

# Height, weight, and mortality in the past: New evidence from New Zealand



Minnesota Population Center

UNIVERSITY OF MINNESOTA

Driven to Discover<sup>SM</sup>

Evan Roberts  
Minnesota Population Center  
University of Minnesota

Kris Inwood  
University of Guelph

Les Oxley  
University of Waikato

## Objective

Modern research suggests that body composition—measured by height and body mass—is associated with mortality, although the etiology differs. Is this relationship between height, weight and mortality a biological constant, or are the associations with mortality modifiable? The range of estimates in the existing literature for both height-mortality and body mass-mortality relationships suggest the relationships may vary with socio-economic conditions and over time. Rising average stature, body mass and fat-free mass over the past century also suggest the possibility that the relationship between height, weight and mortality may vary with changes in the distribution of body size. However, there are only two studies that investigate this relationship in cohorts born before 1900. This paper expands our knowledge of how early life conditions—proxied by height—and early adult health—proxied by weight—affect longevity and mortality, and how those associations have changed over time.

## Research questions

The paper examines the life expectancy of a representative cohort of New Zealand men who enlisted in World War I and survived the war, and asks

- Was short stature associated with premature mortality?
- Was being overweight associated with premature mortality?
- Was the relationship between height, weight and mortality in New Zealand similar to that found in nineteenth century cohorts in the United States?
- Is the historical relationship between height, weight and mortality similar to that found in modern studies?

## Background

People who are short, underweight, or overweight have a higher risk of early mortality. The etiology of the relationship differs:

**Short stature:** Being short as an adulthood may reflect periods of nutritional deprivation in the growth period. The stress of being undernourished scars the circulatory system, and makes individuals more likely to die of cardiovascular disease in particular.

**Underweight:** Individuals who are underweight (BMI < 20) may be suffering from cancer, or gastrointestinal diseases that increase the risk of subsequent mortality. Studies that adjust for disease exposure find “lean and healthy” individuals have lower mortality risk.

**Overweight:** Being overweight places a strain on the circulatory system and is associated with increased mortality from cardiovascular conditions and some cancers.

## Context

In the late nineteenth and early twentieth century New Zealand was a slightly healthier place than comparable countries. Infant mortality began to decline significantly in New Zealand in the 1880s, around the time that the cohort we study was born, suggesting a favorable public health environment. The cohort we study were eligible for free and universal primary schooling in the late nineteenth century, and were later covered by a single-payer health care system introduced in the 1930s. Per-capita income in New Zealand was high, but similar to that achieved in the United States.

Approximately half of the cohort of men born in New Zealand between 1885 and 1895 served in World War I. One in six of New Zealand men who served died in service between 1914 and 1919. Although New Zealand’s health environment was somewhat better than other English speaking countries, the country is broadly comparable to other developed countries.

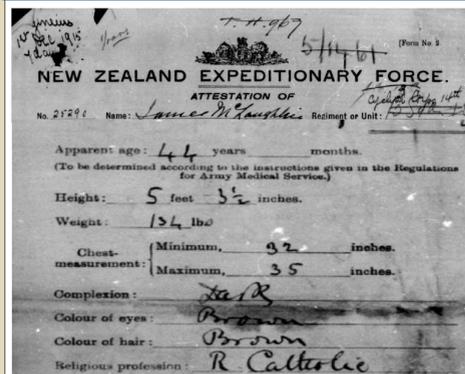
Low out-migration and a national system of death registration are critical in constructing a historical longitudinal panel.

### Life expectancy at birth in major English-speaking countries

Country	1870	1913	1950	1975
Australia	48.0	59.1	69.6	71.7
New Zealand	50.4*	61.4	69.6	71.7
Canada	42.6	52.5	69.1	73.1
United Kingdom	41.3	53.4	69.2	72.0
United States	44.0	51.6	69.0	71.3

\* 1876

## Data



Our data comes from a sample of New Zealand men who served in World War I, linked to birth and death certificates.

Military enlistment papers provide information on terminal stature and body mass in early adulthood. Birth and death certificates provide accurate information on lifespan and cause of death.

## Results

We selected a group of 2539 men to be linked from military enlistment papers to their birth and death certificates. This group included all of the indigenous Māori men in the original sample of military records. Pākehā (European origin) men were stratified by occupation to ensure a balanced mix of rural and urban backgrounds.

We achieved a high rate of links to birth and death certificates for the Pākehā men, but a low rate for Māori. Compulsory vital registration for Māori did not begin until around World War I. There is evidence from other sources of higher name variation across the life course among Māori men.

### Composition of linked sample

	Not in linked sample		Linked		Failed link		Link rate
	No.	%	No.	%	No.	%	
Pākehā							
Farm	5,086	26.3%	860	45.9%	232	34.9%	<b>78.8%</b>
Non-farm	13,912	71.8%	859	45.8%	275	41.4%	<b>75.7%</b>
Māori							
Farm	153	0.8%	70	3.7%	66	9.9%	<b>51.5%</b>
Non-farm	215	1.1%	86	4.6%	91	13.7%	<b>48.6%</b>
Total	19,366	100.0%	1,875	100.0%	664	100.0%	<b>73.8%</b>

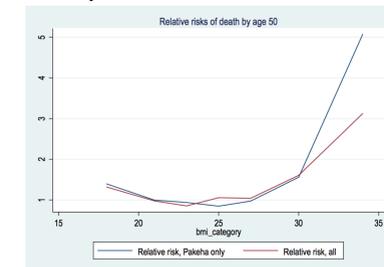
Mean body mass index for Pākehā men was in the middle of the normal range (20-25). On average Māori men were substantially heavier at enlistment, showing that modern ethnic disparities in obesity in New Zealand are long-standing. We do not observe substantial differences in body mass or height conditional between men successfully linked to vital records and those lost to follow-up.

### Mean body mass index by ethnicity and occupation

Linking success	Pākehā		Māori	
	Farm	Non-farm	Farm	Non-farm
Not in linked sample	22.92 0.03	22.70 0.02	24.57 0.21	24.04 0.16
Linked	22.80 0.08	22.53 0.08	24.27 0.34	24.13 0.23
Failed link attempt	23.08 0.16	22.88 0.16	24.54 0.31	24.45 0.32

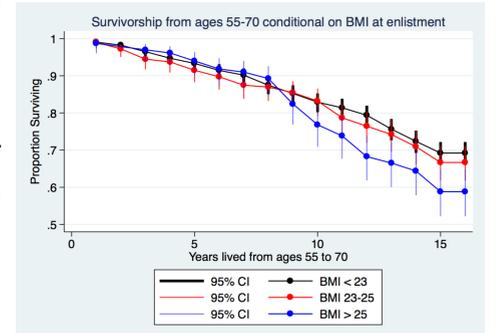
## Results

**Weight doesn’t kill you immediately, but it might kill you eventually:** Consistent with the results obtained in modern research and two other studies of cohorts born in the nineteenth century we find that being overweight in early adulthood is associated with earlier mortality.



The relative risk of death before age 50 rose sharply for men enlisting with a BMI over 27 (moderately overweight). Unlike other historical studies we find only small rises in mortality risk for underweight men. This may reflect a superior public health environment in New Zealand.

Although the relative risk of mortality before 50 was high for overweight men, the absolute numbers were small. Consistent with modern research we also observed that the relative risk of being overweight diminished in the very old.



Conditional on surviving to 55, we observed significant differences in the survival experience to age 70 of overweight men. These differences began to emerge when men were in their mid-60s.

We observed no significant differences in survival and life expectancy for men of different stature.

## Conclusion

Our results support research in the modern era that being overweight is an important risk factor for mortality. Our estimates of the hazard of mortality show that overweight and obese men had a chance of dying before age 70 that was more than half as great again as men of normal weight. These results were robust to controlling for social and economic background and lend support to the hypothesis that the mortality risk of being overweight has not changed substantially in the past century.