupational groups to capture socio-economic influences.

In Table 3 we report coefficients from separate estimations on WWI and WWII data; most of the former describe men born in the final quarter of the 19th century and most of the latter describe the first quarter of the 20th century. The omitted categories are Pākehā in the 'other' occupational class born 1885-1889 and 1910-1914.

The pattern of cohort co-efficients provides no indication that stature was increasing over time as in Australia, Canada and the United States through most of this period. Indeed, the WWI data for New Zealand show a significant decline in stature from the early 1880s to the later 1890s; those born in the early 1920s were also significantly shorter than other cohorts. We use five-year cohorts in an attempt to identify these effects as specifically as possible. The disadvantage of short cohorts is that the number of observation in each cohort is small. We do not yet have enough data to know if the apparent fluctuations in stature should be understood as purely cyclical in nature. The Australian data also show a reversal in the 1890s although not in the 1920s (Whitwell and Nicholas 2001).

The coefficients estimated on occupational group suggest the presence of significant socio-economic inequality. In both periods men in the rural

occupations were taller. Men in the professional and clerical occupations were taller – as expected from the higher class standing and family circumstances permitting greater spending on food and healthy housing. Men in the labouring and manufacturing (omitted) occupations, especially those in urban areas and lacking in specific skills, probably grew up with lower family income in less healthy environments, and consequently are shorter. There are some signs of increasing inequality inasmuch as the differential between shorter and taller groups increased from the late 19th to the early 20th centuries.

The most dramatic change between the two estimations reported in Tables 3 and 4 is in the effect of being Māori. The WWI data suggest that men with indigenous names were not systematically shorter, controlling for other influences, during the late 19th century. The estimation on WWII soldiers, however, shows that the early 20th century Māori cohorts were nearly three-quarters of an inch shorter. This differential cannot be the result of Māori soldiers being younger on average or shifting into lower-status jobs since the estimation independently controls for these influences (admittedly in a somewhat rigid manner). The size of the Māori stature penalty for WWII cohorts – four-fifths of an inch - is striking.

Thus far we have examined information for the adults who have stopped growing. However, substantial numbers of men also enlisted at ages 18-20 years. We attempt to make use of this evidence through a simple comparison of men of the same age and ethnicity who enlisted in the two wars. The unconditional means and differentials are reported in Table 7. A difference of means test on the hypothesis that the young adults in the two wars were the same height cannot be rejected for any age, Pākehā or Māori. However, the same test allows us to reject the hypothesis of common Māori-Pākehā stature for 19- and 20-yr olds in WWI and, much more strongly, 18- and 19-yr olds in WWII. We would not want to make too much of these results because samples are small for some pair-wise comparisons and the use of unconditional means does not take account of any potentially confounding factors. Nevertheless, this evidence is consistent with the evidence of Tables

3 and 4 that stature was not changing over time except for Māori, who were becoming absolutely shorter.

As a rule of thumb, it is useful to have at least 200 observations in order to identify most effects in the presence of genetic variation and other sources of variability in anthropometric data. The identification of small or complex effects may require even larger samples. The detail reported in Tables 3 and 4 make clear that our samples are small relative to the questions we wish to ask of them. Accordingly, it would be unwise to interpret a failure to identify an effect as reliable evidence that it in fact does not exist or to assume that the coefficients will not change as samples expand. Nevertheless we may summarize some preliminary conclusions and compare with other kinds of information in order to identify consistency and value added by the anthropometric data.

The WWI medical data reveal no systematic ethnic or racial difference in stature – again recognizing the limitation of having only 140 Māori observations. It is easier to interpret the large (0.8 inches) and significantly negative co-efficient on the WWII marker. We infer that some combination of nutrition, disease vulnerability and the demands of work during childhood undermined the health of Māori born during the early 20th century. If we believe the results for WWI, the physical well-being of the Māori deteriorated relative to Pākehā and to earlier generations of Māori.

VI. Evidence from prison records

Our final original evidence on changes in Māori stature comes from prison records. Prison records have played second fiddle to military records in the anthropometric history literature, but there may be reasons to prefer them to military records.¹⁹ Since prisoners were more likely to be from lower socio-economic groups more vulnerable to nutritional shocks prison records could show more sensitivity to diet and disease. Taking a more agnostic view, it is desirable to confirm trends in multiple sources.

¹⁹ Scott Alan Carson, "Geography, Insolation, and Vitamin D in Nineteenth Century US African-American and White Statures," *Explorations in Economic History* 46, no. 1 (2009).

At this stage we have completed data entry for three sets of prison records, from prisons in the North Island of New Zealand, in areas with substantial Māori populations. We completed data entry for the New Zealand-born inmates recording height and weight, and socio-demographic variables, the most valuable of which is occupation. Literacy and education were not consistently collected across the different prisons, and have not been included in these preliminary analyses. As is evident from Table 8 the prison data gives us greater purchase on other birth cohorts than the concentration in the 1880s/1890s and 1910s/1920s that we see in the military samples. The prison sample presently includes 4380 Pākehā and 3810 Māori.

On average Māori were slightly shorter than Pākehā in the prison samples (Table 9), except in some of the early cohorts. However in the nineteenth century the gaps are typically small and do not reach statistical significance in any decade. In the twentieth century the gaps between Māori and Pākehā widen, and reach statistical significance. As with the military data we can adjust for characteristics of the prisoners in a regression model (Table 10). As there was not a minimum height requirement to enter prison we use a standard model with no truncation.²⁰ The reference individual in the regression is a Pākehā in a skilled or semi-skilled manufacturing, transport or utilities job born in the 1950s.

As in the military data there was no tendency towards rising heights in nineteenth century New Zealand. This conclusion is robust to including controls for ethnicity and occupation. A slightly different pattern of late nineteenth century height decline is evident in the prison records with the cohorts of the 1870s being the shortest, and height then gradually rising into the early twentieth century. Thus, our broad picture of late nineteenth century pressure on heights is maintained, although the pattern across decades differs slightly.

²⁰ Nor really a minimum age requirement. Nineteenth century New Zealand prisons often had the function of looking after abandoned children who were duly recorded and measured upon arrival.

Again we find statistically significant evidence of social differences in height. The direction, but not the magnitude of the effects is similar to the military estimates. There are few professionals in our sample and are taller than skilled workers, but barely. Farmers do better, but farm laborers worse. In separate regression for Māori and Pākehā, the height advantage for farmers of 0.4 – 0.48 of an inch was consistent.

For Māori we find insignificant differences from the 1950s in most cohorts. The cohorts born in the 1860s were noticeably shorter, which was a generation that grew to maturity after substantial Māori land loss in the New Zealand wars of 1859-1873.²¹ For Māori the only other cohorts to have significantly different height from the modern mean was the cohort of the 1910s. This is consistent with our finding from the military estimates. Māori living standards appeared to have been poor relative to Pākehā, and their own previous generations in the inter-war era. We should not make too much of the size of the finding, as the differences are small, half to three quarters of an inch, but they are statistically significant and we have evidence from two independent sources—military and prison records.

VII. Discussion and conclusion

Seeing the same evidence of a stagnation in Māori height relative to Pākehā in the early twentieth century birth cohorts in two sources we need to assess the credibility of this pattern, and so we examine other health indicators that would reflect the experience of the same cohorts. In Table 11 we summarize mortality information as it appears in the annual reports of the Department of Public Health 1925-1940. The 5-year infant mortality and crude death rates of the Māori were 2 to 4 times that of Pākehā. The differential does not tend to diminish, indeed the last five year window 1935-1939 appears to have been particularly difficult for the Māori.

²¹ James Belich, *The New Zealand Wars and the Victorian Interpretation of Racial Conflict* (Auckland: Penguin, 1987).

There is no easy way 90 years later to assess the relative importance of disease vs nutrition for Māori mortality, stature or any other indicator of physical well-being. Most observers have explained high Māori infant mortality during the 1920s and 1930s as the result of child pneumonia, diarrhoea and enteritis, which themselves were understood to be a consequence of poor living conditions and an increasing reluctance to breast-feed (Bryder). The 1935 report of the Department of Public Health also points to the importance of disease rather than nutrition: “The two main conditions in which the Māori child compares unfavourably with the European child are tuberculosis and skin diseases ... The percentage of Māori with subnormal nutrition, however, is lower than that of the European children”.²² The losses of life attributed to various diseases, reported in Table 12, reinforce this perspective. The Māori were 5x more likely to die of influenza, 10x more likely to die of pulmonary tuberculosis, 20x more likely to die of measles and nearly 40x more likely to die of typhoid.

These differentials arose from some combination of differences in disease exposure, differences in acquisition of the disease upon exposure and variability of the impact of disease after it has taken hold. For tuberculosis, which was studied more than other diseases at the time, disease acquisition clearly mattered a lot. The 1940 report of the same department notes that TB was found in 0.2% of all Pākehā children and an astonishing 40% of Māori children examined the previous year.²³

The mortality and morbidity data confirm that disease of various kinds severely compromised Māori health during the 1920s and 1930s. A substantial Pākehā-Māori difference in physical stature among WWII soldiers is hardly surprising in this context. It is harder to understand why we do not encounter a comparable difference in stature among WWI soldiers. The lack of comparable mortality data for the late 19th century complicates the picture, but continuing population decline until the end of the 19th century makes it

²² New Zealand, Appendices to the Journals of the House of Assembly, H-31, Report of the Department of Public Health, 1935, p. 8.

²³ New Zealand, Appendices to the Journals of the House of Assembly, H-31, Report of the Department of Public Health, 1940, p. 3.

unlikely that other health indicators would show Māori in a more favourable light than during the 1920s and 1930s. Unfortunately the limitations of available evidence make it impossible to advance further on this question at the present time.

Table 2. Thomson's survey of Māori height, 1849

Height	Number of Māori men in height range
5 feet to 5 feet, 1 inch	6
5 feet, 1 inch to 5 feet, 2 inches	
5 feet, 2 inches to 5 feet, 3 inches	1
5 feet, 3 inches to 5 feet, 4 inches	2
5 feet, 4 inches to 5 feet, 5 inches	9
5 feet, 5 inches to 5 feet, 6 inches	20
5 feet, 6 inches to 5 feet, 7 inches	37
5 feet, 7 inches to 5 feet, 8 inches	20
5 feet, 8 inches to 5 feet, 9 inches	18
5 feet, 9 inches to 5 feet, 10 inches	17
5 feet, 10 inches to 5 feet, 11 inches	13
5 feet, 11 inches to 6 feet	2
6 feet to 6 feet, 1 inches	1
6 feet, 5.5 inches	1

Table 3: Maximum Likelihood Truncated (64'') Estimation of Stature, NZ-born Soldiers 21-49 years

World War One (n=3051)

World War Two (n=2279)

Coef. P>|z|

Coef. P>|z|

	Coef.	P> z			Coef.	P> z
Born 1860-1874	+.59	.06		Born 1890-1899	+.26	.36
Born 1875-1879	-.17	.39		Born 1900-1904	-.14	.57
Born 1880-1884	+.31	.06		Born 1905-1909	-.13	.52
Born 1890-1894	-.08	.57		Born 1915-1919	+.06	.71
Born 1895-1899	-.52	.02		Born 1920-1924	-.51	.07
Farmer	+.77	.00			+.95	.00
Labourer, farm	+.22	.23			+.21	.36
Professional-Clerical	+.51	.00			+.38	.05
Labourer, other	+.06	.71			+.01	.95
Indigenous Name	-.07	.77			-.78	.00
Constant	67.5	.00			67.6	.00

Table 4: The Urban Effect within a Maximum Likelihood Truncated (64'') Estimation of Stature, NZ-born Soldiers 21-49 years

World War One (n=2664)			World War Two (n=1250)		
	Coef.	P> z		Coef.	P> z
Born 1860-1874	+.73	.03	Born 1890-1899	+.08	.84
Born 1875-1879	-.19	.36	Born 1900-1904	-.22	.53
Born 1880-1884	+.42	.07	Born 1905-1909	+.11	.67
Born 1890-1894	-.02	.92	Born 1915-1919	+.05	.81
Born 1895-1899	-.44	.08	Born 1920-1924	-.64	.10
Farmer	+.69	.00		+.99	.00
Labourer, farm	+.34	.08		+.04	.90
Professional-Clerical	+.63	.00		+.43	.09
Labourer, other	+.11	.52		-.10	.72
Indigenous Name	-.15	.58		-.69	.01
Born Auckland	+.06	.80		-.43	.18
Born Dunedin	-.32	.15		-.07	.88
Born Christchurch	-.33	.13		+.70	.02
Born Wellington	-.22	.33		-.01	.99
Constant	67.6	.00		67.6	.00

Table 5: Structure of World War I Sample

	All useable records	With intra-NZ birthplace
All records, 21=<age=<49, hgt>=64	3051	2664
Farmer	633	549
Farm labourer	356	300
Profesional-clerical	398	347
Labour	427	377
Manufacturing-transport (omitted)	1237	1091
Aboriginal name	140	125
Born before 1874	83	67
Born 1875-1879	300	245
Born 1880-1884	477	416
Born 1885-1889 (omitted)	740	655
Born 1890-1894	1214	1074
Born 1895-1899	237	207
Auckland		194
Wellington		154
Christchurch		180
Dunedin		180

Table 6: Structure of WWII Sample

	All useable records	With birthplace intra-NZ
All records, 21=<age=<49, hgt>=64	2279	1250
Farmer	192	109
Farm labourer	218	60
Profesional-clerical	306	191
Labour	476	251
Manufacturing-transport (omitted)	1087	637
Aboriginal name	547	297
Born 1890-1899	130	79
Born 1900-1904	186	100
Born 1905-1909	362	202
Born 1910-1914 (omitted)	610	343
Born 1915-1919	822	435
Born 1920-1924	169	91
Auckland		106
Wellington		88
Christchurch		105
Dunedin		52

Table 7: Unconditional Mean Stature for 18-20 Year olds

	Mean Stature (in)		t-statistic for difference
	WWI	WWII	WWI-WWII
Pākehā 18 yrs	na	68.0	na
Pākehā 19 yrs	67.7	68.0	-1.1
Pākehā 20 yrs	67.7	67.6	+0.6
Māori 18 yrs	66.7	66.7	+0.8
Māori 19 yrs	66.8	66.6	+0.5
Māori 20 yrs	67.3	67.1	+0.6
t-statistic for Pākehā-Māori difference			
18 yrs	na	6.1	
19 yrs	2.4	5.3	
20 yrs	2.7	1.3	

Table 8. Chronological coverage of prison sample

Decade	Born in decade	Admitted to prison
1830	15	
1840	116	
1850	259	
1860	384	
1870	331	52
1880	85	288
1890	224	503
1900	508	314
1910	962	
1920	1,239	
1930	1,387	609
1940	1,980	904
1950	700	1045
1960		2062
1970		2413
Total	8,190	8,190

Totals are for New Zealand born men, aged 21-49.

Table 9. Mean height of Pākehā and Māori by decade of birth, prison sample

Birth decade	Pākehā	Māori	Total
1830		66.78	66.78
1840	68.58	67.30	67.80
1850	67.39	67.58	67.48
1860	67.69	67.01	67.45
1870	66.74	67.56	66.86
1880	67.49	66.25	67.39
1890	67.86	67.42	67.77
1900	67.67	67.62	67.66
1910	67.65	67.04	67.43
1920	67.98	67.26	67.68
1930	68.32	67.42	67.84
1940	68.60	67.49	67.92
1950	68.39	67.53	67.88
Total	67.97	67.39	67.70

Shaded cells indicate Māori stature greater than Pākehā.

Table 10. Stature regressions from prison data

Model	Decades only b/se/p	Māori indicator b/se/p	Century-specific Māori indicator b/se/p	Adds occupations b/se/p	Full model, Māori only b/se/p	Full model, Pākehā only b/se/p
Born in 1830s	-1.10 0.67 0.10	-0.79 0.66 0.23	-1.32 0.68 0.05	-1.36 0.68 0.05	-0.79 0.63 0.21	
Born in 1840s	-0.08 0.26 0.75	-0.07 0.26 0.78	-0.41 0.27 0.14	-0.42 0.28 0.12	-0.25 0.32 0.42	0.17 0.42 0.70
Born in 1850s	-0.40 0.19 0.03	-0.49 0.19 0.01	-0.76 0.20 0.00	-0.73 0.20 0.00	0.10 0.25 0.69	-0.97 0.28 0.00
Born in 1860s	-0.43 0.16 0.01	-0.61 0.16 0.00	-0.83 0.17 0.00	-0.78 0.18 0.00	-0.48 0.25 0.05	-0.65 0.23 0.00
Born in 1870s	-1.02 0.17 0.00	-1.36 0.17 0.00	-1.48 0.17 0.00	-1.42 0.18 0.00	0.07 0.37 0.84	-1.59 0.22 0.00
Born in 1880s	-0.49 0.29 0.09	-0.88 0.29 0.00	-0.96 0.29 0.00	-0.89 0.29 0.00	-1.16 0.91 0.20	-0.83 0.34 0.01
Born in 1890s	-0.11 0.20 0.57	-0.41 0.20 0.04	-0.55 0.20 0.01	-0.51 0.20 0.01	-0.07 0.38 0.86	-0.48 0.25 0.06
Born in 1900s	-0.22 0.15 0.14	-0.48 0.15 0.00	-0.51 0.15 0.00	-0.47 0.15 0.00	0.17 0.25 0.51	-0.69 0.21 0.00
Born in 1910s	-0.45 0.13 0.00	-0.63 0.13 0.00	-0.65 0.13 0.00	-0.60 0.13 0.00	-0.41 0.18 0.02	-0.72 0.19 0.00
Born in 1920s	-0.20 0.12 0.09	-0.33 0.12 0.01	-0.34 0.12 0.00	-0.32 0.12 0.01	-0.21 0.16 0.18	-0.39 0.19 0.03
Born in 1930s	-0.05 0.12 0.70	-0.09 0.12 0.46	-0.09 0.12 0.44	-0.08 0.12 0.51	-0.10 0.15 0.51	-0.06 0.19 0.75
Born in 1940s	0.04 0.11 0.72	0.05 0.11 0.63	0.06 0.11 0.62	0.06 0.11 0.58	-0.04 0.14 0.79	0.22 0.18 0.24
Māori		-0.75 0.06 0.00	-0.27 0.16 0.08	-0.23 0.16 0.15		
Māori, 20th century			-0.56 0.17 0.00	-0.55 0.17 0.00		
Professional, clerical sales				0.12 0.11 0.30	0.35 0.28 0.20	0.07 0.13 0.58
Labourer				-0.19 0.07 0.01	-0.16 0.10 0.12	-0.24 0.10 0.01
Farmer				0.41 0.23 0.07	0.48 0.34 0.16	0.43 0.31 0.17
Farm labourer				-0.12 0.08 0.17	-0.04 0.11 0.74	-0.16 0.13 0.23
Constant	67.88 0.10 0.00	68.33 0.10 0.00	68.37 0.10 0.00	68.40 0.11 0.00	67.57 0.13 0.00	68.46 0.16 0.00

Table 11: Demographic Indicators of Māori and Pākehā Health

	Māori	Pākehā	M/P
deaths/1,000 people			
1920-1924	16.0	9.0	1.77
1925-1929	15.6	8.5	1.83
1930-1934	15.9	8.3	1.92
1935-1939	20.2	9.0	2.25
infant mortality/1,000 live births			
1925-1929	115.8	37.7	3.07
1930-1934	93.2	32.3	2.88
1935-1939	114.7	32.1	3.58

Source: New Zealand, Appendices to the Journals of the House of Assembly, H-31, Report of the Department of Public Health, 1925-1940

Table 12: Disease Impact, Māori and Pākehā, 1937-1940

Deaths/10,000 people

	Māori	Pākehā	M/P
Pulmonary Tuberculosis	31.68	3.28	9.7
Other Tuberculosis	9.13	0.65	14.0
Influenza	4.10	0.75	5.5
Thyphoid	1.83	0.05	36.5
Measles	24.30	1.10	22.1

Source: New Zealand, Appendices to the Journals of the House of Assembly, H-31, Report of the Department of Public Health, 1925-1940

Figure 1: Frequency Distribution of Stature, Adult NZ-born Soldiers, WWI

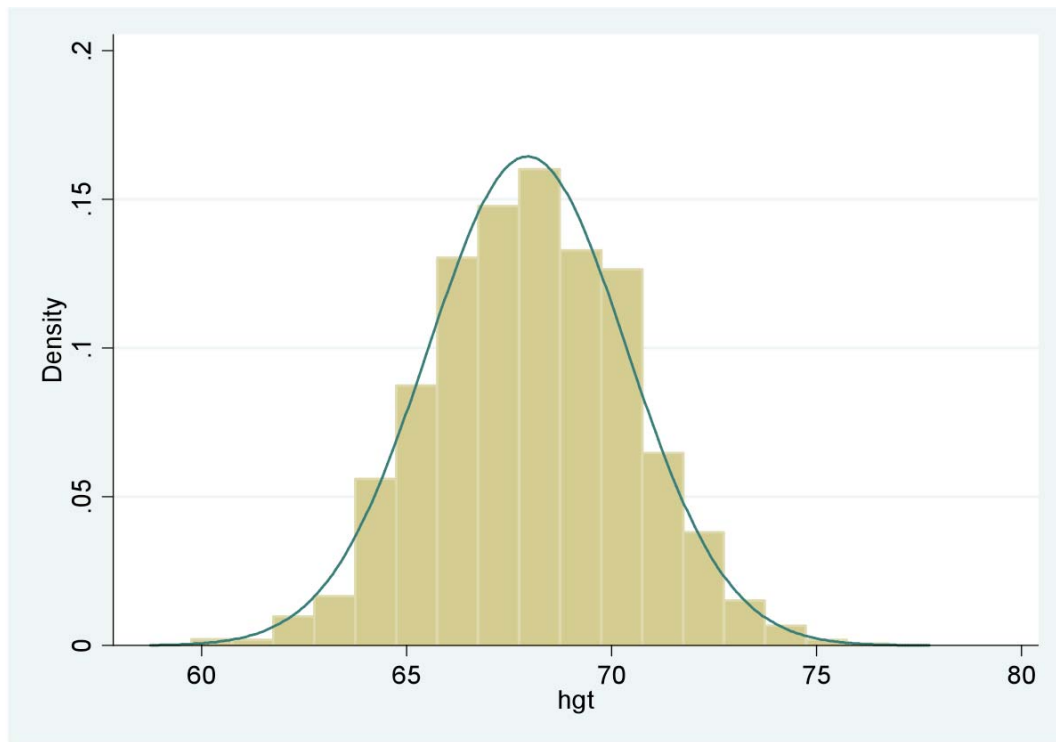


Figure 2: Frequency Distribution of Stature, Adult NZ-born Soldiers, WWII

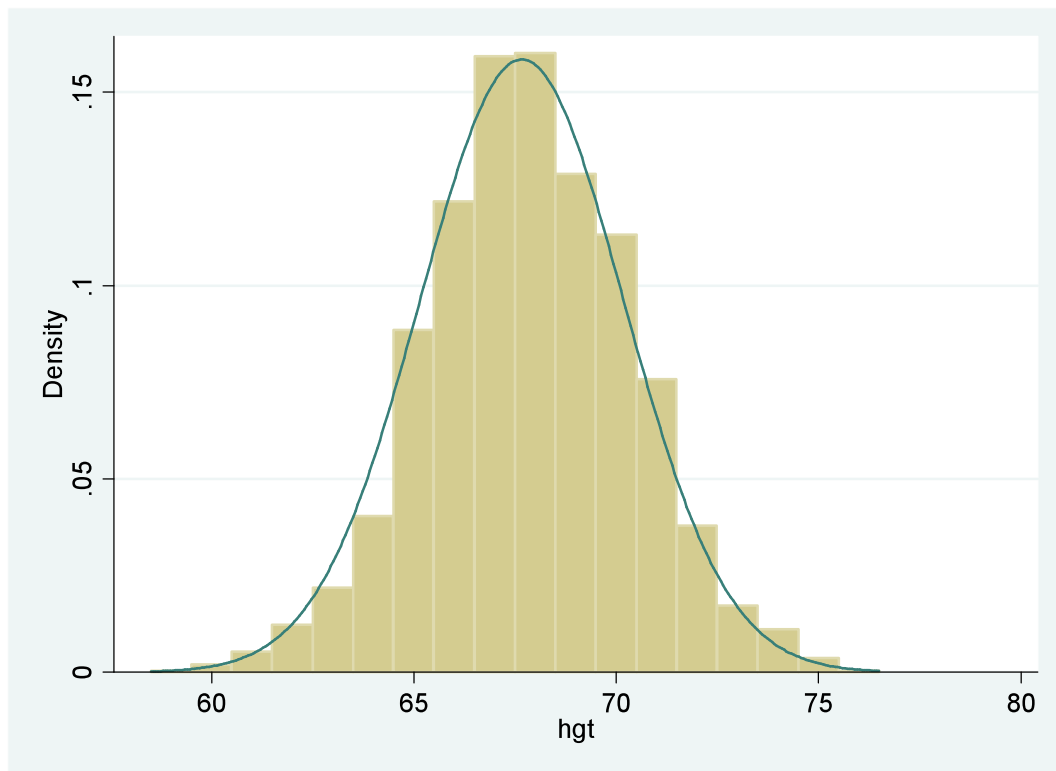
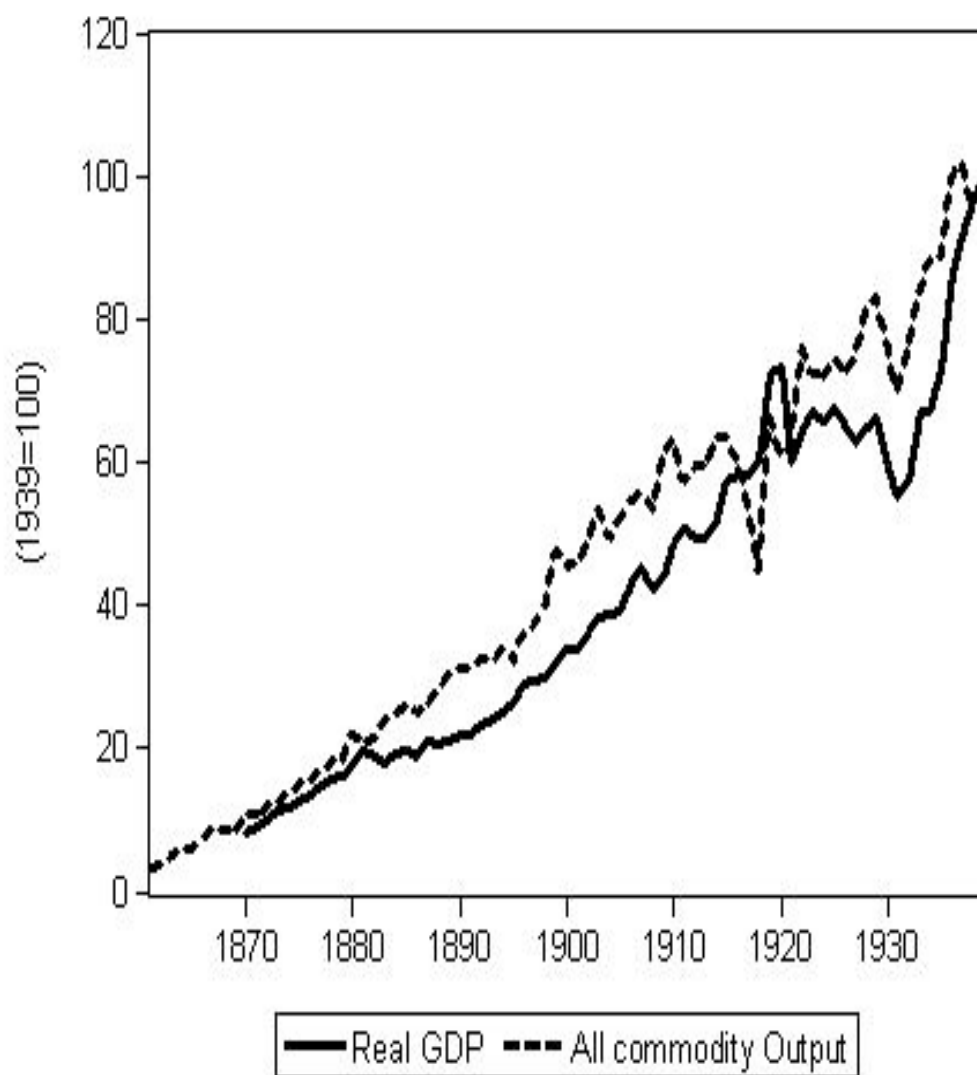


Figure 3: Long-term Pattern of Real GDP and Commodity Output



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