

The Long-run Decline and Rise of Canadian Stature

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A progressive decline of physical stature among Canadians born in the nineteenth century gave way to rising heights in the twentieth century. Stature varied regionally within Canada; the Quebec population was especially short. Nevertheless, each of the Canadian regions appears to have followed a similar long-run trajectory of declining and then rising height.

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Introduction

For many countries the historical experience of physical well-being provides a useful complement to other evidence of the changing standard of living. Net nutrition, or nutrition after allowing for losses through work, climate and disease, is a central concept to the study of physical well-being over the long-term. The analysis of net nutrition is complicated because it reflects individual choices about work, consumption and where to live as well as the broader socio-economic constraints such as income, the relative price of different foods, the provision of public health services and other factors that shape disease exposure including, at its most basic, population density. Nevertheless, we have considerable evidence over a wide range of income levels and in different cultures that improvements in net nutrition will produce taller people who live longer and are healthier in most respects. (Komlos 1994; Komlos 1995; Steckel 1995; Steckel and Floud 1997).

During the twentieth century, in much of the world, measures of physical well-being such as stature and mortality improved more or less together with income, wages, consumption and other socio-economic indicators (Bielicki 1986; Fogel et al 1983; Van Wieringen 1986). The nineteenth century patterns appear to have been more complex, although admittedly our understanding is limited by the availability of evidence. Military and prison records are commonly examined for evidence of physical characteristics such as height and weight. Such sources indicate that for at least part of the nineteenth century physical stature declined in a number of other countries and it did so, surprisingly, in spite of rising incomes. The explanation for this complexity is generally agreed to lie in the patterns of industrialization and market integration that increased inequality, disease exposure and the relative price of food (Costa and Steckel 1997; Fogel 1986; Haines 2004; Komlos 1996).

The participation of Canadians in these broad trends is relatively well-documented for the twentieth century. Research by human biologists, demographers and health scientists makes clear that, with the possible exception of aboriginal communities, stature increased and mortality diminished more or less steadily throughout the twentieth century. We review this research in the next section of the paper. In a subsequent section we provide a preliminary report on our attempt to ascertain the physical stature of Canadians born during the nineteenth century. We draw evidence from four sources: (i) records of the Canadian-born who enlisted in the Union Army, (ii) military personnel who served in the Canadian regiments of the South African War, (iii) men who served in the Canadian Expeditionary Forces during the 1914-1918 War and (iv) admission records to federal penitentiaries. The evidence remains preliminary because sample size is small for the Union Army, and data entry is incomplete for the prison and WWI records. Nevertheless, something of a pattern is beginning to emerge.

The evidence collected to date provides a clear indication that average height of the Canadian-born diminished during the second half of the nineteenth century. Canadians from some lower-

income parts of the country were only slightly shorter than those from higher-income regions although the Quebec population was especially short. As best we can tell, the stature of Canadians born in various parts of the country followed parallel trajectories with some convergence during the twentieth century. The weight of evidence suggests that at some point Canadians experienced a reversal of nineteenth century trends and hence a 'U-shaped' long-run pattern in stature and physical well-being. In a final section of the paper we provide preliminary interpretative comments and attempt to frame several issues that will be of interest for future analysis.

The Twentieth Century Experience

The earliest known benchmark study of physical stature in Canada population is a survey of Toronto school children organized by the anthropologist Frans Boas during the 1891-1892 school year (Boas 1895, 1898). These data may be compared with studies of Toronto schoolchildren undertaken on somewhat similar principles in 1923 and 1939 (Keyfitz 1942). The three surveys are large enough (13,000 observations in 1892, rising to 59,000 in 1923 and 78,000 in 1939) to identify differences between benchmark years with some precision.

Meredith and Meredith (1944) use the data to show that median height was roughly 6% greater in 1939 than in 1892 for both girls and boys at all ages (possibly excepting 14 year-olds girls due to small sample imprecision). The increase may be slightly exaggerated because the 1892 study excluded parochial school children who were slightly shorter, but this effect is too small to threaten the trend (Keyfitz 1941, p. 26). The 25th and 75th percentile heights moved in a way that suggests an increase in inequality in height for boys although not for girls from 1892 to 1939.

Keyfitz (1942) shows in some detail that from 1923 to 1939 the entire distribution of heights shifted to the right, for all ages. For example, nine year old boys and girls were, on average, 3% taller in 1939 than in 1923. Among fourteen year-olds the average increase was 3.4% for boys and 2.3% for girls. The cohort born during the 1920s was at most ages, roughly 3% taller than those born in the years preceding World War One. The three Toronto surveys, taken together, make clear that children born in the 1920s, despite the stress of growing up during the great depression, were taller than those born immediately before World War One, who in turn were taller than those born in the 1880s.

Other studies of individual communities or particular populations reinforce the impression of secular growth. Twenty-year old University of Toronto students born 1912-1915 were 11% taller than those born in 1906; seventeen year-old students born during the War were 20% taller than those born in 1908 (Allan 1939). Ottawa public school children were slightly taller in 1943-45 than in 1933-35 (Hopkins 1947). Children in London 1969, Montreal 1970 and Toronto 1974-76 were taller than those in the 1939 Toronto study (Demirjian, Jenicek and Dubuc 1972; Farkus and Wood 1982; Stennett and Cram 1970). Small samples, shifting locations and minor variations in research design may reduce confidence in individual comparisons but the cumulative significance of the various studies taken together is clear.

The strongest evidence for increasing stature in the first half of the century comes from adults examined in the 1953 National Weight-Height Survey, a national sample of 22,000 people designed to be representative on the basis of the 1951 census (Pett and Ogilvie 1956, 1957; Pett

1955). Stoudt et al (1965, p. 3) refer to this Canadian study as “probably the first adequate sampling survey of a national population” anywhere in the world. Published reports from the 1953 survey, reproduced in our Table 1, indicate that adult men born 1923-27 were taller on average than those born 1918-22, who were taller than the 1908-1917 birth cohort, who in turn were taller than those born 1898-1907 (Pett and Ogilvie 1956, 1957). Women became taller in comparable fashion except, surprisingly, that the 1923-27 cohort was slightly shorter than the group born five years earlier.

A second national survey with sampling informed by the 1961 census was undertaken from October 1970 to October 1972 (Demirjian 1980). Men and women of all ages were found to be taller than their counterparts two decades earlier. Within the new sample, adults born in the 1940s (aged 20-29 in 1971) were taller than those born in the 1930s, who in turn were taller than those born in the 1920s (Table 1). The data reveal a progressive increase in adult stature for both men and women, and within each of three income classes (Demirjian 1980, p. 20-21, 133).

The 1953 and 1970-72 surveys command more confidence than a comparison of local studies organized on slightly different principles and, in some cases, with limited observations. Moreover, the national surveys describe final adult stature rather than children who are still growing and may yet compensate for early difficulties with a late adolescent catching up (Tanner 1978, chs. 9, 10). The 1953 and 1970-72 surveys share one weakness with most other studies insofar as they do not distinguish birthplace. Although a minor consideration in the face of a strong secular increase in stature, the lack of birthplace detail in a country that has seen major waves of immigration is disappointing.

A number of nutrition and health surveys provide evidence of the continuing growth of average stature from the 1970s to the 1990s (Torrance, Hooper and Reeder 2002). Access to the underlying microdata from the 2000 Canadian Community Health Survey permits direct examination of the Canadian-born, reported in Table 1. Final height for those born in the 1970s was greater than that of Canadians born during the 1960s, who in turn were taller than those born in the 1950s. For these decades, at least, we confirm that the experience of the Canadian-born closely paralleled that of Canadian residents. The most recent National Public Health surveys hint at an end during the 1990s to the era of secular increase but there has yet to be a systematic cohort-based investigation of a possible plateau in Canadian stature (Katzmarzyk 2002). On balance, there seems little reason to disagree with Hoppa and Gairlie (1998) who characterize the twentieth century experience as a one long secular increase.

The enormity of secular increase does not deny that regional differences in stature within Canada have been significant. Most studies find that western Canadians have been taller, on average, than eastern Canadians. Within the east, stature is greatest in Ontario and least in Quebec (Pett and Ogilvie 1957, p. 30; Best and Doughty 1963; Demirjian, Jenicek and Dubuc 1972; Jetté 1980; Shephard et al, 1984). Of course, a steady national trend increase with a constant or slowly diminishing pattern of regional inequality does not rule out the possibility of a different experience in particular subpopulations or communities.

Rural communities, for example, appear to have been characterized by smaller stature during the third quarter of the twentieth century (Rajic et al 1978; Shephard et al 1984; Tanner 1978, p. 144;

Thibault et al 1985). Since rural people undoubtedly were taller in the nineteenth century, this observation implies a smaller secular increase in rural heights.

The experience of some aboriginal communities also may have followed a different pattern. A series of surveys undertaken in the high Arctic community of Igloolik during 1969/70, 1979/80 and 1989/90 show that adult stature diminished by birth decade from the 1930s to the 1960s for men and from the 1940s to the 1960s for women (Rhode and Shephard 1984a, 1984b, 1994a, 1994b). The decline may have lost momentum by the 1980s, judging by an apparent increase in age-specific heights for children during that decade.

In another community, Moose Bay, mortality risk increased from 1851-1906 to 1914-1945 before falling again after World War Two (Hoppa 1998). Mortality is of interest because it responds to some of the same influences as does stature, including nutrition for children and adolescents, disease exposure, public health infrastructure and population inequality (Haines and Steckel 2000; Haines, Craig and Weiss 2003). Hoppa (1988) explains heightened mortality during the war and interwar period in Moose Bay as a consequence of nutrition deterioration as fur trade income declined, the Hudson's Bay Company withdrawal of medical services before government programs became available and epidemic-like mortality peaks during the war.

In contrast, for most Canadians mortality risk has diminished more or less continuously since the early decades of the twentieth century. Compulsory birth and death registration provides a relatively precise understanding of the secular decline in age-specific mortality risk since the 1920s (Bourbeau, Légaré and Émond 1997; Canada 1993; Canada 1994; McInnis 2000c). Indeed, mortality appears to have been declining as early as the 1880s in one small Ontario town (Emery 1993 ch. 3; Emery and McQuillan 1988). On the other hand, parishes on the west coast of Cape Breton saw no change in infant mortality from the early 1870s to the late 1890s (Wagg 1996, ch. 4). During the same period birth weight declined in a Montreal hospital and infant mortality increased in Montreal and Ottawa (Mercier and Boone 2002; Thornton and Olson 2001; Ward and Ward 1984). Hospital records and municipal Board of Health reports from Toronto and Montreal suggest that the deterioration continued a few years into the twentieth century (Canada 1993; Turmel et Hamelin 1995; Ward and Ward 1984).

In the absence of additional information there seems no reason to disagree with McInnis' speculation that infant mortality in Canada did not begin to improve generally until after 1900 (McInnis 2000a; McInnis 2000b). It is useful, however, to recognize the possibility of distinctive patterns for individual regions and sub-populations. The considerable variation between urban and rural environments and among cities and provinces, when data become available, raises the possibility that infant mortality may have begun to decline earlier in rural and small-town Ontario, and somewhat later in large cities and rural Quebec and Nova Scotia.

Evidence of the Nineteenth-Century Experience

A near-total lack of evidence for mortality in nineteenth century Canada reinforces interest in the experience of stature, since it is the only indicator we are likely ever to have for the physical standard of living before 1900. A preliminary examination of Northwest Police recruiting files show an increase in height from the 1870s to the end of the century (Dick 1995). This optimistic view, however, is not easily reconciled with the mortality evidence cited above. Admittedly, our

understanding of both stature and mortality is limited. The strongest evidence for a deterioration of well-being comes from a single city, Montreal, which although important may have been atypical within Canada. The strongest evidence of improvements comes from police medical and application files. Most of these files do not indicate birth-place; some of them reveal neither age nor birthdate (Appendix 1.5). Hence it is impossible to isolate the Canadian-born or to organize the data by birth cohort. Moreover the Northwest Police, a mounted police force, maintained a minimum height requirement that was so high (5 feet and 8 inches) as to make sample truncation a very serious problem. On both sides of the debate, then, the evidence brought forward to date is valuable but limited. Not surprisingly we lack a clear picture of nineteenth century Canada.

The search for additional evidence takes us to military enlistment and prison admission records. The available data are summarized in tables 1 and 2 and in greater detail in the appendices. We organize the data to compare mean and median stature for successive birth cohorts. Komlos argues that this relatively simple method yields the most reliable depiction of trend providing that any truncation is applied consistently to all of the data (Komlos 2005; Komlos and Kim 1990). The caveat requires some attention since some people were exempted from the minimum height requirement (63 inches) of the Canadian forces during World War One. We do not know the extent of shortfall, although it is likely that exceptions became more frequent as the war advanced. The only way to obtain a consistent sample from the World War One data is to ignore all observations below 63 inches.

We confine our attention to people from 21 to 49 years, since adult height is relatively stable over this interval (Sorkin, Muller and Andres 1999a, 1999b). We do not mingle data from different sources because of possible inconsistency arising from different recruiting practice and measurement methodology. Changing labour market conditions also have the capacity to alter sample characteristics from one source to another (Mokyr and O Grada 1994). In our case, we know that recruiting for World War One began during a serious recession in contrast to the buoyant labour market conditions that coincided with the onset of the South African War. Even more important, recruiting for the Canadian Expeditionary Forces in World War One penetrated deeply into all corners of Canadian society, while the South African War enlistment was much smaller and dominated by the middle classes (Miller 1975).

The earliest records available to us describe Canadian-born who entered the Union Army during the Civil War. Slightly greater than 3% of the 35570 Union Army veterans examined by Robert Fogel and collaborators were born in Canada (Fogel et al). Extrapolation to the entire Union Army would suggest that 80,000 or more Canadian records potentially could be available from a thorough search of all Union Army records.

Some of these Canadian recruits were the children of American immigrants in Canada, while others had migrated south before the war or had cross-border business interests. For many the motivation for enlistment would have been some combination of adventure, money, ideals or simply being tricked (Belanger 2001; Hoy 2004; Raney 1923; Winks 1958). On balance there seems no reason to doubt that the Canadians who enlisted in the Union Army were reasonably representative of young males of their generation. Even if some characteristics are represented disproportionately, the evidence might still be informative as long as the bias operated consistently for those born earlier and later.

We summarize in Table 1 the records of Canadians in the Union Army. Their principal limitation is simply the small number of observations collected as a byproduct of the American project. Although sample size is small, it is sufficient to suggest a decline in Canadian adult height from those born before 1830 to those born in the 1830s to those born during the 1840s. We cannot analyze or even describe this small sample at a level of detail comparable to that of the American studies, but the broad pattern of declining Canadian height roughly follows the experience of the American-born during the second quarter of the nineteenth century (Craig, Haines and Weiss 2003).

Men born from the 1850s to the early 1880s are represented in our next source, medical and personnel records of men who served in the South African War 1899-1902 (Appendix 1.2). Roughly 5100 of these records contain minimal information needed for analysis; more than four-fifths of these soldiers were born in Canada. The South African War volunteers probably were not typical of the Canadian population. Some of the units were mounted and for this reason would have sought taller men (Miller 1993). Indeed, experienced horsemen were likely to come disproportionately from rural areas that *ceteris paribus* were characterized by greater height. Moreover, an analysis of the occupational status of volunteers before enlistment suggests that they came disproportionately from the middle and upper classes (Miller 1975).

Nevertheless, to the extent these or any other biases operated similarly for those born earlier and later, the South African records may be useful. Preliminary tabulations support the view that mean and median heights were greater for those born during the 1860s than those born during the 1870s, and the latter were taller than the 1880s cohort. There is no reason to doubt the broad impression of declining height in successive cohorts of volunteers for the Canadian units in the South African War.

Further evidence comes from the medical examinations of men who entered the Canadian Expeditionary Forces during the World War One (Appendix 1.3). Large numbers of Canadians volunteered for this conflict. The sheer volume of enlistment, more than 700,000 people, makes it likely that military personnel in this conflict were broadly representative of the Canadian population. No known selection bias affects these data aside from a 5 foot 3 inch minimum height requirement.

To date we have made available for analysis about 7100 records from the 1914-1918 enlistments. Of these about 4500 were between 21 and 50 years old and over 63 inches tall. About half of these men were born in Canada (appendix table 3f). Further data entry is ongoing, but already the sample has begun to suggest a familiar pattern. The summary data reported in Table 1 indicate that height declined from the 1870s and 1880s cohorts to those born in the 1890s.

Our final evidence is taken from Kingston Penitentiary Prisoner Records Book. Prison records may over-represent the working classes and the poor, but they have the great advantage of being collected without regard to a minimum height restriction. These data are particularly valuable because they permit confirmation of trends otherwise only visible subject to the truncation of military records. The prison records also provide evidence of female stature and provide information about decades not well covered by military enlistment in the periodic conflicts.

Trial data entry for 18 months during 1880 and 1881 yields roughly 300 observations (Appendix 1.5). Because numbers are small, we divide into two groups of roughly equal size the men born in Ontario and aged 21-50 at the time of incarceration and therefore measurement. The group born 1834-1854 averaged 67.9 inches while the 1855-1860 group averaged 67.7 inches in height. Clearly more data entry is needed, but for the moment at least we can say that the evidence of prison populations is broadly consistent with that of military enlistment.

Discussion

We do not mingle data from the Civil War, South African War and World War One and from the Kingston Penitentiary. Each enlistment experience was distinctive. To the extent that we may identify or suspect selection biases, they differ among the four groups. Within each set of data, however, we find some evidence of a decline in heights through successive decadal cohorts. Cumulatively, the evidence directs us to consider the possibility of a continuous decline in the stature of the Canadian-born throughout the nineteenth century. Larger data sets are needed to confirm the trend and to isolate any fluctuations in response to transitional economic cycles. If our preliminary finding survives the addition of further evidence, nineteenth-century Canada would join the list of populations in which biological and economic indicators diverged during the nineteenth century.

In contrast, our review of the earlier studies makes clear that Canadian experience during the twentieth century was one of continuous or near-continuous rising heights, albeit with regional differences. With the possible exceptions of aboriginal communities (which clearly require more study), the biological and economic indicators would seem to have moved in the same direction. The broad parallel between biological and economic indicators does not extend to cyclical fluctuations since, as best we can tell, the economic setback of the Great Depression had no lasting impact on stature. In fact it is difficult to see even a transitional effect of the depression on heights.

The Canadian evidence of secular decline and then rise of stature suggests a process not unlike that of the United States (Costa and Steckel 1997; Haines 2004; Haines and Steckel 2000; Steckel 1994; Steckel and Haurin 1994). Analysis of the American experience has focused on the effects of urbanization, increasing rural population density, sectoral redistribution, a changing relative price of food figure, and a broad correlation with patterns of infant mortality (Costa and Steckel 1997; Haines 2004; Haines, Craig and Weiss 2003; Komlos 1987, 1996). Growth and industrialization may have been less intense and income levels lower in Canada, but the basic patterns of economic development do not seem to have differed greatly north and south of the border (Green and Urquhart 1993). Perhaps not surprisingly, there also appears to be a broad similarity in the experience of physical well-being.

One useful addition to this research will be to consider whether the national average data reflect the experience of individual regions within Canada. The large size and diverse regional economies of Canada recommend a regionally disaggregated approach. We summarize in Table 2 regional evidence of stature from the same sources as are reported in Table 1. Our 'regions' here are Ontario, Quebec and the maritime or Atlantic coastal provinces (Nova Scotia, New Brunswick, Prince Edward Island). Sample size does not permit consideration at the present time of those born in western Canada.

The regional evidence from both wars suggests that in the nineteenth century men born in the low-income Maritime region were as tall as those born in Ontario. We have not yet investigated if men in comparable occupations enlisted in each region. In the interim, however, the rough equivalency of height is remarkable because average incomes were significantly lower in the Atlantic coastal region (Green 1971; Inwood and Irwin 2002). One explanation for the ‘tall but poor’ paradox, borrowing a phrase from Nicholas and Steckel (1997), is the offsetting influence of two contrary forces. Individual incomes were lower in the Maritimes, but so too were population densities. The lower level of rural population density and the smaller size of cities and towns would have reduced exposure to disease for Maritime men regardless of income level.

In the nineteenth as in the twentieth century we see that the Quebec population was particularly short. Higher levels of rural population density and the unhealthy urban environment in Montréal and Quebec City may help to explain why Quebec-born military personnel were the shortest, even though incomes in that province were higher on average than those of the Maritime region. Another possible influence is the extent of inequality within Quebec. This might conceal within the provincial average relatively more men at very low incomes who would have been at greater risk of nutritional stress.

The data in Table 2 also reveal that the experience of declining heights is replicated within each of the three regions. Although regions differed significantly, height in each of them appears to have declined. Hence there is no evidence that the pattern visible in Table 1 is an artifact produced by changing regional composition. Individual regions within Canada apparently differed in complex and important ways that invite further investigation, but nonetheless they shared a common experience of declining stature.

The long-run pattern of Canadian physical stature, if confirmed by the addition of more data, directs attention at several research questions. What is the precise timing of the turnaround from secular decline to secular increase? To what extent does the Canadian shift from falling to rising stature coincide with experience elsewhere? If as seems possible the timing of turnaround is broadly similar in different countries, does this imply that broad international forces were at work? Or, alternately, does the timing reflect local influences such as the Canadian ‘wheat boom’ growth spurt? Similar questions may be asked within Canada. Is the timing of change more or less the same in all regions and, regardless of the answer to this question, what can we learn from it? To the extent that stature varied regionally within Canada, how do we explain the differences? Is the evidence of mortality change sufficient to corroborate the presumed correlation between stature and mortality? Finally, how do we explain the at least partial divergence of economic and biological indicators, and what are the implications for our understanding of the well-being of Canadians in the long-run?

Table 1: Stature (inches) of Canadian Adults, by birth, 1820s to 1970s

	N	Mean	Median	Std Dev
I. Canadian-born soldiers, Union Army, aged 21-49				
born 1800-29	174	67.9	67.5	2.77
“ 1830s	400	67.5	67.5	2.63
“ 1840s	253	67.2	67.0	2.56
II. Canadian-born soldiers, South African War, aged 21-49				
born 1850s	1	71.3	71.3	-
“ 1860s	235	68.5	68.5	2.13
“ 1870s	1936	68.2	68.0	2.01
“ 1880s	530	67.5	67.5	1.88
III. Canadian-born soldiers, 1914-1918 War, aged 21-49, 63” and taller				
born 1860s	7	66.7	66.0	2.69
“ 1870s	185	67.4	67.0	2.38
“ 1880s	601	67.4	67.3	2.31
“ 1890s	1358	67.1	67.0	2.33
“ 1900s	1	71.0	71.0	-
IV. Canadian males, 1953 Canadian Height-Weight Survey, aged 20-54				
born 1898-1907	446	66.9	66.8	
born 1908-1917	624	67.5	67.6	
born 1918-1922	303	68.0	68.1	
born 1923-1927	220	68.3	68.3	
born 1928-1932	244	67.9	68.3	
V. Canadian females, 1953 Canadian Height-Weight Survey, aged 20-54				
born 1898-1907	506	61.8	61.8	
born 1908-1917	796	62.4	62.4	
born 1918-1922	393	62.8	62.6	
born 1923-1927	399	62.7	62.6	
born 1928-1932	331	62.8	62.9	
VI. Canadian males, 1970-1972 Canadian Nutrition Survey, aged 20-49				
born 1921-1930	550	67.5	67.7	3.24
born 1931-1940	494	68.0	68.1	2.95
born 1941-1950	531	68.8	68.8	3.11
VII. Canadian females, 1970-1972 Canadian Nutrition Survey, aged 20-49				
born 1921-1930	731	62.6	62.6	2.71
born 1931-1940	679	63.0	63.1	3.23
born 1941-1950	683	63.0	63.1	2.44
VIII. Canadian males, 2000 Canadian Community Health Survey, aged 20 +				
born 1950s	10208	69.7	70.0	2.94

“ 1960s	9143	70.2	70.0	3.01
“ 1970s	6694	70.6	70.0	3.09

Sources:

I. Union Army: Center for Population Economics, University of Chicago, Union Army Military, Pension and Medical Records, Life-Cycle Datasets, National Institute of Aging Project #PO1 AG10120

II. South African War: National Archives of Canada, Record Group 38 (Veteran Affairs), Boer War Personnel Records, 1899-1902

III. 1914-1918 War: National Archives of Canada, Record Group 150 (Overseas Military Forces), Canadian Expeditionary Force, 1914-1920

IV-V. L. B. Pett and G.F. Ogilvie, “The Canadian Weight-Height Survey”, Human Biology 28 (1956), pp. 177-188 and “The Report on Canadian Average Weights, Heights and Skinfolts”, Canadian Bulletin of Nutrition 5 (1957), pp. 1-81.

VI-VII. A. Demirjian, Anthropometry Report (Ottawa: Nutrition Canada, 1980).

VIII. Statistics Canada, Canadian Community Health Survey, 2000. No adjustment is made for shrinkage at ages above 40. The data remain approximate because the public use file summarizes in one category everyone 72” or higher. Direct access to the CCHS masterfile would permit a focus on 21 rather than 20 years +, the full 72+ distribution. Currently permission is being sought to access the masterfile.

Table 2: Mean Stature of Canadian-born Soldiers, by Region and Birth Decade

	Maritimes	Quebec	Ontario
South African War			
born 1860s	68.6 (n=38)	67.7 (35)	68.6 (144)
“ 1870s	68.2 (297)	67.7 (213)	68.3 (1158)
“ 1880s	67.5 (144)	66.8 (61)	67.5 (276)
1914-1918 War			
born 1860s	66.0 (n=1)	66.8 (3)	67.6 (2)
“ 1870s	68.0 (31)	66.8 (41)	67.4 (105)
“ 1880s	67.2 (120)	66.8 (122)	67.4 (313)
“ 1890s	67.3 (259)	66.2 (368)	67.3 (594)
“ 1990s	71.0 (1)		

notes:

- heights are measured in inches
- the sources for this table are the same as Table 1.
- included in this table are all men between 21 and 49 years of age

- we include all regions with more than 30 observations in at least two decades
- sample size is reported in parentheses
- 1914-1918 war records are for those 63” and taller

References

John Allan, “Some Observations Concerning the Stature of Freshman Entering the University of Toronto, Canada”, Man 156-157 (August 1939), pp. 123-126.

Damien-Claude Bélanger, Franco-Americans in the Civil War Era (1861-1865) (Montreal: Études sur l’histoire des relations canado-américaines/Studies in the History of Canadian-American Relations, 2001).

E.W. Best and J.H. Doughty, “Charts for Recording Heights and Weights of Children”, Canadian Journal of Public Health 54 (1963), pp. 67-72.

Tadeusz Bielicki, “Physical Growth as a Measure of the Economic Well-Being of Populations: The Twentieth century”, pp. 283-306 in F. Falkner and J.M. Tanner, eds, Human Growth, vol. III (New York: Plenum Press, 1986 2nd ed.).

Frans Boas, “The Growth of First-Born Children”, Science ns 1 n15 (Apr. 12 1895), pp. 402-404.

Frans Boas, “The Growth of Toronto Children”, pp. 1541-1599 in Report of the Commissioner of Education for 1896-96 (Washington: GPO, 1898)

Robert Bourbeau, Jacques Légaré and Valérie Émond, New Birth Cohort Life Tables for Canada and Quebec, 1801-1991 (Ottawa: Statistics Canada, 1997).

Canada, Statistics Canada, Selected Infant Mortality and Related Statistics, 1921-1990 (Ottawa: Statistics Canada, 1993 DBS 82-549)

Canada, Statistics Canada, Selected Mortality Statistics, 1921-1990 (Ottawa: Statistics Canada, 1994 DBS 82-548)

Canada, Statistics Canada, Canadian Community Health Survey, 2000.

Dora Costa and Richard H. Steckel, “Long-Term Trends in Health, Welfare and Economic Growth in the United States”, pp. 47-90 in Richard H. Steckel and Roderick H. Floud, eds., Health and Welfare during Industrialization (Chicago: University of Chicago Press, 1997).

A. Demirjian, Anthropometry Report (Ottawa: Nutrition Canada, 1980).

A. Demirjian, M. Jenicek and M.B. Dubuc, “Les norms stature-pondérales de l’enfant urbain canadien francais d’âge scolaire”, Canadian Journal of Public Health 63 (1972), pp. 14-30).

Trevor Dick. "Heights, Nutrition and Per Capita Income: Canada", pp. 123-132 in John Komlos, ed., The Biological Standard of Living on Three Continents (Boulder: Westview, 1995).

Christine de Souza, "Height, Health and Living Standards of Australian Men, 1861-1902", MCommerce thesis, University of Melbourne, 1994

George Emery, Facts of Life: The Social Construction of Vital Statistics, Ontario, 1869-1952 (Kingston and Montreal: McGill-Queen University Press, 1993).

George Emery and Kevin McQuillan, "A Case Study Approach To Ontario Mortality History: The Example of Ingersoll, 1881-1971", Canadian Studies in Population 15 n2 (1988), pp. 135-158.

I.G. Farkus and M.M. Wood, "Height and Weight in Caucasian School Children in Central Canada", Canadian Journal of Public Health 73 (1982), pp. 328-334.

R.W. Fogel, Stanley L. Engerman, Roderick Floud, Gerald Friedman, Robert A. Margo, Kenneth Sokoloff, Richard H. Steckel, James T. Trussell, Georgia Villaflor and Kenneth W. Wachter, "Secular Changes in American and British Stature and Nutrition", Journal of Interdisciplinary History 14 (1983), pp. 445-481.

"Physical Growth as a Measure of the Economic Well-Being of Populations", pp. 263-281 in F. Falkner and J.M. Tanner, eds, Human Growth, vol. III (New York: Plenum Press, 1986 2nd ed.).

R.W. Fogel et al, Union Army Military, Pension and Medical Records, Life-Cycle Datasets, National Institute of Health Project #PO1 AG10120, Center for Population Economics, University of Chicago

Alan Green, Regional Aspects of Canada's Economic Growth (Toronto: University of Toronto Press, 1971).

Alan Green and M.C. Urquhart, "Estimates of Output Growth in Canada: Measurement and Interpretation," pp. 158-176 in Perspectives on Canadian Economic History, 2nd edition, edited by Doug McCalla and Michael Huberman, (Toronto: Copp Clark, 1993).

J.W. Hopkins, "Height and Weight of Ottawa Elementary School Children of Two Socio-Economic Strata", Human Biology 19 (1947), pp. 68-82

Michael R. Haines, "Growing Incomes, Shrinking People: Can Economic Development Be Hazardous To Your Health", Social Science History 28 n.2 (summer 2004), pp. 249-270.

Michael R. Haines, Lee A. Craig, and Thomas Weiss, "The Short and the Dead: Nutrition, Mortality and the 'Antebellum Puzzle' in the United States", Journal of Economic History 63 n.2 (June 2003), pp. 382-413.

Michael R. Haines and Richard H. Steckel, "Childhood Mortality and Nutritional Status as Indicators of the Standard of Living: Evidence from World War I Recruits in the United States", Jahrbuch für Wirtschafts Geschichte (2000, No. 1), 43-59.

Robert D. Hoppa, "Mortality in a Northern Ontario Fur-Trade Community, 1851-1964", Canadian Studies in Population 25 n2 (1998), pp. 175-198.

Robert D. Hoppa and T.N. Gairlie, "Secular Changes in the Growth of Toronto Children during the Last Century", Annals of Human Biology 25 n6 (1998), pp. 553-561.

Kris Inwood and Jim Irwin, "Land, Income and Regional Inequality: New Estimates of Provincial Incomes and Growth in Canada, 1871-1891", Acadiensis xxxi n2 (Spring 2002), pp. 157-184.

Maurice Jetté, "A Regional Analysis of Anthropometric Measurements in a Canadian Employee Population Study", Canadian Journal of Public Health 71 (1980), pp. 32-36.

Peter Katzmarzyk, "The Canadian Obesity Epidemic: An Historical Perspective", Obesity Research 10 n7 (July 2002), pp. 666-674.

Nathan Keyfitz, A Height and Survey of Toronto Elementary School Children 1939 (Ottawa: Ministry of Trade and Commerce, 1942).

John Komlos, "Anomalies in Economic History: Toward a Resolution of the Antebellum Puzzle", Journal of Economic History 56 n.1 (March 1996), pp. 202-214.

John Komlos, "The Height and Weight of West Point Cadets: Dietary Changes in Antebellum America", Journal of Economic History 47 n.4 (Dec. 1987), pp. 897-927

John Komlos, "How To (and How Not To) Analyze Deficient Height Samples", Historical Methods, forthcoming 2005.

John Komlos and Joo Han Kim. "Estimating Trends in Historical Heights", Historical Methods 23 (1990), pp. 116-120.

Marvin McInnis, "What Do We Know About the Fall of Infant Mortality in Canada", paper presented to the Canadian Historical Association (Quebec City, 2000a).

Marvin McInnis, "The Population of Canada in the Nineteenth Century," ch. 9 in Michael Haines and Richard Steckel, eds, A Population History of North America (New York: Cambridge University Press, 2000b).

Marvin McInnis, "Canada's Population in the Twentieth Century," ch. 12 in Michael Haines and Richard Steckel, eds, A Population History of North America (New York: Cambridge University Press, 2000c).

Michael Mercier and Christopher G Boone, "Infant Mortality in Ottawa, Canada, 1901: Assessing Cultural, Economic and Environmental Factors" Journal of Historical Geography 28 n4 (Oct. 2002). pp. 486-507.

Howard V. Meredith and E. Matilda Meredith, "The Stature of Toronto Children Half a Century Ago and Today", Human Biology 16 (1944), pp. 126-131.

Carman Miller, "A Preliminary Analysis of the Socio-Economic Composition of Canada's South Africa War Contingents", Histoire sociale/Social History Nov. 1975, pp. 219-237.

Carman Miller, Painting the Map Red: Canada and the South African War, 1899-1902 (Montreal: Canadian War Museum, 1993).

Joel Mokyr and Cormac O Grada, "The Heights of the British and the Irish c 1800-1815: Evidence from Recruits to the East India Company's Army", pp. 39-59 in John Komlos, ed., Stature, Living Standards and Economic Development (.Chicago: University of Chicago Press, 1994).

Stephen Nicholas and Richard H. Steckel, "Tall But Poor: Living Standards of Men and Women in Pre-Famine Ireland", Journal of European Economic History 26 n1 (Spring 1997), pp. 105-136.

L.B. Pett, "A Canadian Table of Average Weights for Height, Age and Sex", American Journal of Public Health 45 n7 (July 1955), pp. 862-868.

L. B. Pett and G.F. Ogilvie, "The Canadian Weight-Height Survey", Human Biology 28 (1956), pp. 177-188.

L.B. Pett and G.F. Ogilvie, "The Report on Canadian Average Weights, Heights and Skinfolts", Canadian Bulletin of Nutrition 5 (1957), pp. 1-81.

M.K. Rajic, H. Lavallée, R.J. Shephard, J.C. Jéquier, R. Labarre and C. Beaucage, "Height-Weight Comparisob of Canadian Schoolchildren", pp. 60-74 in R.J. Shephard and Huges Lavalée, eds., Physical Fitness Assessment (Springfield:Charles C. Thomas, 1978).

William F. Raney, "Recruiting and Crimping in Canada for the Northern Forces, 1861-1865", Mississippi Valley Historical Review 10 n1 (June 1923), pp. 21-33.

Andris Rhode and Roy J. Shephard, "Growth, Development and Acculturation: a Ten Year Comparison of Canadian Inuit Children", Human Biology 56 n2 (May 1984a), pp. 217-230.

Andris Rhode and Roy J. Shephard, "Ten Years of 'Civilization': Fitness of Canadian Inuit", Journal of the Applied Physiology 56 (1984b), pp. 1472-1477.

Andris Rhode and Roy J. Shephard, "Secular and Age Trends in the Height of Adults among a Canadian Inuit Community", Arctic Medical Research 53 n1 (January 1994a), pp. 18-24.

Andris Rhode and Roy J. Shephard, "Growth and Fitness of Canadian Inuit: Secular Trends, 1970-1990", American Journal of Human Biology 6 (1994b), pp. 525-541.

R.J. Shephard, H. Lavallée, R. LaBarre, M. Rajic, J.C. Jéquier and M. Volle, "Body Dimensions of Québécois Children", Annals of Human Biology 11 n3 (1984), pp. 242-252.

John D. Sorkin, Denis C. Muller and Reuben Andres, "Longitudinal Change in the Heights of Men and Women: Consequential Effects on Body Mass Index", Epidemiologic Reviews 21 n2 (1999a), pp. 247-260.

John D. Sorkin, Denis C. Muller and Reuben Andres, "Longitudinal Change in Height of Men and Women: Implications for Interpretation of Body Mass Index", American Journal of Epidemiology 150 n9 (1999b), pp. 969-977.

Richard H. Steckel, "Heights and Health in the United States, 1710-1950", pp. 153-172 in John Komlos, ed., Stature, Living Standards and Economic Development (Chicago: University of Chicago Press, 1994).

Richard H. Steckel, "Stature and the Standard of Living", Journal of Economic Literature 33 n4 (Dec. 1995), pp. 1903-1940.

Richard H. Steckel and Donald R. Haurin, "Health and Nutrition in the American Midwest: Evidence from the Height of National Guardsmen, 1850-1910", pp. 117-128 in John Komlos, ed., Stature, Living Standards and Economic Development (Chicago: University of Chicago Press, 1994).

R.G. Stennett and D.M. Cramp, "Cross-sectional, Percentile Height and Weight Norms for a Representative Sample of Urban, School-Aged, Ontario Children", Canadian Journal of Public Health 60 (1969), pp. 465-470.

H.W. Stoudt, H. Damon, A. McFarland and J. Roberts, Weight, Height and Selected Body Dimensions of Adults, United States, 1960-1962 (Public Health Service Publication 1000- series 11, no. 8 (Washington: GPO, 1965).

J. M. Tanner, Foetus in Man: Physical Growth from Conception to Maturity (Cambridge: Harvard University Press, 1978).

H.W. Thibault, L. LaPalme, R. Tanguay and A. Demirjian, "Anthropometric Differences between Rural and Urban French-Canadian Schoolchildren", Human Biology 57 n1 (Feb. 1985), pp. 113-129.

Patricia Thornton and Sherry Olson, "A Deadly Discrimination among Montreal Infants 1860-1900", Continuity and Change 18 n1 (May 2001), pp. 95-135.

G.M. Torrance, M.D. Hooper and B.A. Reeder, "Trends in Overweight and Obesity among Adults in Canada (1970-1992)", International Journal of Obesity 26 n2 (June 2002), pp. 797-804

André Turmel et Louise Hamelin, “La grande faucheuse d'enfants: la mortalité infantile depuis le tournant du siècle”, The Canadian Review of Sociology and Anthropology/ Revue canadienne de sociologie et d'anthropologie 32 n4 (1995), p. 439-463.

Phyllis Wagg, Families in Transition: Richmond County, Nova Scotia, 1871-1901. Dalhousie University, unpublished PhD dissertation, 1996.

Peter W. Ward and Patricia C. Ward, “Infant Birth Weight and Nutrition in Industrializing Montreal”, American Historical Review 89 (1984), pp. 324-345.

Robin Winks, “The Creation of a Myth: ‘Canadian’ Enlistments in the Northern Army during the Civil War”, Canadian Historical Review 39 n1 (1958), pp. 24-40.

J.C. van Wieringen, “Secular Growth Changes”, pp. 307-332 in F. Falkner and J.M. Tanner, eds, Human Growth, vol. III (New York: Plenum Press, 1986 2nd ed.).

Appendix: Information on the Stature of Canadians Born in the Nineteenth Century

1.1 United States Union Army Veteran Records

We base the summary tabulations in this paper on observations extracted from the Fogel et al sample (Source: Center for Population Economics, Union Army Military, Pension and Medical Records, Life-Cycle Datasets, National Institute of Aging Project #PO1 AG10120). Sample size remains small. Currently we are developing plans to add to the Fogel et al sample through a more intensive examination of the regiments which are most likely to have attracted significant numbers of the Canadian-born.

1.2 South African War Personnel Records

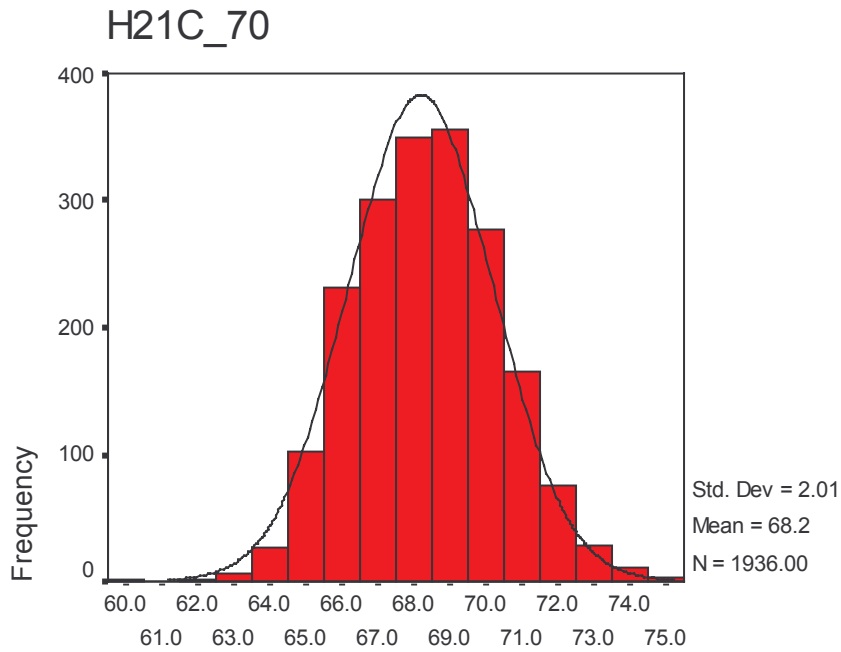
The Veteran Affairs Record Group in the National Archives of Canada holds personnel files for more than 7300 veterans of Canadian units which served in the South African War 1899-1902 (Record Group 38, South African War Records). Not every South African file has useful information. Files for those who died in service are missing. Files for those who transferred into the South African forces from other units have less information. A typical South African war record with useable information contains one or more of five kinds of documents: an attestation record, a medical summary, two other summary sheets that include medical as well as non-medical information and an ‘agreement’ (which includes a brief medical report). Overall, between 85% and 90% of the files have useful information on stature; many files record chest size and expansion while slightly more than half identify weight. Age (typically expressed in years and months) but not birthplace is recorded.

Minimum height restrictions probably applied but are not yet known. Indeed, they may have differed among the various forces from which some men transferred into the South African contingent. De Souza (1994, p. 77) reports that minimum height for two Australian contingents to the South African War was 66 inches; a third group had a 63 inch threshold. Australian

recruits were required to be good horsemen and have experience with bush life, which again would have reinforced the tendency for a high minimum stature. Nevertheless, for the Australian troops as for the Canadian, some men were able to enlist despite not meeting the height standard.

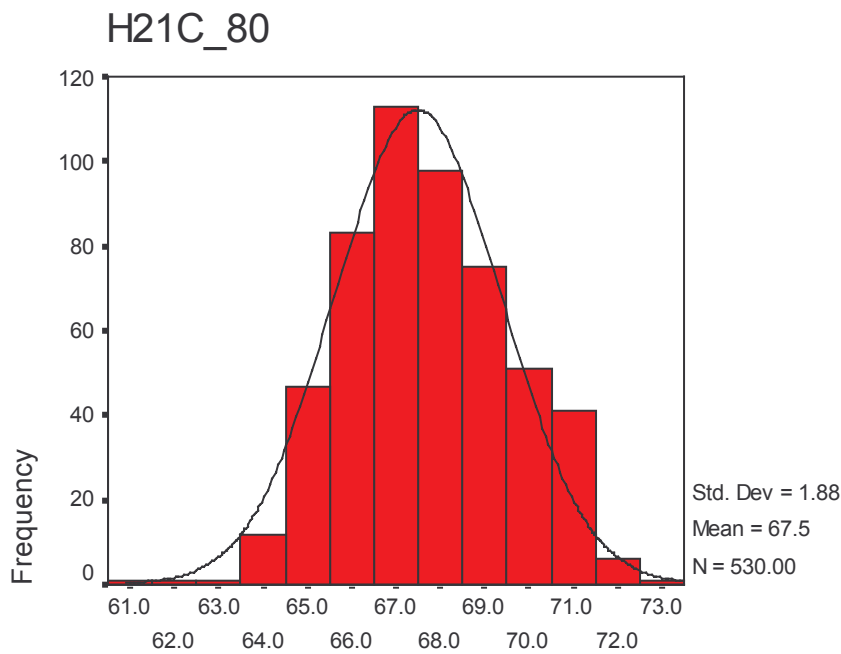
The shortest adult Canadian soldier encountered to date has 60 inches, although inspection of histograms suggest some truncation at a height of 63 inches. Not surprisingly, the height variable does not appear to be distributed normally. A test overall all data rejection of the null hypothesis of normally distributed heights (Table 2f). A Box-plot analysis shows a number of outliers pulling the distribution of heights to the right. The scattering of very tall people has no counterpart at the other end of the distribution. Mixed results are obtained when the data are examined by decade or country of birth. Histograms and fitted distributions for the adult Canadians born in the 1870s and 1880s are reported in Figures 1 and 2.

Figure 1: Histogram and distribution of heights for those >20 years and <50 of age, and who where born in Canada in the 1870s.



H21C_70

Figure 2: Histogram and distribution of heights for those >20 and <50 years of age, and who where born in Canada in the 1880s.



H21C_80

Appendix Table 2: Summary Statistics for South African War Personnel Records

Table 2a: Heights of Men between 21 and 49 Years, by Decade of Birth

Birth Decade	N	Mean	Median	Std. Deviation	Minimum	Maximum
1850s	13	68.9	69.5	2.12	65.75	73.00
1860s	543	68.6	68.5	2.11	63.00	75.50
1870s	3077	68.2	68.0	2.07	60.00	75.50
1880s	669	67.5	67.5	1.91	61.00	72.50
Total	4302	68.1	68.0	2.07	60.00	75.50

Table 2b: Heights of Men between 21 and 49 Years, by Birthplace

Country of Birth	N	Mean	Median	Std. Deviation	Minimum	Maximum
Canada	2736	68.1	68.0	2.03	60.00	75.50
England	957	67.9	68.0	2.09	63.00	75.50
Ireland	166	68.6	68.8	2.17	64.00	73.50
Scotland	184	68.2	68.0	2.04	62.50	74.75
US	90	68.4	68.5	1.99	64.00	75.00
Other	125	68.9	69.0	2.51	64.00	75.00
Total	4258	68.1	68.0	2.07	60.00	75.50

Table 2c: Heights of Men between 21 and 49 Years, by Decade and Birthplace

Birth decade	Country of Birth	N	Mean	Median	Std. Deviation	Minimum	Maximum
1850s	Canada	1	71.3	71.3	.	71.25	71.25
	England	5	67.9	67.3	1.63	65.75	69.50
	Ireland	3	68.3	69.5	2.02	66.00	69.50
	Scotland	1	67.5	67.5	.	67.50	67.50
	US	1	71.0	71.0	.	71.00	71.00
	Other	2	71.0	71.0	2.83	69.00	73.00
	Total	13	68.9	69.5	2.12	65.75	73.00
1860s	Canada	235	68.5	68.5	2.13	64.00	75.50
	England	166	68.3	68.0	2.09	63.00	74.50
	Ireland	33	68.9	69.0	1.59	66.00	72.00
	Scotland	39	68.7	68.8	1.73	66.00	73.00
	US	21	68.2	68.3	2.04	64.50	71.50
	Other	34	69.7	69.9	2.29	65.50	75.00
	Total	528	68.6	68.5	2.09	63.00	75.50
1870s	Canada	1936	68.2	68.0	2.01	60.00	75.00
	England	691	67.9	68.0	2.09	63.00	75.50
	Ireland	116	68.6	69.0	2.31	64.00	73.50
	Scotland	123	68.1	68.0	2.14	64.00	74.75
	US	55	68.6	68.8	1.99	64.00	75.00
	Other	83	68.5	68.5	2.54	64.00	74.38
	Total	3004	68.2	68.0	2.07	60.00	75.50
1880s	Canada	530	67.5	67.5	1.88	61.00	72.50
	England	88	67.5	67.5	2.01	64.00	72.00
	Ireland	9	67.5	67.5	2.22	64.50	71.50
	Scotland	17	67.9	68.0	1.49	66.00	71.00
	US	11	67.2	67.5	1.81	64.50	70.00
	Other	6	68.5	69.3	2.27	65.25	71.50
	Total	661	67.5	67.5	1.89	61.00	72.50

Table 2d: Heights of Canadian-born Men between 21 and 49 Years, by Region

Province of Birth	N	Mean	Median	Std. Deviation	Minimum	Maximum
Maritimes	586	68.0	68.0	2.01	63.00	74.00
Quebec	321	67.5	67.5	2.01	61.50	74.00
Ontario	1602	68.2	68.0	2.01	61.00	75.50
Western Canada	94	68.1	68.0	1.95	60.00	73.00
Northwest Territories	31	69.1	69.0	2.03	65.50	74.00
Province not given	60	68.2	68.5	2.53	63.00	74.00
Newfoundland	43	67.5	67.5	1.89	63.00	71.50

Table 2e: Heights of Canadian-born Men 21 Years and Older, by Birth Decade and Region of Birth

Birth decade	Province of Birth	N	Mean	Median	Std. Deviation	Minimum	Maximum
1860s	Maritimes	38	68.6	68.5	2.15	65.00	74.00
	Quebec	35	67.7	67.3	2.25	64.00	73.50
	Ontario	144	68.6	68.5	2.13	64.00	75.50
	Western Canada	4	68.1	68.5	2.25	65.50	70.00
	Northwest Territories	1	68.8	68.8	.	68.75	68.75
	Province not given	9	69.1	68.8	1.62	67.00	72.25
	Newfoundland	4	68.6	68.8	1.69	66.75	70.00
1870s	Maritimes	397	68.1	68.0	2.02	63.00	73.50
	Quebec	213	67.7	67.5	1.95	63.50	74.00
	Ontario	1158	68.3	68.3	1.97	62.25	75.00
	Western Canada	69	68.3	68.0	1.99	60.00	73.00
	Northwest Territories	21	68.8	68.8	2.28	65.50	74.00
	Province not given	51	68.0	68.5	2.63	63.00	74.00
	Newfoundland	28	67.4	67.6	2.03	63.00	71.50
1880s	Maritimes	144	67.5	67.4	1.85	63.38	72.00
	Quebec	69	66.8	66.5	1.92	61.50	72.00
	Ontario	276	67.6	67.5	1.85	61.00	72.50
	Western Canada	21	67.8	67.5	1.81	64.50	70.50
	Northwest Territories	9	69.8	70.0	1.29	67.50	72.00
	Province not given	11	67.3	66.8	1.64	65.50	70.50
	Newfoundland	139	67.5	67.5	2.03	64.00	72.00

Table 2d: Tests of Normality

For the entire sample, the Kolmogorov-Smirnov test has a test statistic of 0.061 (asymptotic p-level of 0.000), which rejects the null hypothesis of normality. Normality tests by birth decade and country follow.

Tests of Normality – by birth decade^b

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
1850s	.162	13	.200*	.952	13	.633
1860s	.077	543	.000	.983	543	.000
1870s	.056	3095	.000	.993	3095	.000
1880s	.069	1390	.000	.990	1390	.000

Canada	.060	3329	.000	.993	3329	.000
England	.073	1043	.000	.986	1043	.000
Ireland	.064	177	.078	.987	177	.091
Scotland	.090	206	.000	.987	206	.053
US	.072	103	.200*	.981	103	.149
Other	.063	133	.200*	.984	133	.131

a Lilliefors Significance Correction

b HEIGHT is constant when B_DECADE = 1850 (omitted, only one observation).

* This is a lower bound of the true significance.

1.3 Personnel Records of the Canadian Expeditionary Force (1914-1918 War)

The Ministry of Overseas Military Forces (Record Group 150) in the National Archives of Canada holds more than 700,000 personnel files of individuals who served in the Canadian Expeditionary Force (CEF), 1914-1920. Most files contain an attestation document although the nature of the attestation form and therefore the information collected varied during the course of the war. The records for officers (which includes most or all of the women) are especially stark and for the most part do not include medical information. Between 20% and 30% of the men did not volunteer, rather they were inducted under the Conscription Act in 1917 or 1918.

We have available for this paper roughly 7100 observations for which height, birthplace and birthdate are known or may be inferred. Further data entry is now underway. Ultimately, this source will yield as large a sample as might be desired for men born in the 1880s and 1890s. A small but still useful number of files record men born in the 1870s although most date from the 1880s and 1890s. Overall, between 85% and 90% of the CEF files contain useful information on height and chest size and expansion; fewer than 1% report weight. Birthdate (as well as age) and birthplace are available on most files although the precision of locational detail varies considerably.

Minimum height was established at 63 inches although many men who did not achieve that height were able to enlist. The shortest individual has 58 inches. Not surprisingly, these data do not appear to be distributed normally. Apart from the truncation at 63 inches, another source of non-normality is a scattering of very tall men. Histograms and fitted distributions are reported in Figures 3 and 4. The records entered to date which have useful information are reported in Appendix Table 3 (below).

Figure 3: Heights of enlistees >20 and <50 years of age, of Canadian birth, born in the 1880s, and 63" and taller.

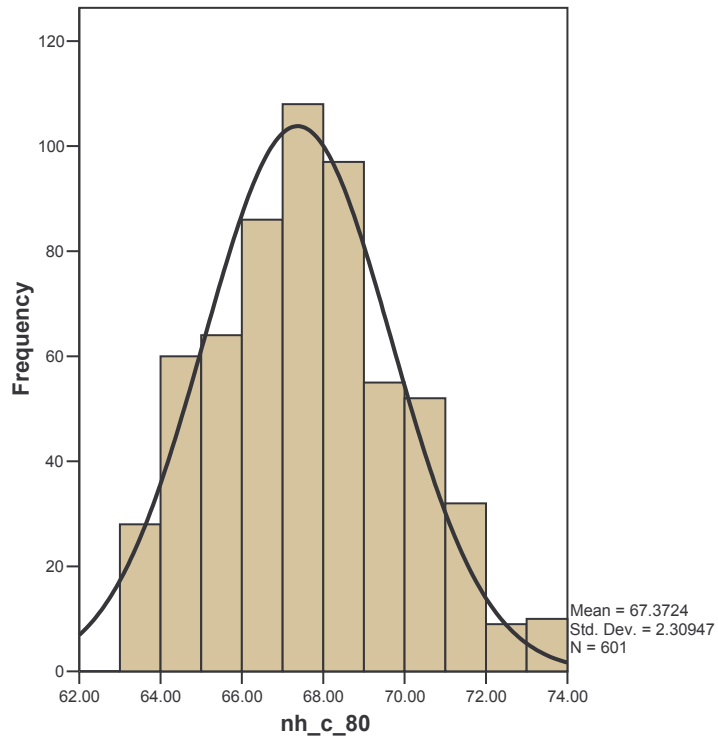


Figure 4: Heights of enlistees >20 and <50 years of age, of Canadian birth, born in the 1890s, and 63" and taller.

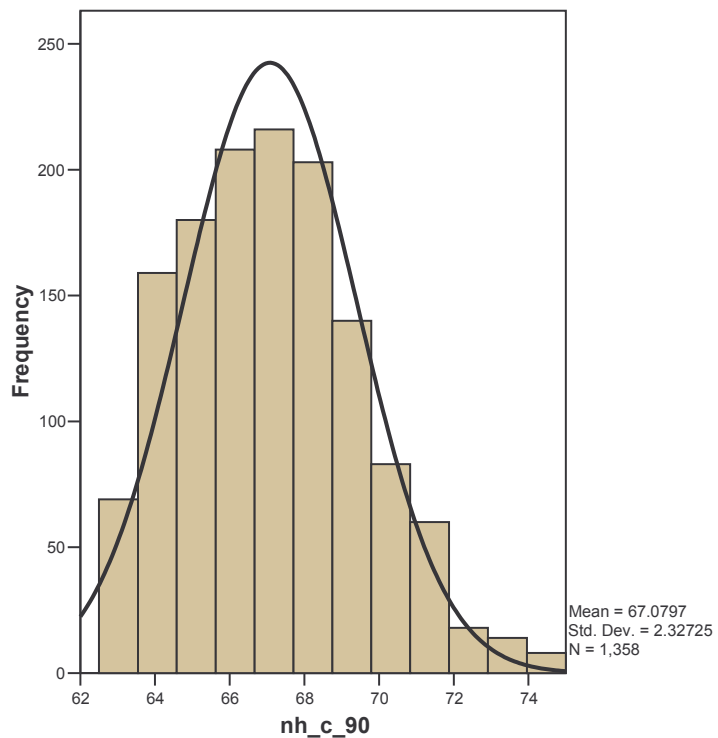


Table 3a: Summary statistics of heights of enlistees >20 and <50 years of age, 63” and taller.

	N	Mean	Median	Std. Deviation	Minimum	Maximum
Height in inches	4481	67.30	67.00	2.37	63.00	79.50

Table 3b: Stature (inches) of enlistees >20 and <50 years of age, 63” and taller, by Decade of Birth.

Birth Decade	N	Mean	Median	Std. Deviation	Minimum	Maximum
1860s	13	66.67	66.50	2.40	63.00	71.75
1870s	568	67.29	67.00	2.37	63.00	78.50
1880s	1653	67.42	67.25	2.32	63.00	78.50
1890s	2244	67.22	67.00	2.40	63.00	79.50
1900s	3	66.83	65.00	3.62	64.50	71.00
Total	4481	67.30	67.00	2.37	63.00	79.50

Table 3c: Stature (inches) of enlistees >20 and <50 years of age, 63” and taller, by Year of Enlistment

Enlistment Year	N	Mean	Median	Std. Deviation	Minimum	Maximum
1905	1	68.00	68.00	.	68.00	68.00
1912	1	69.50	69.50	.	69.50	69.50
1914	461	67.65	67.50	2.32	63.00	75.00
1915	1107	67.29	67.00	2.33	63.00	77.00
1916	1146	67.50	67.25	2.41	63.00	78.50
1917	528	67.28	67.00	2.37	63.00	79.50
1918	1223	67.01	67.00	2.36	63.00	78.50
1919	12	67.65	67.25	2.66	63.50	72.25
Total	4479	67.30	67.00	2.37	63.00	79.50

Table 3d: Stature (inches) of enlistees >20 and <50 years of age, 63” and taller, by Type of Enlistment Record.

Enlistment type	N	Mean	Median	Std. Deviation	Minimum	Maximum
Unknown	2	67.13	67.13	1.24	66.25	68.00
A	1371	67.42	67.25	2.36	63.00	77.00
B	1486	67.43	67.25	2.37	63.00	78.50
C	419	67.12	67.00	2.39	63.00	79.50
D	1194	67.05	67.00	2.36	63.00	79.00
E	4	68.00	68.75	2.12	65.00	69.50
F	2	69.00	69.00	2.83	67.00	71.00
G	8	67.47	66.63	2.34	64.50	72.00
H	1	66.00	66.00	.	66.00	66.00
Total	4487	67.30	67.00	2.37	63.00	79.50

Notes of Different Attestation Forms:

A - 12 questions; many are these forms from 1914 and 1915; no information on current residence or relationship to next of kin

B – 15 questions (adds 1a, 1b and 4a); many are from 1916 and 1917

C - 19 questions (1-16, plus 1a, 1b, 4a); many are from 1917 and 1918; adds questions about discharge, rejection and why

D - 17 questions (including 15a, 15b, 15c) one-page 'drafted under military service act, 1917'; religion is unstructured, asks 'M, W or S', reduces questions on previous service, willingness etc

E- 'officers' declaration paper'; 1917 and 1918 only; does not ask marital status, no height or other medical information

F - 18 questions, same as c, but no question on willingness to serve in CEF (1-15, plus 1a, 1b, 4a)

G - 19 questions, same as 'f' above but all questions listed separately

Table 3e: Stature (inches) of enlistees >20 and <50 years of age, 63" and taller, by Area of Residence

Area of residence	N	Mean	Median	Std. Deviation	Minimum	Maximum
Alberta	227	67.89	68.00	2.59	63.00	78.50
B.C.	224	67.56	67.50	2.10	63.00	73.00
Manitoba	242	67.55	67.50	2.46	63.00	79.50
New Brunswick	114	67.57	67.63	2.40	63.25	74.00
Newfoundland	6	65.75	65.50	1.78	64.00	69.00
Nova Scotia	128	67.23	67.00	2.08	63.00	72.50
Ontario	996	67.13	67.00	2.29	63.00	74.50
PEI	22	67.00	67.00	2.05	64.00	70.50
PQ	424	66.31	66.00	2.17	63.00	74.50
Sask	287	68.11	68.00	2.59	63.00	78.50
Other	344	67.05	67.00	2.20	63.00	75.00
Total	3014	67.24	67.00	2.36	63.00	79.50

Table 3f: Stature (inches) of enlistees >20 and <50 years of age, 63" and taller, by Country of Birth

Country of birth	N	Mean	Median	Std. Deviation	Minimum	Maximum
Canada	2154	67.19	67.00	2.34	63.00	74.50
England	1199	67.24	67.00	2.39	63.00	79.00
Ireland	192	67.62	67.50	2.54	63.00	78.50
Scotland	286	67.36	67.25	2.28	63.00	79.50
U.S.	315	67.93	67.50	2.56	63.00	75.50
Other	309	67.46	67.25	2.23	63.00	74.00
Total	4455	67.30	67.00	2.37	63.00	79.50

Table 3g: Stature (inches) of enlistees >20 and <50 years of age, 63" and taller by Country of Birth and Birth Decade

Birth Decade	Country of Birth	N	Mean	Median	Std. Deviation	Minimum	Maximum
1860	Canada	7	66.68	66.00	2.70	63.50	71.75
	England	5	66.40	66.50	2.41	63.00	69.50
	Other	1	68.00	68.00	.	68.00	68.00
	Total	13	66.67	66.50	2.40	63.00	71.75
1870	Canada	185	67.36	67.00	2.38	63.00	74.50
	England	228	67.13	67.00	2.49	63.00	78.50
	Ireland	35	67.39	67.00	2.19	63.00	73.00
	Scotland	45	67.21	67.00	1.95	63.00	71.00
	U.S.	28	68.56	68.75	2.38	64.00	74.00
	Other	41	67.10	67.00	1.98	63.50	72.00

1880	Total	562	67.30	67.00	2.37	63.00	78.50	
	Canada	601	67.37	67.25	2.31	63.00	74.00	
	England	562	67.29	67.00	2.23	63.00	77.00	
	Ireland	100	67.67	67.25	2.70	63.00	78.50	
	Scotland	157	67.53	67.50	2.32	63.00	73.75	
	U.S.	89	67.74	67.50	2.62	63.00	74.50	
	Other	133	67.63	67.50	2.21	63.50	73.00	
1890	Total	1642	67.42	67.25	2.32	63.00	78.50	
	Canada	1358	67.08	67.00	2.33	63.00	74.50	
	England	401	67.23	67.00	2.54	63.00	79.00	
	Ireland	56	67.72	68.00	2.47	63.00	73.00	
	Scotland	84	67.10	67.00	2.38	63.50	79.50	
	U.S.	198	67.92	67.63	2.55	63.50	75.50	
	Other	132	67.40	67.00	2.33	63.00	74.00	
1900	Total	2229	67.22	67.00	2.40	63.00	79.50	
	Canada	1	71.00	71.00	.	71.00	71.00	
	England	1	65.00	65.00	.	65.00	65.00	
	Ireland	1	64.50	64.50	.	64.50	64.50	
	Total	3	66.83	65.00	3.62	64.50	71.00	
	Total	Canada	2152	67.19	67.00	2.33	63.00	74.50
		England	1197	67.24	67.00	2.39	63.00	79.00
Ireland		192	67.62	67.50	2.54	63.00	78.50	
Scotland		286	67.36	67.25	2.28	63.00	79.50	
U.S.		315	67.93	67.50	2.56	63.00	75.50	
Other		307	67.46	67.25	2.23	63.00	74.00	
Total		4449	67.30	67.00	2.37	63.00	79.50	

Table 3i: Stature (inches) of enlistees >20 and <50 years of age, 63” and taller by Birth Decade and Region of Birth

Birth Decade	Region of Birth	N	Mean	Median	Std. Deviation	Minimum	Maximum
1860	Maritimes	1	66.00	66.00	.	66.00	66.00
	Quebec	3	66.75	65.00	4.39	63.50	71.75
	Ontario	2	67.63	67.63	.88	67.00	68.25
	Western Canada	1	65.25	65.25	.	65.25	65.25
	All other regions	6	66.67	67.00	2.25	63.00	69.50
	Total	13	66.67	66.50	2.40	63.00	71.75
1870	Maritimes	31	68.02	68.00	2.64	63.00	73.00
	Quebec	41	66.78	67.00	2.39	63.00	74.00
	Ontario	105	67.38	67.00	2.33	63.00	74.50
	Western Canada	6	67.67	67.25	1.33	66.00	69.50
	All other regions	379	67.27	67.00	2.36	63.00	78.50
	Total	562	67.30	67.00	2.37	63.00	78.50
1880	Maritimes	120	67.16	67.00	2.11	63.00	73.00
	Quebec	122	66.85	66.63	2.36	63.00	73.00
	Ontario	313	67.45	67.50	2.25	63.00	73.50
	Western Canada	44	68.86	69.00	2.54	63.00	74.00
	All other regions	1044	67.45	67.50	2.33	63.00	78.50

	Total	1643	67.42	67.25	2.32	63.00	78.50
1890	Maritimes	259	67.30	67.00	2.21	63.25	74.00
	Quebec	368	66.24	66.00	2.10	63.00	74.50
	Ontario	594	67.32	67.00	2.38	63.00	74.00
	Western Canada	134	67.93	68.00	2.26	63.00	74.25
	All other regions	874	67.43	67.00	2.50	63.00	79.50
	Total	2229	67.22	67.00	2.40	63.00	79.50
1900	Maritimes	1	71.00	71.00	.	71.00	71.00
	All other regions	2	64.75	64.75	.35	64.50	65.00
	Total	3	66.83	65.00	3.62	64.50	71.00
Total	Maritimes	412	67.32	67.00	2.23	63.00	74.00
	Quebec	534	66.42	66.00	2.21	63.00	74.50
	Ontario	1014	67.37	67.25	2.33	63.00	74.50
	Western Canada	185	68.13	68.00	2.33	63.00	74.25
	All other regions	2305	67.41	67.00	2.40	63.00	79.50
	Total	4450	67.30	67.00	2.37	63.00	79.50

1.4. Canadian National Police Records

Most personnel records of the North West (subsequently Royal Canadian) Mounted Police (Record Group 18, v. 2650) are not publicly accessible. In order to view these records it is necessary to submit a request explaining the nature of the research interest. The file is then “reviewed” and a decision is made; the review process can take up to 6 months. It is also possible to apply through the Freedom of Information legislation. Trevor Dick (1995) gained access to these records during the 1990s. Access appears to have become more restricted subsequently; today it is impossible to locate the records that he examined. He reports (1995, p. 126) height for 1543 records of men over the age of 21 who enlisted between 1873 and 1899.

Another component of the same record group holds Dominion Police Files 1872-1920 (RG18-E, reel C-13876), which predate the RCMP records. One section of this reel contains a register of “Applications for Police Jobs”. (The register reports name, address, weight, and height. There are about 38 entries on each of 17 pages). We have been able to examine a small number of Applications for Enlistment 1903-1907 and 1920-1921 in RG18, v. 2648-2650. These three volumes yield 263 applications, of less than one-quarter of which indicate birthplace. Of these, only 36 are known to be Canadian-born.

The first of these volumes, number 2648, contains copies of North-west Mounted Police, Application Form No. 114 (Ottawa, 2nd July, 1902) and Medical Exam Form No. 65, both of which document minimum requirements for entry into the NWMP: “The minimum height is 5 feet 8 inches, the minimum chest measurement 35 inches, and the maximum weight 175 lbs.”. The small number of observations discovered to date and the very high minimum height implies that, for the moment at least, we are unable to use records from this source.

1.5 Canadian Prison Records

The Kingston Penitentiary Prisoner Records Book (Record Group G13, D-1, v. 1046) is a spreadsheet-style book that includes date, name, marital, age, height, eye colour, complexion,

hair colour, former profession/trade, religion, birthplace, crime. The book contains 350 pp with 43 individuals per page (potentially 15,050 individual observations 1843-1890). Similar records for the Stony Mountain Penitentiary (Manitoba) record admissions for 1871-1885 (v. 23), 1885-1916 (v. 24) and 1913-1922 (v. 25) periods. Volume 24 (1885-1916) has 348 pages at an average of 12 inmates/page while volume 25 (1913-1922) has 182 pages at 6 inmates/page. Hence there is a potential sample of more than 5000 individuals incarcerated 1885-1922. Within the same record group Corrections Canada has many archives of inmate records from other institutions, although most cannot be accessed except by special application and review (as above for police records).

Very recently we have begun to enter data from the Kingston Penitentiary as a way of exploring the potential of this source. From March 1880 to October 1881 302 prisoners were admitted, including 17 women. Roughly 40% of the men were born in Ontario, 15% in Quebec and 10% each in Ireland, England, the United States and the maritime provinces. In order to obtain a preliminary tabulation we divide the Ontario-born 21-50 years into two equal-sized groups by birthdate - 43 men born 1834-54 and 42 men born 1855-1860, with mean heights of 67.9 and 67.7 inches. More data entry is planned!