"Tall, active and well made"?
Māori and Pākehā health inequalities in long-term perspective

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In this paper we review ethnic differences in physical well-being in New Zealand since the 18th century. The Māori were relatively tall at first contact with Europeans. They experienced little or no stature decline in the 19th century, in spite of a significant diminution of population during European colonization. In the early decades of the 20th century, however, Māori stature declined absolutely and relative to other New Zealanders. Other indicators point to the early 20th century as a period of severe physical stress. We argue that health inequality along ethnic lines is not genetic in origin, at any rate not in a simple sense. Neither is it an inevitable result of vulnerability to introduced European diseases. Rather, health inequality in New Zealand reflects the Māori experience of colonization as New Zealand industrialized and urbanized during the late 19th and early 20th centuries.

"Tall, active and well made"[1]? New insights into Māori stature and health[2]

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Introduction

Between the sixteenth and nineteenth centuries the arrival of Europeans brought about a drastic decline of indigenous populations and a colonization of previously independent societies almost everywhere in the Americas and Australasia. Population declined because of military conflict, the epidemological shock of new disease, lost access to means of subsistence, and erosion of the will live leading to fertility decline and suicide. Understanding the relative importance of different causal mechanisms, however, is challenging because few sources survive, and these were generated almost entirely by the colonizers.

A particularly well-known experience is the encounter between the Māori and European colonizers in New Zealand. In this paper we examine the evolution of physical standards of well-being for the Māori, as reflected in their stature, beginning with the arrival of large numbers of Europeans in the seond quarter of the 19th century. The Māori population declined through the entire 19th century to a nadir in the 1890s.[3] In spite of rising population in the twentith century Māori health has been demonstrably inferior to that of New Zealanders of European descent, or Pakeha. Health disparities between Māori and the Pakeha (Europeans and their descendents in New Zealand) have been a persistent policy concern from the 1960s[4] to the present day.[5]

The origin of ethnic health disparities in New Zealand is unclear primarily

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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.

[2] We gratefully acknowledge the support and assistance of the New Zealand Defence Force, Archives New Zealand, the New Zealand Department of International Affairs, the Health Research Council of New Zealand, the Marsden Fund of the Royal Society of New Zealand, the Social Sciences and Humanities Research Council of Canada and our current and former universities. We have benefited from the excellent research assistance of Karen Cheer, Cora Clarkson, Pete Connor, Chelsea Jack, Melanie Malchow, Nick Radburn, Sam Ritchie and Sarah Van Sligtenhorst.

[3] D. Ian Poole, *The Māori Population of New Zealand, 1769-1971* (Auckland: Auckland University Press, 1977).

[4] Ian Prior, "Health" in Erick Schimmer, ed., *The Maori People in the Nineteen-Sixties* (Auckland: Blackwood and Janet Paul, 1968): 270-289; R.J. Rose, *Māori–European Standard of Health* (Wellington: Department of Health, 1960) and *Māori–European comparisons in mortality* (Wellington: Department of Health, 1972).

[5] Tony Blakely et al, "Widening ethnic mortality disparities in New Zealand 1981–99". *Social Science and Medicine*, 61 (2005): 2233–51; *Mason Durie, Whaiora: Maori Health Development* (Ocford: Oxford University Press, 1994); E. Craig et al, *Te Ohonga Ake 2: The Health Status of Māori Children and Young People in New Zealand* (Dunedin: New Zealand Child and Youth Epidemiology Service, 2012).

because reliable evidence for the Māori became available only in the 1920s with the requirement, for the first time, to register all Māori births, marriages and deaths[6] and with the emergence of a government commitment to monitor and support health in general and Māori health in particular.[7] For earlier generations systematic evidence about individual health and demographic experience is unavailable. Aggregate-level information from historical census tabulations is useful in a broad way, but there is considerable uncertainty about the basis for Māori coverage and no way to investigate in the absence of micro-data.[8]

We expand the information available for analysis by drawing on the methodological tradition of 'net nutrition', which interprets adult stature as a reflection of the physical well-being of children.[9] 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 we can move beyond differences in stature observed between the samples. Their biases go in different directions; how much military, anthropological and correctional samples should differ from each other is not clear. Nevertheless, where multiple sources point to a similar pattern we are able to remark more confidently on the trends and differences in Māori stature.

Early European Impressions of Māori Stature

The physical condition of Māori impressed Europeans when they first met. 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 especialy the men …. They seem to injoy a good state of hilth and many of them live to a good old age.

As well as being impressed by physique, Europeans from the early contact period were unusually impressed by Māori mental capacity and social organization. M□ori were seen by many Europeans—within New Zealand and outside—as

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[6] Poole, *The Māori Population*: 63

[7] Derek Dow, *Maori Health and Government Policy, 1840–1940 (*Wellington: Victoria University Press, 1999); Raeburn Lange, *May the People Live. A History of Maori Health Development, 1900-1920* (Auckland University Press, Auckland, 1999).

[8] Poole, *The Māori Population;* Tahu Kukutai, "Building Ethnic Boundaries in New Zealand: Representations of Maori Identity in the Census", chapter 2 in Per Axelsson and Peter Sköld, eds. *Indigenous Peoples and Demography. The Complex Relation Between Identity and Statistics* (New York: Bergahn, 2011).

[9] Richard H. Steckel, "Biological Measures of the Standard of Living", *Journal of Economic Perspectives* 22 (2008): 129–52 and "Heights and Human Welfare: Recent Developments and New Directions", *Explorations in Economic History* 46 (2009): 1-23; Roderick Floud, et al, *The Changing Body: Health, Nutrition, and Human Development in the Western World since 1700* (Cambridge: Cambridge University Press: 2011).

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."[10]

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."[11] John George Wood's 1870 magnum opus on the Uncivilized Races of Men described Māori as

> a singularly fine race of people—tall, powerful, and well made," though also noting that "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.[12]

In 1884 the writer Anthony Trollope attempted a more precise description: an "active people—the men averaging 5 feet 6 inches in height—and are almost equal in strength and weight to Englishmen."[13] A presenter at the 1890 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."[14] A belief in great Māori stature even 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."[15]

By 1899, however, around the point of the Māori population nadir, the American historian John Clark Ridpath published a different characterization by observing

> The Maori are by no means an attractive people … In the first place, the stature of the Maoris is below the average. The men are rarely more

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[10] *Missionary Records: Tahiti and Society Islands* (London: Religious Tract Society, 1799): 22.
[11] Abraham Thompson Rowe, *The Columbian Class Book: Consisting of Geographical, Historical and Extracts* (Worcester: Dorr & Howland, 1825), 155.
[12] 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.
[13] Anthony Trollope, *New Zealand* (London: Ward, Lock & Co., 1884): 2.
[14] 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.
[15] "The Taller Person Has the Advantages in Life," *Popular Mechanics*, January 1946, p.75A.

than five feet six inches in height.[16]

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 may derive from a pioneering study half a century earlier. In April 1849 A.S. Thomson, a Regimental Surgeon with the British army, measured Māori men who presented for vaccination at the military hospital in Auckland.[17] Our reworking of Thompson's data places the mean for this group at 67.2 inches. This understates adult stature insofar as the age of nearly one-third of those measured was 16-20 years. On the other hand Thomson noted that they were "Waikato natives or men employed on the government works, both of which classes are usually better fed than the natives generally."

Thompson's data can be compared with archaeological evidence. Houghton et al had access to 98 skeletons from museum collections around New Zealand.[18] They used limb length and total stature from a sample of WW1 Māori soldiers to estimate the stature of pre-historic Māori from skeletal limbs.[19] The Houghton et al estimate of 68 inches suggests that pre-European Māori men reached an average stature well above European standards of the day. The skeletal evidence also agrees relatively closely to the Thompson data, which in turn suggests 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.

Quantitative evidence of Māori stature

The attainment of basically modern stature by pre-contact 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. It is less clear what to expect from the generations of Māori who experienced European colonization. Following Cook's visit in 1769 the presence of sealing and whaling stations, escaped Australian convicts and missionaries increased steadily. A second wave of loggers and farmers needed to provision the early settlements soon began to export. The expansion of trade and later mining booms made New Zealand an attractive destination for immigrants from Europe, Australia, China and the Pacific Islands.

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

[17] 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 with minor revisions also appeared as "Observations on the Stature, Bodily Weight, Magnitude of Chest, and Physical Strength of the New Zealand Race of Men" in *Journal of the Ethnological Society of London* 3 (1854): 123-31 and *Journal of the Royal Geographical Society* 23 (1854): 87-92. Thompson later wrote the first general history of New Zealand: *The Story of New Zealand: Past and Present, Savage and Civilized* (London: Murray, 1859).

[18] 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).

[19] Te Rangihiroa (Peter Buck), "Māori Somatology," *Journal of the Polynesian Society* 31, no. 1 (1924): 37.

The signing of the Treaty of Waitangi in 1840 inaugurated formal British colonization; European immigration and settlement accelerated and, with it, the loss of Māori land. Intensified resistance in the "Land Wars" of the 1860s and 1870s failed to arrest the patterns of substantial social and economic change and, demographic decline and the loss of Māori land. The Māori experience of the nineteenth century, in short, was one of lost land, demographic decline and colonization amid substantial social and economic change.[20] It would be surprising if this did not bring repercussions for the health and stature of surviving Māori. Quantitative evidence is needed to assess this experience.

Direct evidence of Māori and Pakeha stature is available for those who participated in local police and military forces of the period. For example, the Armed Constabulary enlisted both ethnicities in the 'Land Wars' of the 1860s and 1870s.[21] Here we distinguish Māori from Pakeha on the basis of surname. Intermarriage is a complicating factor of unknown prevalence within our sources. Some scholars suspect there was a great deal more mixing of the races than is identified by published sources.[22]

In the face of these complications we identify as Māori anyone who enlisted using a Māori name. Self-identification through the choice of name is a clear signal that someone has chosen to live visibly as Māori. We recognize that a genetically 'pure' Māori could adapt a European name, and a European might adopt a Māori name. For our purposes, though, the precise genetic composition of an individual matters less than how she or he lived. The reporting of an indigenous name probably does point to someone who lived within and identified with the indigenous community, and most importantly grew up in a Maori environment. This social and environmental influence is what we wish to capture. Name-based identification is also broadly consistent with the modern self-identification criterion for ethnicity.[23]

Evidence from the Armed Constabulary is reported in Tables 1 and 2.[24] The number of observations is small: 346 Māori and 465 Pakeha. Some records are not useable because of missing information or the individuals had not reached the age of 21 years. Mean Pakeha age was 24.3 years against 28.3 years for the Māori.

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[20] James Belich, *The New Zealand Wars and the Victorian Interpretation of Racial Conflict* (Auckland: Penguin, 1987) and *Making Peoples: A History of the New Zealanders* (Auckland: Penguin, 1996); Richard Boast and Richard S. Hill, eds., *Raupatu, The Confiscation of Maori Land* (Wellington: Victoria University Press, 2009).

[21] Peter Cooke and John Crawford, *The Territorials: the history of the territorial and volunteer forces of New Zealand* (Auckland: Random House, 2011).

[22] John Harre, Maori-Pakeha Intermarriage", in Erick Schimmer, ed., *The Maori People in the Nineteen-Sixties* (Auckland: Blackwood and Janet Paul, 1968): 118-131; Poole, *The Maori Population*: 43ff; Te Rangihiroa (Peter Buck), "The Passing of the Maori", *Transactions of the New Zealand Institute* 55 (1925): 362-375. The South Island tribe Ngai Tahu may have been especially likely to intermarry. See P. Callister, R. Didham, and D Potter, *Ethnic Intermarriage in New Zealand*, Official Statistics Research Series 1 (2005). Angela Wanhalla, "One White Man I Like Very Much," *Journal of Women's History* 20, no. 2 (2008).

[23] Per Axelsson and Peter Sköld, eds. *Indigenous Peoples and Demography. The Complex Relation Between Identity and Statistics* (New York: Bergahn, 2011). See especially chapter 2 - Tahu Kukutai, "Building Ethnic Boundaries in New Zealand".

[24] Archives of New Zealand, *Armed Constabulary Description Book* [P 8 1*1; MICRO 6429].

A large majority of Pakeha were foreign-born (including the Australian colonies); we set these records aside. The Māori enlistment was *not* regionally representative of the entire population. The data in Table 2 confirm that Taranaki, Bay of Islands and Hawkes Bay were under-represented in the Armed Constabulary. This is not surprising. The Bay of Islands had a long tradition of resisting colonial authority. The Armed Constabulary as a fighting force was raised to counter Māori guerilla campaigns in the Waikato, Taranaki and Hawkes Bay. Not surprisingly, these regions contributed few soldiers to the government forces. The Waiapu (east coast) and Bay of Plenty (Opitiki and Maketu on the north coast), on the other hand contributed a large majority of the Māori troops; they were substantially over-represented in the Armed Constabulary.

A recognition that the sample is small and describes only a subset of the Māori conditions our use of the data. We do not know if the patterns of stature in the Bay of Islands and Waiapu are representative of the entire North Island although, equally, there is no reason to think they are unrepresentative. With this caution, however, we observe that Māori participants with government forces in the Land Wars were were relatively tall and roughly comparable to the first generations of NZ-born Pakeha soldiers. Later-born Māori cohorts in the Armed Constabulary appear to have become shorter, and the Pakeha may have become taller, although the small size of sample recommends caution on any observation about paticular subgroups.[25]

Cohorts born later in the century are described in two additional sources: mounted rifle and other units which acted as a militia 1885-1910 and troops volunteering to serve in the South African conflict 1899-1902.[26] Annual capitation rolls for the militia units report name and occupation but not birthplace. Accordingly we can identify the Māori but, unfortunately, we cannot distinguish NZ-born from foreign-born Pakeha. Rolls from across New Zealand for the period 1885-1908 record 2671 entries with a Māori name. There is some repetition, of course, because of multi-year service. 1204 unique names with useable detail are available, although not all had reached 21 years.[27] Many (although not all) South African war soldiers reported birthplace; they were entirely Pakeha as best we can tell from their names. The evidence of these sources reported in Table 3 indicates that Māori in the militia achieved roughly

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[25] One reason to be cautious about the representativeness of the Māori in the Armed Constabulary is that some of those resisting the government appear to have been shorter. The stature of prisoners reportedly captured c1870 in the Hawkes Bay area averaged 66.8 inches. See Archives New Zealand, *Descriptions of and comments on Maori prisoners of war*, ACFK 8169 AGG-HB7 1/2b. We make this calculation for 198 men aged 21-50 years. Of course the representativeness of the prisoners of war is no more clear than the Armed Constabulary.

[26] Archives of New Zealand, *Capitation Rolls of Volunteer Corps* 1860-1911, ARM 41 and *Volunteer Corps* 1863-1872 AD23. The South Africa War personnel records are part of the World War One collection described below.

[27] The capitation rolls report occupation but not birthplace. 90% of militia with Maori names report one of 7 occupations: farming trades (49%), labourer (15%), settler (12%), flax cutter/miller (5%), sheep and stock trades (4%), bushmen (4%) and fishermen (1%). Occupations for the remaining one-tenth are diverse; they include trades such as coach-builder, butcher, bookbinder, blacksmith, carpenter, baker, billiard-maker and painter as well as service sector roles such as teacher, shop-assistant, clerk, clergy, lawyer, chemist, cook, store-keeper, manager, lawyer, journalist and letter-carrier.

the same stature as Pakeha in South African War, although both were tending to become shorter.

The militia and South African War data reported in Table 3 describe similar but independent enlistment processes, each of which differs from the Armed Constabulary. We suspect that all three were somewhat unrepresentative of the broader population. Probably these men were taller than average. Nonetheless, the tables are broadly consistent with each other in two important respects. (i) Māori born in the 1870s and 1880s who undertook military service were roughly as tall as their Pakeha counterparts, just as was true of the Armed Constabulary. (ii) Stature appears to have declined slightly over time within each of the sources represented in Tables 1 and 3. This is a clear indication that the net nutrition of Māori children, while very good by the standards of the day, may have been declining slowly through the nineteenth century.

World War One and World War Two Personnel Records

The samples derived from nineteenth century sources are small and provide no basis to compare forward to subsequent cohorts. The personnel records of men who enlisted in World War One (WW1) and World War Two (WW2) provide a window into the experience of those born from 1870 to 1925. WW1 and WW2 were relatively broad enlistments that are as close to representative of Pakeha men aged 20-40 as is available for New Zealand in this period.[28] Very large numbers of young and middle-age New Zealanders sought to enlist in both wars. Middle-class patriotic fervour was sufficiently strong to ensure that those with limited labour market opportunities did *not* dominate this enlisment, as is the case with so many military enlistments.[29]

Archives New Zealand took custody of 122,000 WW1 records and South African War records in 2005.[30] The collection is being released to the public slowly in response to requests from individuals most of them family historians. Hence our principal access to the record is a byproduct of genealogical interest. In order to increase the count of Māori soldiers we secured permission to examine the personnel and casualty files of men with indigenous surnames and with names falling in sections of the alphabet with significant indigenous representatio.[31] Some Pakeha or European-descent men were acquired in this process. Thus we begin with records for 17300 Pakeha selected in an ad hoc way albeit with no detectable bias and an oversample of 1800 Māori and 800 Pacific Islanders.

For these men we have information on name, place and date of birth, enlistment date, occupation at enlistment, marital status, educational achievement and religion, military identification number, and height and weight. Heights were

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[28] John Crawford and Ian McGibbon, *New Zealand's Great War: New Zealand, the Allies and the First World War*, (Auckland: Exisle Publishing, 2007).

[29] Unfortunately, in the absence of census microdata there is no easy way to assess under- or over-representation of specific social groups.

[30] About 5% of WW1 records were not transferred from the New Zealand Defence Force to Archives in 2005 because the individuals went on to serve post-WW1. These service files are not yet publicly available.

[31] 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.

measured to the quarter inch. The New Zealand military had measured men without shoes since the South African War of 1899-1902 if not before.[32] Many of the men were assessed as having 'good' health along various dimensions of health. If any aspect of a man's health was poor, further details from medical tests are sometimes given. Thus, while more detailed quantitative health information is available selectively for the less fit recruits, it is not easily used in the analysis of overall population health.[33]

We have set aside the records in our sample of women who served as nurses because their numbers re not sufficient to support analysis. We exclude men who enlisted before the age of 21 years because some of them were still growing and men older than 49 years in order to minimize the effect of height diminution at advanced ages. We also discard men born outside New Zealand. This is 30% of our sample - roughly the same as the foreign-born share of men at appropriate ages in the 1911 census (32%).[34] Roughly 1 in 8 of our men were born in Great Britain.[35] The New Zealand-born personnel divide equally between the North Island and the South Island, reflecting the approximately equal populations of the two main islands in the late nineteenth century.

Following our examination of the Armed Constabulary (above) it is useful to assess the regional representativity of Māori records for WW1, in Table 4. Here we compare the regional origins of Māori with their proportions in the 1881 and 1901 censuses. Inconsistent reporting of data by region makes this an imperfect comparison. Nevertheless it it seems clear that Māori in most regions enlisted roughly in proportion to their share of the young male population. The under-representation of Waikato, Taranki and Northland (Bay of Islands in Table 2) continued, although the bias was much diminished from the experience of the Armed Constabulary fifty years earlier. Māori enlistment in WW1 was more nearly representative of the entire population than sources we have examined previously.

Our data for WW2 are of a similar character. We obtained permission to examine personnel files directly at the military personnel archive. The entry of all files on a random selection of microfilms provides the core of the sample; most Pakeha records and a few Māori records are obtained in this way. Entry of all records from sections of the alphabet with significant indigenous representation greatly expands the Māori sample and adds a few Pakeha records as well.

The WW1 and WW2 personnel files have sufficient detail for a multivariate estimation to identify change over time in a way that takes account of confounding influences on stature. We employ a maximum likelihood truncated regression model that assesses the contribution of birth cohort, occupation and.

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[32] South African War attestation of William Eli Johnston, 1902. AABK/18805/W5515, Box 29, Record 2872. Archives New Zealand, Wellington.

[33] L. Callon, *'Fighting Fit: A Study of the Army's Medical Examinations, 1916-1918'*, BA(Hons) Thesis, University of Otago, 1980.

[34] Government Statistician, *Results of a Census of the Dominion of New Zealand Taken for the Night of 2nd April, 1911,* (Wellington: Registrar General's Office): xii, 228-229.

[35] British migration to New Zealand peaked in the early-1860s and mid-1870s; see J. Phillips, and T. Hearn, *Settlers: New Zealand Immigrants from England, Ireland & Scotland 1800-1945* (Auckland: Auckland University Press, 2008).

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 WW1 fitness requirements may have excluded a disproportionate number of the shorter men.[36] 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. WW2 stature norms for military enlistment were more flexible; they explicitly permitted enlistment above 62 inches. For comparability we use the same truncation standard for both estimations. The distribution of stature for both wars approximates normality with very little sign of truncation.

Estimated co-efficients are reported in Table 5 for separate estimations on WW1 and WW2 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 Pakeha 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. There is some tendency for the oldest WW1 soldiers to be taller than the youngest, but low levels of statistical significance undermine any attempt to identify change from cohort to cohort. Pakeha stature appears to have changed very little, if at all, between 1870 and 1925.

The coefficients estimated for occupational groups, even though they are rather broad, suggest the presence of significant socio-economic inequality.[37] In both periods men in the rural occupations were relatively tall. 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 were 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 striking change between the two estimations is the effect of being

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[36] In both wars very few men were rejected for military service on the basis of their stature; see Callon, *'Fighting Fit'* and Archives New Zealand, *General Instructions for medical Examination of Army Recruits*, AD 1 box 1252 271/18/2 part3 May 20 1943.

[37] We use the soldier's occupation as a proxy for father's occupation on the assumption of intergenerational persistence at the level of broad occupational classess. This will overstate the influence of socio-economic circumstances during childhood to the extent there is an independent self-selection by stature into occupations.

Māori. The WW1 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 a full half-inch shorter than Pakeha and also shorter than the WW2 Māori. 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 is striking.

The cohort dummies and a comparison of constant terms in the two regressions confirm that Pakeha stature changed little if at all from 1875 to 1925. The occupational correlations with stature follow a pattern familiar in other countries of the same period.[38] Remarkably, however, those with an indigenous were half an inch shorter in the WW2 enlistment after being statistically indistinguishable from Pakeha in the first enlistment. The military evidence would appear to be that the net nutritional experience of children born in the first quarter of the twentieth century was very different for Māori and Pakeha – a difference that had not been visible in the ninetheenth century sources or even WW1.

Prison Records

A similar pattern of Māori becoming shorter absolutely and relative to Pakeha among cohorts born after 1900 is visible in prison records. This source portrays an entirely different selection of the population. We have collected data on all the New Zealand-born individuals in prison registers that have been transferred to Archives New Zealand. These include four large sets of records for prisons in New Plymouth, Witako and Wanganui and smaller record sets from 34 other prisons, some of them national institutions of a specialized nature and others local gaols.[39] Three-fifths of the records come from New Plymouth and Napier which, fortuitously, are located near areas with substantial Māori populations. In total we have more than 28,000 records male prisoners although not all have reached adulthood and there is some duplication insofar as some men were incarcerated more than once. The admissions stretch from the 1860s to the 1970s. After exclusions for missing information and age we are left with nearly 24,000 records for New Zealand-born men between 21 and 49 years.

We distinguish men who were entirely or largely of European descent (Pakeha) from Māori by the descriptions of nativity made in the prison registers themselves. The nativity descriptions had a crude "blood quantum" concept behind it with some men described as being between ¼ and ¾ Māori. Others were merely described as Māori; many of these men likely were "full-blooded" although we do not know this with certainty. We examine all all men indicated as Māori, no matter the blood quantum noted. Our interpretation is a social one, that being noted as Māori of whatever proportion reflects something about the origins of that person. The reporting of someone as Māori probably does point to someone who lived within and identified with the indigenous community,

[38] Eg, John Cranfield and Kris Inwood, "The Great Transformation: A Long-Run Perspective on Physical Well-Being in Canada", *Economics and Human Biology* v5 n2 (July 2007), pp. 204-228.

[39] Registers for the largest prisons in the four main centres – Auckland, Christchurch, Dunedin and Wellington- have not been transferred to Archives New Zealand.

growing up in a Māori environment. This social and environmental influence is what we wish to capture.

A rolling average of unconditional mean stature by year of birth is shown for both ethnicities in Figure 1. One advantage of the prison records is that heights were recorded continuously each year rather than in a small number of years (1914-1918 and 1939-1945). The prison data describe men people born every year on a continuous basis between the 1880s and the 1950s. The prison records also describe a different selection of Māori and Pakeha men than do military records. On average prisoners came from less affluent social backgrounds than did the soldiers.

A clear pattern of divergence of Māori from Pākehā height can be seen in the rolling average of stature (Figure 1). The average statures of the two ethnic groups were similar until the early twentieth century, after which there is a growing divergence. No difference between Māori and Pakeha mean stature is discernible among those born between the 1880s and the early 1900s. After that point, however, a gap opened up and, for a time at least, the Māori became shorter. This is broadly consistent with the evidence of military personnel records reported above.

Conclusion

The patterns of stature signal a marked deterioration of Māori physical well-being, absolutely and relative to Pakeha, in the early decades of the 20th century. We cannot judge consistency with other sources because no other time series evidence of Māori health spans the late nineteenth and early twentieth centuries. When useful data became available in the 1920s the existence of a substantial health disparity became visible to the public. In Figure 2 and Table 6 we summarize infant mortality and crude death rates as it was reported in the annual reports of the Department of Public Health 1925-1940. The 5-year infant mortality and crude death rates of the Maori were 2 to 4 times that of Pakeha. The differential does not tend to diminish, indeed the last five year window 1935-1939 appears to have been particularly difficult for the Maori.

Not surprisingly during the 1930s concern grew in government and professional circles for the 'Māori health problem'. Information collected by the Department of Public Health pointed to to the importance of disease rather than nutrition:

> "The two main condition in which the Māori child compares unfavourably with the European child are tuberculosis and skin diseases … The percentage of Māori children with subnormal nutrition, however, is lower than that of the European children."[40]

The losses of life attributed to various diseases, reported in Table 7 reinforce this perspective. The Maori 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

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

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 tuberculosis was found in 0.2% of all Pakeha children and an astonishing 40% of Māori children.[41]

The mortality and morbidity data confirm that diseases of various kinds severely compromised Māori child health during the 1930s. In these circumstances a substantial Pakeha-Māori difference in physical stature for those born 1900-1925 (military records) or even 1900-1950 (prison records) is unsurprising. By the 1960s, even more extensive evidence of Māori-Pakeha differences in disease morbidity and mortality brought the issue to a broader public. The ethnic health gradient remains a significant focus of government to the present day.

The long-run trajectory of stature casts new light on the origins of ethnic health disparities in New Zealand. It is clear that the Māori health experience is deeply historical in the sense that the underlying patterns did not begin in the 1960s, or even in the 1930s. However, there is no evidence that Māori stature was compromised to any significant extent in the 18th and early 19th centuries. This rules out a simple genetic explanation.

The evidence also suggests a possibly surprising maintenance of Māori stature amid population decline in the later 19th century. Admittedly, the 19th century sources are fragmentary and require considerable interpretative caution. Nevertheless, our dominant impression is that Māori stature remained roughly comparable to that of Pakeha throughout the 19th century. And yet Māori population was declining. Reconciling these divergent trends may lead to a reconsideration of the contribution of fertility as well as mortality in the population decline. It is possible as well that some sources of mortality risk such as military conflict may have had relatively weak adverse consequences for the survivors. Population loss probably mitigated the impact on standards of living of widespread dispossession of Māori land.

Whatever the precise balance of causal forces in the 19th century, the evidence of a significant deterioration in the early decades of the 20th century is clear. Of course, we must view the early 20th century experience in the context of the previous century of colonial expansion by Europeans into Māori New Zealand. By 1900 an accelerating process of industrialization and urbanization was challenging the health of both Māori and Pakeha. The cumulative effect of diminishing land, loss of political sovereignty and social and economic disruption over several generations appear to have enhanced Māori vulnerability and provided little of the protections being developed for Pakeha community health. The consequences for Māori are visible in declining stature during the first quarter of the twentieth century and elevated mortality and morbidity when data become available in the 1930s. Alongside the immediate demographic

[41] New Zealand, Appendices to the Journals of the House of Assembly, H-31, *Report of the Department of Public Health*, 1940, p.

consequences of 19th century invasion and war we also need to consider the health consequences of the peace ie the long-run impact of colonization for Māori health.

Table 1: Mean Stature of NZ-born males, 21+ yrs, serving in the Armed Constabulary, 1866-1881

	Māori		Pakeha	
	# obs	mean hgt	# obs	mean hgt
born 1820s & 1830s	64	70.0	11	68.7
born 1840s	114	69.2	103	69.2
born 1850s & 1860s	44	68.0	153	69.7

Table 2: Spatial Distribution of Māori in the Armed Constabulary Sample and Māori Population in the 1874 (first) Census

Census district	Proportion of Armed Constabulary	Proportion of Māori Men >15 years 1874 Census
Auckland	1.6%	1.0%
Bay of Islands	6.6	12.4
Hawkes Bay	1.9	22.4
Maketu	35.8	12.1
Opitiki	23.0	8.7
Otago	0.4	2.2
Raglan	0.8	8.9
Taupo	1.9	3.4
Taranaki	1.2	14.9
Waiapu	26.1	10.0
Otaki	0.4	3.1
Wellington	0.4	0.9

Table 3: Mean Stature (inches) of NZ-born males, 21+ yrs, serving in the South African War 1899-1902 (Pakeha) and Militia 1885-1910 (Māori)

	Māori		Pakeha	
	# obs	mean hgt	# obs	mean hgt
born 1850s & 1860s	183	69.1	39	68.8
born 1870s	384	69.0	479	68.6
born 1880s	216	68.7	123	68.0

Table 4: Spatial Distribution of the WW1 Māori Sample and Māori Population in the 1881 and 1901 Censuses

	Proportion of WW1 Māori	Proportion of 1881 Census Māori	Proportion of 1901 Census Māori
North Island			
Auckland	2.8%	3.7%	3.5%
Bay of Plenty	23.4	25.4	12.4
Chatham Is		0.4	0.3
Coromandel	0.9		1.5
Gisborne	10.4		10.2
Hawkes Bay	13.0	9.3	12.1
Manawatu-Wanganui	6.8	8.1	8.6
Northland	16.3	16.8	20.3
Taranaki	2.0	6.4	5.8
Waikato	15.6	21.9	18.2
Wellington	3.7	3.4	2.4
South Island			
Canterbury	3.1	1.6	1.8
Marlborough	0.3		0.7
Otago	1.4	1.6	0.9
Southland	0.7		0.5
Tasman	0.3	1.6	0.4
West Coast	1.3		0.2

Table 5: Maximum Likelihood Truncated (64”) Estimation of Stature, NZ-born Soldiers 21-49 years, 1NZEF (WWI) and 2NZEF (WWII)

WWI (n=4371)			**WWII (n=4939)**		
	Coeff	P>|z|		Coeff	P>|z|
born 1860-1874	**0.51**	0.1	born 1890-1899	0.13	0.5
born 1875-1879	-0.5	0.13	born 1800-1904	-0.07	0.68
born 1880-1884	0.02	0.91	born 1905-1909	-0.08	0.54
born 1890-1894	-0.12	0.25	born 1915-1919	0.14	0.2
born 1895-1899	-0.36	0.14	born 1920-1924	-0.15	0.41
farmer	**0.71**	0	farmer	**0.84**	0
farm labourer	**0.24**	0.1	farm labourer	0.01	0.96
professional, clerical	**0.59**	0	professional, clerical	**0.47**	0
labourer, other	0.12	0.36	labourer, other	-0.19	0.13
indigenous	-0.34	0.22	indigenous	**-0.55**	0
constant	67.6	0	constant	67.6	0

Table 6: Demographic Indicators of Maori and Pakeha Health

deaths/10,000 people	Maori	Pakeha	M/P
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 7: Disease Impact, Maori and Pakeha, 1937-1940

Deaths/10,000 people

	Maori	Pakeha	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: Rolling Average of Mean Stature, Māori and Pakeha Prisoners, by Birth Cohort 1840-1955

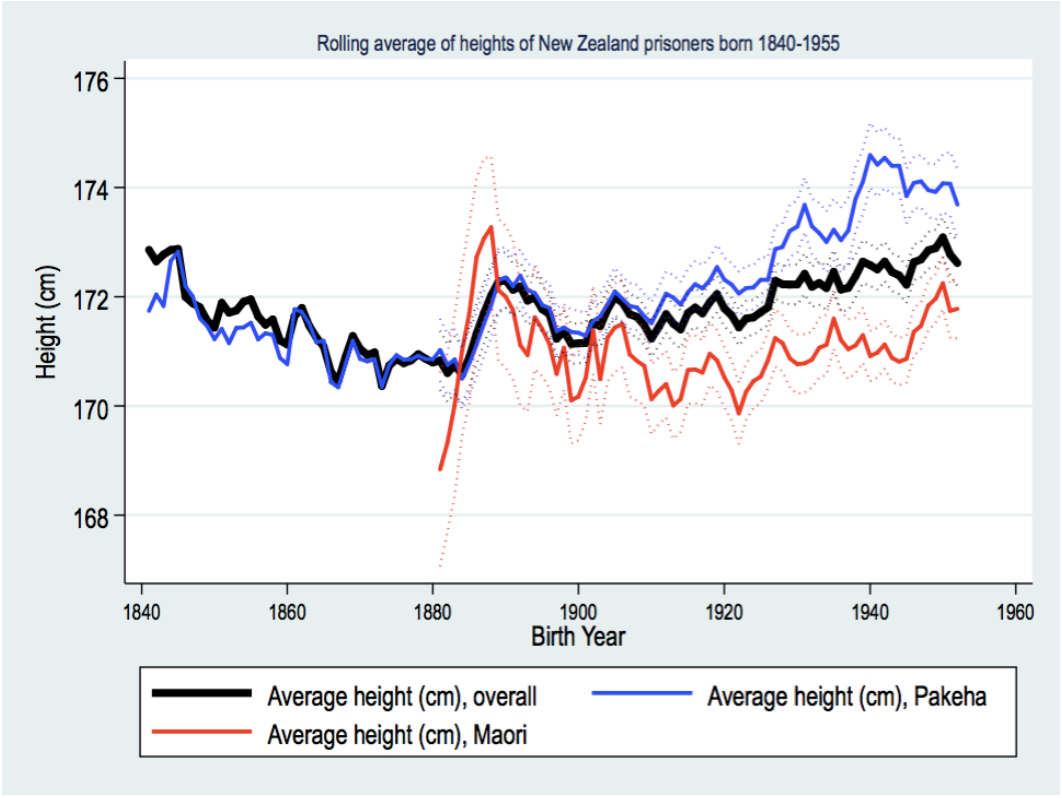

Figure 2: Infant Mortality in New Zealand 1861-1938