THE DETERMINANTS OF PHYSICAL STATURE
IN SOUTH AFRICA circa 1860-1918

Abstract
We use height as an indicator of the welfare changes among South African men from about 1860 to 1918. Using the first evidence from World War One South African military enlistment records, we consider how the rapid economic progress of South Africa—beginning in the last third of the nineteenth century— influenced the biological and socio-economic conditions of colored and white males. The results reflect the gross inequalities in the health status of different groups people in South Africa, whites and coloreds on the one hand and affluent whites and poor whites on the other. Industrialization, poor wages and working conditions and segregation led to overcrowding among the coloreds and Africans in mines and towns. The resulting squalid living and environmental conditions encouraged the spread of preventable infections like gastrointestinal, malnutrition and tuberculosis, which had lingering effects on the stature of coloreds and as well as poor whites. Even after controlling for occupation type, place of birth and decadal birth cohort, the height difference between adult whites and adult coloreds remained significant. Among whites themselves, farmers are significantly taller and unskilled whites are significantly shorter than all occupations. The results support existing literature on the stature effects of early-life poor socio-economic conditions.

Introduction
Unlike most developing countries, South Africa has a long history of research into the social and economic determinants of health. Such research has made important contributions to the understanding of health disparities under apartheid and, more generally, in societies characterized by inequality. Thematically, the main focus has been on the historical factors and forces—public policies, medical ideologies and attitudes and the heavy
hand of private capital – that shaped the nature of disease patterns and healthcare delivery in South Africa. These factors include racial segregation, disease ecology, the socio economic forces of industrialization and urbanisation as well as resistance against apartheid domination. Early colonization may have altered the nature and pattern of diseases in South Africa like elsewhere, but it was the forces of industrialization from the last third of the nineteenth century that were to fundamentally alter lifestyles, health and disease patterns in twentieth century South Africa.

The continued economic and political changes in the twentieth century, also led to changes in the disease profiles as well as the attitudes and policies in the provision of health care services by the state and private capital. While the health of the urban populations improved later in the century, racial segregation in health care and sanitation had lingering effects on the health of the coloreds and Africans. These changes included the sustained economic growth, scientific advances and reforms in the health system (sewage, portable water, disease prevention and control especially tuberculosis). Improved wages and living conditions among colored/Africans were accompanied by increased caloric intake and improved nutrition in the mines and towns.

To date, there is little information available on the stature outcomes of disparate socio-economic conditions between coloreds and whites in industrializing South Africa. Studies exist on the demographic trends and pestilence of health care in South Africa in the nineteenth century especially the twentieth century. This literature pays considerable attention to the relationship of political and economic power to disease patterns and health care systems. It particularly focuses on the relationship between racial inequalities, the prevalence of diseases of poverty and deprivation-tuberculosis, adult and infant mortality malnutrition and associated illnesses- and the policies that perpetuated them (Swanson, 1977; Swanson, 1983; Unterhalter, 1982; Swanson, 1985; Packard, 1989; Wylie, 1989; Marks and Andersson, 1987; Shapiro, 1987; Simkins and Heyningen, 1989; Packard, 1989;
Coovadia and Jinabhai, 1990 pp.87-116). Some have focused more on the medical ideologies (Dubow, 1995).¹

In the developing world, interpretations of western medication vary. In some parts of Africa, western medicine has been viewed as a success in reducing mortality and in achieving population growth. However, in South Africa the literature has been radical underlining the devastating effects of racialized health policies and health care delivery. This strand is summed up by Coovadia and Jinabhai (1990 pp90-91) as follows:

‘for south Africa’s citizens, race determines nearly all life’s chances: the probability of survival at birth and in infancy, access to health services, immunization, susceptibility to preventable diseases, quality of curative care, food, growth and development, adequate housing, stimulating residential environments, early learning, schools and education, recreation and sports facilities, employment and incomes. These aspects of life always favor whites and disadvantages blacks’.

The documented evidence of the disparities in health/economic opportunities and longevity between white and the urban poor in South Africa is instructive. Studies examining particular cities have broadened our understanding of both the general and city specific public health policies and forces-divisions among physicians and between government officials and municipal authorities and conflicts of interest between public health, capital and private white interests- that shaped successive changes. However these studies make very little use of demographic data. This is partly due to lack of quantitative data covering the early periods of industrialization.² The first systematic census was done in the Cape Colony in 1891 and the first national census was in 1904 as part of the imperial censuses undertaken by the British government. Even the data that exists has not been rigorously

¹ Dubow (1995) thoroughly discusses how European views of race-scientific racism-dominated discussions on disease morbidity among Africans in the early twentieth century.
² By 1900, only the Cape colony had an administrative framework and infrastructure to collect consistent and accurate demographic data. Until 1979, key demographic numbers on blacks were not kept save for death in some urban areas (Wylie, 1989 p.3; Feinstein, 2005). Even the 1980 and 1985 censuses undercounted black South Africans( Simkins and Van Heyningen, 1985, p.108).
examined (Simkins and Heyningen, 1989 p.79). More work is needed to give clarity to the effects of the early industrial period on human health and welfare and changes over time.

The effect of stature as a proxy for well-being which has become crucial to our understanding of the social stratification and inequality before, during and after the industrial revolution has not been done in Southern Africa. By examining the trends in physical stature among South African white and colored men we can gain some insights into the biological welfare indicators across races and societies that were worlds apart in their socio-economic system. As the extant anthropometric literature shows, physical stature enables us to quantify how well the human organism itself thrives during childhood and adolescence in its socioeconomic and epidemiological environment.

Our paper is structured as follows. Section two briefly reviews the extant literature on height and how it is mediated through social-economic circumstances. This is followed by a discussion of the health conditions in South Africa up to the end of the First World War. In section four we then present that data sources and estimation methods, followed by a discussion of the results and the summary of findings.

**Brief Literature Review**

The literature on biological living standards in the nineteenth century Americas and Europe has provided a lot of insights. This extant literature shows that early life nutrition, level of deprivation, disease exposure, physical and work environment etc, have an influence on height at a particular age until adulthood (for example Nicholas and Steckel; 1991; Johnson and Nicholas, 1995; Komlos, 1985,1993,1995, 1998; Komlos and Kim, 1990; Carson, 2006; Clay and Troesken, 2006; Bassino, 2006) and other long life physiological effects such as susceptibility to diseases such as cancer, stroke later in life (see Clay and Troesken, 2006). The average height attained at adulthood is a net measure of nutrition status gained during childhood and adolescence. And genes play a minor role in adult average heights across most populations (Steckel, 1995 p.1903; Bodenhorn, 1999 p.985). Thus height reflects nutritional advantages or deprivation net of the demands placed on the body by work intensity, health care, diseases, sanitation, housing and numerous other factors.
Height is also correlated with economic growth and general living conditions (Komlos, 1993; Steckel, 1995; Bodenhorn, 1999; Cole, 2003; Sunder and Woitek, 2005; Arcaleni, 2006). Systematic height differences have also been identified by occupation, social status, place of birth, reflecting inequalities in the biological standard of living (Lynch and Kaplan, 1997; Komlos and Baten, 1999; Komlos and Coclains, 1997). Race may matter, but when whites and blacks are brought up under equivalent conditions, the effect of race diminishes (Margo and Steckel, 1982; Bodenhorn, 1999).

**Background: Health and Demography in South Africa, 1860s-1918**

A number of factors shaped the epidemiology of diseases in South Africa particularly on coloreds, Africans and the poor whites in farming, urban and mining centers. The disease effects in eighteenth century industrial Europe and America may have been class biased, but those in late nineteenth and early twentieth century South Africa were largely along color differences (Swanson, 1977, 1983, 1985; Unterhalter, 1982; Simkins and Van Heyningen, 1985; Legassick, 1985 p.43-59; Swanson 1995, p.26; Packard, 1989; Marks and Anderson, 1987; Shapiro, 1987).

Our focus is on the whites and coloreds. While the definition of white Europeans and Black Africans was clear that of coloreds was contentious. From the late nineteenth century coloreds had no real definition and were in a process of self-identification in the face of race prejudice and exclusion (Marais, 1958 p.256-257; Simkins and Van Heyningen, 1989 p.91). This ambivalence is reflected through the confusion in the various acts and in the courts during the twentieth century. Part of this definitional problem was because coloreds

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3 The colored people are the offspring South Africa; coloreds were offspring of parents of three main groups, the Europeans who landed the cape, the eastern slaves imported into the Cape and the indigenous races (Bushmen, Hottentots and Africans) which inhabited various parts of South Africa. Their origins and history is detailed by Marais 1958, The Cape Coloured People: 1652-1937. Chapter One pp.1-31). Like the Chinese and Indians, they incurred the hostility of whites who felt economically threatened by them.

4 Patterson(1953 Appendix I page 361-363) lists a gamut of laws governing coloreds which showed confusions and inconsistent definitions of a ‘colored person’
represented a different case. They were not raised to the status of whites, nor lowered to the status of Africans. This is because there exists a number of groups as follows: (i) those who look more European in appearance and racial feature, (ii) those who are close to the aboriginal stock and (iii) those who are in between European and aboriginal in racial character (this is discussed in detail in Patterson, 1953 p.14-21; Golding and Joshua, 1951 p.71; Marais, 1958 Chapter One pp.1-31). In addition, the word ‘colored’ was also applied to Cape Malays who differed from the mixed persons in religion and culture, which was essentially Muslim and eastern (Golding and Joshua, 1951, p.71; Simkins and van Heyningen, 1989 p.91). In terms of numerical importance and administrative purposes, the coloreds are the third of the four main groups of the South African society. Most cases of intermixture increased the colored population, but some of them joined the ranks of Europeans. The advantages of doing so were obvious. The majority that failed to get acceptance among the ranks of the whites - in spite of their distinctive color and their sharing of language and culture with the whites - were to face the innumerable obstacles to their economic and political advancement. Just like Africans, they were very poor and restricted in their occupations and other activities (Patterson, 1953, p.31; Marais, 1958 p.282). However, unlike Africans and especially Indians (who had a strong sense of community solidarity), coloreds also suffered from lack of identity and thus greater social marginalization (Hellman, 1968 pp.1-3).

It is instructive to note that at the time of the discovery of diamonds both whites and other races across South Africa lived simple rural and subsistence lives often as isolated communities in large and sparsely populated farms (Wilson, 1971 p.109). The discovery of diamonds in 1867 and gold in 1886 was a portent of changes that were to dramatically transform rural South Africa into an industrialized and urbanized society in less than two generations. The influx of speculators and laborers to mines and cities simultaneously

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5 Wilson (1971 p.113) notes that many both whites and blacks lived in clay huts. Others lived nomadic lives - the whites who owned wagons and tents moved to wherever they would find enough pastures. In the Cape Colony, Orange Free State and Natal, the rich white farmers had houses which consisted of a front room in which the family ate and lived by the day and a kitchen and bedrooms. Clothing was expensive and the Boers saw no need for finery.
increased commerce and the impoverishment of the rural areas\(^6\) which were to have devastating effects on the health and physical well-being of whites but more importantly coloreds and blacks. At the turn of the century, port cities remained largely commercial centers.\(^7\) Most of the larger towns in the interior were market centers, with some administrative functions, serving domestic markets and supporting small production activities. But soon progress everywhere was stimulated by the capital investments-in railways, light manufacturing and public works and a growth of a more sophisticated civil service-from gold and diamond mining (see Simkins and van Heyningen, 1985, p.99; Feinstein, 2005, pp90-123).

Simkins and van Heyningen (1989) had access to the first census in South Africa but this was only for the Cape Colony\(^8\). By 1904 the total population of South Africa was 5.192 million, rising to 5.877 million by 1910 and 6.838 million by 1920\(^9\). At the time of the union, in 1910, the different colonies and republics which later formed the provinces, Cape, Natal, Transvaal and Orange Free State had followed different policies, which created different social conditions for non-white races. In Cape were concentrated the Xhosa and

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\(^6\) The economic factors that attracted men to mines and cities were complemented by push factors in the rural areas. First population pressure increased with the closing of the frontier. Linked to this was the process of subdivision. Under the Roman Dutch law of inheritance each child got an equal amount of land and speculators locked up vast tracts of land. In addition, the rinderpest which swept through South Africa in the 1890s, the long drought of 1897 and the devastation of the 1899-1902 war intensified rural exodus. The abolition ‘kafir’ farming through the 1913 land Act threw many Africans off the land (Wilson, 1971 pp.126-127).

\(^7\) The dominant classes were merchants, retailers, traders, masons, carpenters most of them being English-speaking (Feinstein, 2005p.114).

\(^8\) Simkins and Van Heyningen (1989), had access to the first census in the Cape Colony of 1891 and 1904. They identified six population groups based on social and ethnic basis. These are European (White), Coloreds (Malay, Hottentot, Mixed and other colored) and Native (Fingo, Kafir and Bechuana). In 1904, urban areas were defined as centers with more than 2000 inhabitants (Simkins and van Heyningen, 1989 p.94).

\(^9\) The population figures of South Africa particularly before 1900 are imprecise at best indicative (Feinstein, 2005, Simkins and Heyningen, 1989; Packard, 1989). In later censuses, the problems of undercounting remained of the rural, small towns and black homelands during apartheid. Patterson (1953 Appendix A p.351) shows population trends. Through extrapolation of 1904 figures, Feinstein (2005, Annex 1, Table 1A.2 and Table A1.3 pp.257-259) provides annual population figures from 1904 to 1996 as well as racial composition by decade from 1904 to 2000.
the Colored\textsuperscript{10}. Of the total population of 2.5 million in Cape by 1911 census, about 59% were African, 23% white and 18% colored (including and Asian population of about 0.3%)(Wilson, 1971 pp.426-427). The population of Natal in the 1911 census was about 1.2 million. Africans -mainly Zulu-made 80% of the population, Indians made about 11%, whites 8% and only 1% coloreds. The Orange Free State had a relatively small population of only over half a million. About 62% was Africans-mainly Tswana, 33% whites-largely Afrikaans speaking- and 5% coloreds. Transvaal had the largest growth of population due to migration of both whites and non whites from the rural areas and by immigration of Europeans to the mines. At the time of the 1911 census, there were 1.75 million, of which about 72% were Africans, 25% whites, both Afrikaans and English speaking, 2% coloreds and less than 1% Asians (Wilson, 1971 pp.426-431; Packard, 1989). The 1936 census showed that out of the 768,000 coloreds that were in South Africa, 682,000(88.8%) lived in the Cape, mainly Western Cape, 50,000 (6.5%) in Transvaal, 18,500(2.4%) in Natal and 17,700 (2.3%) in the Orange Free State (Patterson, 1953 Appendix C p.352; Marais, 1958 p.vii).This 1936 census also showed that about 50% of the Cape Coloreds lived in the rural areas(Marais, 1958 p.266; Patterson 1953 Appendix C p.352).

\textbf{A Sharpening Social Gradient:}

Side by side with urban creation and influx were other potent forces. After 1870, the main arena of conflict between whites and other races became the industrial labor market, skills acquisition, and the development of an exclusive white education system. Concerned that a lack of education would cause whites to lose their \textit{prescribed station}, schools became segregated allowing whites better skills training. From 1860s, government schools became the preserve of European children bolstered by increased funding and compulsory education was introduced across South Africa between 1879 and 1909, beginning with Orange Free State in 1897(Wilson, 1971 p.124; Welsh, 1971 pp.221-226; Wollheim, 1951

\textsuperscript{10} In 1879, the Cape colony’s African population was 2,984 but by 1907, the African population of Cape Town alone was 7,492 (Packard, 1989, p34; Simkins and Van Heyningen, 1989). The South African born whites in the Cape Colony numbered 376,987 in 1891 and 606,014 in 1906 (Simkins and van Heyningen, 1989, p.87). In 1904, the Malay numbered 15,615 located in Cape Town and a further 1,066 in Port Elizabeth.

\textsuperscript{11} By 1890 there were about 20 000 Africans working in the diamond fields of Kimberley and about 60 000 working in the Rand. By 1910, there were over 200 000 African mine workers on the Rand (Packard, 1989 p.34).
By 1899 there were over 80,000 white pupils and 300 teachers in 200 government schools in Orange Free State. Farm schools were established for children in remote farms and by 1900 education was compulsory between ages of 10 and 16 (Wilson, 1971 p.124). In the Cape Colony the number of schools both white and non-white children more than trebled between 1870 and 1900. Like in other areas, farm schools were created (Wilson, 1971 p.124). From 1890 onward, white pressure for school segregation increased and the Cape Government implemented this largely by creating a new class of public school, which made it unnecessary for whites to send their children to mission schools. The Superintendent General’s report of 1909 is said to have highlighted that ‘the first noteworthy differences between the school system of 1909 and 1901 is the separation of European and colored children…..’ (Quoted in Welsh 1971, pp.221-226).

Transvaal education was less organized than in the Cape and Orange Free State and in spite of the value placed on education by authorities, only 25% of white children of school age went to school by 1895. In Natal as in other areas, special provision was made for the rural white children especially after 1888 (Wilson, 1971 p.124).

However, within the Boers, another class of poor whites was emerging with the closing in of the frontier and the expansion of the railways. This was speeded by the agricultural malaise of the late 1880s and Anglo-Boer war which served to create a landless Boer society (Keegan, 1987, 20-50). The impoverishment was aggravated by lack of education and skills amongst the Boers in the 1890s. In 1889, only 2200 white children of school going age were in school against 10,500 who were growing up without education and skills. They were unable to use tools, build houses, make and mend wheeled vehicles and

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12 For much of the nineteenth century education in the Cape Colony had been funded by local efforts and rural schools both white and non-white had suffered. However, between 1894 and 1909, government expenditure on mission schools increased from 15s.3¼d. to 17s.7d. per pupil. During the same period, expenditure in white schools increased from £2.8s.9d per pupil to £3.15s.11d in ‘farm’ schools, from £2.1s.5d. to £2. 9s.5d in ‘third’ class schools and from £3.5s.0d to £5.13s.6d. in ‘first’ class schools (Marais, 1958 p.272-273).

13 In the Cape Colony white children in remote areas had continued to attend mission schools. Nearly 6,000 white children were still attending mission schools in 1883. The 1905 Cape School Board Act promoted the establishment of separate public schools for white and non-white children. By 1910 about 550 white children were in mission schools. By 1911, the Appellate Division of the Union Supreme Court sanctioned the principle of exclusion by denying the right of certain colored children in the Cape to attend European government schools in their village (Marais, 1958 p.270-271).
repair machinery among other things. Under these circumstances the collapse of their hunting/trading/trekking economy in the face of industrialization was inevitable.

The situation was worse among coloreds as after emancipation of slaves in 1838, the special slave schools closed and were replaced by mission schools and the education of coloreds gradually segregated from that of whites (Marais, 1958 p.269). There were measures that effectively prevented non whites from acquiring formal qualifications necessary for performance of skilled work. For example, the Cape Education Commission of 1910-1912 found prejudice against the education of the colored people (Marais, 1968 p.271). Although in some areas, particularly in the Cape and Natal, Africans, colored and Indians could get education from mission schools as artisans, there were many places where education was not provided (Patterson, 1953 p.92-96; Simkins and Van Heyningen, 1985 p.103; Wilson, 1971 p.124; Shapiro, 1987; Burns, 1998; Marais, 1958 p.270). By 1919, only two colored schools had ‘secondary’ classes, attended by 68 pupils. In 1935, 14 institutions offered either a full or partial course that could be classified as ‘secondary’ and there were 4430 pupils (Marais, 1968, p.273).

**Income Inequality and Poverty:**

The early phases of industrialization saw income becoming more unevenly distributed in favor of whites and of the upper white class. Skewed income distribution and its effects on food intake-reinforced by other factors-could have had an adverse effect on health and stature. In the mines, there developed an organized white labor force pressing for preferential treatment against the competition of white and non-white unskilled workers and later competition between the white unskilled and non white labor. By 1876, the pressures by white skilled workers and capital for job segregation to protect their jobs and income differentials prevailed, with the first formal color bar introduced in 1893 (Wilson, 1971; Katz, 1999; Brekenbridge, 1998; Davies, 1976). The seeds for a comprehensive and formal color bar that was to rigorously exclude all Africans from any skilled or semi-

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14Davies (1976 pp.41-69) and Katz (1999 pp.73-97) discuss the complex set of class-cum-race, safety and economic reasons for the origins of industrial color bar regulations in the 1890s. Safety in the mines improved but regulations bolstered skilled and unskilled white job security and superiority and staved competition from a growing number of relatively skilled proletarianized or semi-proletarianized Africans, Colored and Indians.
skilled work had been firmly sown. Similar but not so rigid restrictions were applied to
colored and Asian workers (Feinstein, 2005 p.74). Africans, coloreds and some Boers-
whose human skills and physical capital had been depressed by technological change-were
at the lower end of the income distribution. At the opposite end, skilled white workers
benefited from the increasing demand for their skills, income differentials and the use of
political and legal system to perpetuate segregation (Davies, 1976; Breckenbridge, 1998;
Katz, 1999; Packard, 1989; Feinstein, 2005 p.75-78).  

The wages paid to Africans and
coloreds were low in absolute terms both as a fraction of those paid to the whites and
declined over time. Feinstein (2005 p.135) argues that blacks and coloreds were both
grossly underpaid and denied any share in the growing income of the new economy they
were creating.

South Africa’s economic growth was impressive with a rise in average per capita income as
growth in output and services outstripped population growth. From 1911 to 1960 the real
average per capita income increased by 2 to 3 percent per year (Houghton, 1964 p.40). At
an international level, figures provides by Feinstein(2005, pp3-10) show that GDP per
capita annual growth of South Africa at 1990 international prices between 1913 and 1950
was 1.3% compared to 0.6% in Europe, 1.% in Latin America and 0.9 %. However when
considered with respect to the extreme income inequality between races in South Africa,
the per capital personal income(in 1995 constant Rand) for whites and blacks shows that
between 1917 and 1960 the average white incomes were more than eleven times greater
than the average African incomes(Feinstein 2005 p.11 Figure 1.3).

In the 1890s farming needed to respond to increased demand from urban centers and over seas markets, but
could not compete for labor with the better wages in mining, railways and urban areas. Labor shortage was
chronic in the Western Cape. Attempts to recruit Chinese and poor whites in 1857, 1878-9 and 1897 were
ineffective because they would desert as soon as they could. Labor shortage was largely due to the
misconception among farmers that the supply curve of farm labor was backward sloping, even though
evidence from other farms showed that supply was positively associated with wages (Feinstein, 2005, p.68-
70; Wilson, 1971 p.121).The only explanation for this attitude was that higher wages would erode profits that
is why capital continued to rely on coercive labor recruitment-taxes, land restrictions, pass laws as long as
there was support from political instruments.

One excuse for low wages was that Africans in particular, were viewed as temporary sojourners in urban
areas with a home in the rural areas. In mining Africans wages were based on the needs of one person and that
because they had a rural base, the incomes would supplement the rural income. This belief affected the whole
structure of African wages even up to the 1940s.There was also a stereotype that the African was unskilled
and migratory served to rationalize lack of progress placed on African progress in industry and the reluctance
by municipalities to improving urban non-white accommodation( Wilson 1971 p.195).
Between 1891 and 1904 whites in the building industry earned a maximum of 9s a day while colored were paid 7s 6d a day, yet both worked a 51-hour week.\textsuperscript{17} Between 1901 and 1904, Africans and coloreds in Witwatersrand mines that were employed in more skilled jobs reserved for whites earned less than their counterparts (see Davies, 1976 p.69). In the Cape colony, coloreds employed in the railways were paid lower than whites doing the same job (Marais, 1968 p.265). In 1866 the average monthly cash wage for white farm foremen and head shepherd in the Cape Colony was £2.18s. 1d, while non-white servants, cattle herders and shepherds earned 12s.10d per month (Wilson, 1971 p.158-161). There was also different types of payment that included part cash payment and part payment in kind (which were rations, grazing rights, land or accommodation). The tot system where workers were paid in wine and brandy aggravated their conditions.\textsuperscript{18} While several commission and reports and churches (including the Dutch Reformed Church) berated the tot system, and showing the inadequacy of farm wages, the gap between whites and non-white actually increased over the century.\textsuperscript{19} Though farm laborers faced bad conditions, most of them could not leave the farms because they had monetary debts (debt peonage) to their employers in addition pass laws and other restrictions on their employment in towns (Wilson, 1971 p.142; Marais, 1968 p.267).

By 1952, white farm employees earned £19.7s.7d in the Cape while non-white colored farm laborers earned £2.7s.10d (Wilson, 9171 pp.158-161).\textsuperscript{20} Marais (1968p.261-262) says that by time of the union in 1910, there was no legal or administrative bar against the

\textsuperscript{17} See Simkins and Van Heyningen (1985, p.105) for detailed statistics. See Feinstein (2005 p.67) Table 3.3 for trends in African miners’ wages from 1911 to 1961. Davies (1976 p.68) also discusses in detail the wage differences between skilled whites and skilled blacks/coloreds.

\textsuperscript{18} By 1866, the ‘tot’ system was firmly established in the Western Cape. The farmers seemed to agree that their laborers would not work without five or six daily tots. In winter when the wine was strong, the rations were less, but some farmers gave a tot of brandy on cold morning. Even by 1966, the tot system was still heavily entrenched in the Western Cape farms (Marais, 1968 p.268; Wilson, 1971 p.162.). For wine farmers the tot was a means of disposing part of their cheap surplus wine in the form of payments in kind.

\textsuperscript{19} The constant labor shortage that plagued farms was largely due to the misconception among farmers that the supply curve of farm labor was backward sloping, even though evidence from other farms showed that supply was positively associated with wages (Wilson, 1971 p.121; Marais, 1968 p.268).

\textsuperscript{20} See Wilson (1971, Table 6 p160) for detailed breakdown of wages.
employment of coloreds in civil service of Cape Colony. However, there were only few coloreds outside the civil service in graded ranks and the ‘backward state of their education prior to the union no doubt rendered but few of them eligible for official appointments’ (Marais, 1968 p.261-262).\(^{21}\)

**Epidemiological Environment:**

While the incidences of diseases and epidemics are exogenous by nature, increased industrialization, urbanization and population densities created conditions for the spread of diseases. There were variations in morbidity between urban and rural areas (Marais, 1968 p.259; Simkins and van Heyningen, 1989). The urban influx of poor Africans, coloreds and landless byowners, resulted in slums\(^{22}\) and diseases of deprivation such as tuberculosis, diarrhea, typhoid and the 1918 influenza(Phillips, 1987; Simkins and Van Heyningen, 1985, p99; Swanson, 1985; Packard, 1989; Deacon, 2000 p.204; Low- Beer *et al.*, 2004 pp.223-245). The fluid interaction between races and social classes that had existed in the pre-industrialization period especially in Cape Town (Bickford-Smith, 1995) and Johannesburg (Marais, 1968 pp.179-199; van Heyningen, 1985 p.98; Packard, 1989 p.42-43) was quickly replaced by residential and health care segregation.\(^{23}\) This was based on the popular stereotyping of Africans as diseased and ‘uncivilized’, even when poverty was recognized as a causal factor (Swanson, 1977, 1983, 1985; Freund, 2001; Packard, 1989

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\(^{21}\) Marais( 1968 pp261-262) argues that ‘after the union, their prospects of obtaining graded positions were destroyed by administrative order except one department of the Public Services, Posts and Telegraphs which employed a number of them as postmen, messengers and so on’. Official state intervention in employment conditions of the private sector only developed on a large-scale in the 1920s. A barrage of laws-including The Apprenticeship Act of 1922, The Industrial Conciliation Act of 1924 and The Wages Act of 1925-26- ensured that coloreds could not compete with whites in the labor market (Marais, 1968 p.267).

\(^{22}\) One such slum was the Malay Location which was dilapidated, lacked lighting, ventilation and sanitation. In 1904, the population of the Malay Location included 1,752 Asiatics, 252 Africans, 937 Mulattos and 405 Europeans. There were also 112 white living in the largely African East Bank location of East London in 1912 (Packard 1989 p.42).

\(^{23}\) According to Swanson (1977, 1983, and 1985) in 1870 the fear of cholera, smallpox and plague led to the segregation of Indians and Africans in Natal and Transvaal. This was followed by a series of laws including the Transvaal Law 5 of 1885 that denied Asians electoral franchise, Public Health Laws of 1883 and 1887, the Native Labor Locations Act of 1899, the Native Reserves Act (No. 40 of 1902) and the Immigration Restriction Act of 1902 pp.34-39. Freund (2001) discusses racial segregation and capital in Durban and Mabin and Smit (1987) in other South African cities. Scott (2003 pp.235-259) focuses on the industrial planning in Durban. Deacon (2000 p203-206) discusses the racialized medical practices in the Cape Colony, in particular the Leprosy Repressions Act of 1891 that reflected a racist stereotyping of the leper as black.
However, segregation failed to ameliorate health conditions in the new locations. If anything they worsened as indicated by the Tuberculosis commission of 1914 which berated the living conditions of Africans, coloreds and poor whites (Marais, 1968; Packard, 1989).  

Few municipalities and white urban rate payers were willing to allocate resources to improving the health of locations from which they got their labor and tax revenue. Sanitation, refuse collection and water supplies usually stopped at the boundary of the location. Where water supplies were available, the rates were extortionate. In 1909, Grahamstown residents paid 10 shillings a year and received two paraffin tins of water per week from tanks that operated twice a week. In 1912, the municipality made a profit of £1,694 on the waterworks. Bloemfontein made a profit of £1,400 from water charges in 1913 (Packard 1989 p.55).

Among the whites, the timing and trends of deprivation also differed from region to region but all showed the effects of class differentiation and income inequality. The white poor problem became a major political and economic issue throughout South Africa from the late 1890s. Phillips (1987) and Unterhalter (1982) discuss poor whiteism and various

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24 The health effects of segregation varied by location as well as the proportion of women and children, regulation enforcement and economic conditions. Diseases were worsened by insecurity of tenure and high rents residents were required to pay for their plots or houses leading to overcrowding. These problems were aggravated by the burden of higher transport costs. In New Brighton outside Port Elizabeth, one month’s rent was equal to what residents had paid per year in Port Elizabeth (Packard, 1989 p.53-54).

25 Packard (1989 p56-57) and Marais (1968 p.258) show that municipalities were reluctant to subsidize investments in African and colored locations, yet they were themselves being supported by a surplus from the taxes and rents that Africans paid. Packard 1989 p.57 Table 1 provides evidence. For example in 1911/1912 the municipality of Cradock had a surplus of about £3,000, which covered only about 12% of ordinary municipal expenses. Of the 217 towns that officially reported their accounts in 1916/1917, over 191 generated more from African revenues than invested in improving African services.

26 Few locations had sanitation facilities and those that were available were inaccessible and therefore not used. The Tuberculosis commission highlighted that in Cape Town, the coloreds had to fetch water from an irrigation furrow after it had passed through the town (Marais, 1968 p.258). Packard (1989 pp.55-56) argues that in the African locations of East London, there were no latrines within the location boundaries in 1912 and the 8,500 residents had to use latrines that were outside the location. Locations on the Rand were near rubbish dumps, like Ndabeni the first location outside Cape Town.

27 For example as early as 1903, 3139 Boers were depended on relief works, which paid them a rate of 4s 6d per day and in 1904, about 6000 whites were on government rations, despite efforts to end ration payments (Keegan 1987 p.28-29). Many pro-poor white efforts continued and by late 1930s the problem of poor whites was being eliminated. This helped the younger people but much older generation failed to adapt and continued to depend on handouts. According to Unterhalter (1982 p.631-632), the 1919 health report indicated that white infants died from malnutrition, due to the inability of families to provide additions food. The report showed that 97% of the cases were breast fed.
schemes including health and housing reforms that were instituted in Bloemfontein and Johannesburg respectively to improve the ‘poor whites’ post 1918 influenza.28

Thus in general whites enjoyed better access to advanced health care and were more inclined to seek it out at an early stage than were coloreds and Africans. They were thus more likely to be diagnosed at an earlier stage than were other races and thus better able to control their infections.29 Whites may have suffered from tuberculosis, malaria30 and the 1902 and 1918 plagues,31 but the death toll fell disproportionately on coloreds and Africans. Between 1891 and 1906, the life expectancy at birth of whites in the Cape Colony was 15 years higher than Africans, coloreds and other groups.32 In the Cape Colony

28 H. Phillips (1987) The Local State and Public Health Reforms in South Africa: Bloemfontein and The Consequences of the Spanish Flu Epidemic of 1918, provides a detailed analysis of the 1918 Spanish flu in Bloemfontein. He shows its ravaging effects on both White and Africans and how ‘self protection’ among whites spurred the first comprehensive health reforms backed by legislation across South Africa. In Bloemfontein they attempted to eradicate poor whiteism through upgrading sanitation, accommodation and other safety net programs for whites. Through the flu, they realized that the health of both blacks and whites was inextricably linked and considered improvements in black areas. In Cape Town the 1918 influenza also spurred health and sanitation reforms but the coloreds benefited little from these reforms. Even with the 1923 Urban Areas Act which required municipalities to invest in locations, the Cape Colored Commission of 1934-1937 lamented that little had changed since the 1914 Tuberculosis Commission (Marais, 1968 p.258-259). Ngalamulume(2004 pp.183-202) discusses yellow fever in St Louis Du Senegal between 1850 and 1940, and shows that because prevention and control strategies by the French colonial officials reflected ignorance of the nature and epidemiology of yellow fever, they were ineffective and misdirected.

29 Up to 1916, there were no provisions for the periodic medical examination of African workers employed in the Rand mines, unless they showed severe wasting. They would only get a cursory examination from the medical officer on their initial employment or if they became too ill to work. By contrast, white workers were periodically examined and received better medical treatment if they fell sick. They did not live in compounds but with their families or in boarding houses. Improvements after WW1 with more hospitals and doctors, mining companies were strictly driven by costs and benefits (Packard, 1989 Chapter 3, see also pp174-184).

30 In Transvaal, whites began settling in the higher areas of the eastern Transvaal in the middle of the nineteenth century, avoiding the lower parts that were malarious. Malaria, in fact, took a heavy toll among Europeans who attempted to settle in the lowveld during the nineteenth century (Packard, 2001 p.595).

31 According to Simkins and van Heyningen(1989 p98), the 1901 plague that hit Cape Town, 189 white( mainly residents of the racially mixed district six) died as opposed to 408 colored people. Of those who caught the disease, 34.4% of whites died against 57.1% coloreds. According to Unterhalter (1982 p.620 Table 2) the 1918 influenza racked havoc among non-whites in Johannesburg. In individual terms, 667 whites died compared to 264 coloreds and Indians and 1,158 Africans.

32 While there was under-enumeration of both birth and deaths, especially variations between urban and rural areas, Simkins and van Heyningen estimate that in the Cape Colony, between 1891 and 1904, the crude death rate among blacks was 33.1/1000. Black male and female life expectancies at birth were 30.1 and 32.5 per 1000 respectively (Simkins and Van Heyningen, 1985 p93). The crude death rate for coloreds dropped
between 1981 and 1906 the infant mortality among other groups was double the rate among whites.\textsuperscript{33} In Johannesburg between 1910 and 1970 infant mortality among coloreds and Africans was more than double that of whites.\textsuperscript{34} Nevertheless, the infant mortality among whites in Johannesburg (110/1000 in 1910 and 90/1000 in 1920) was above the national white average (96/1000 in 1910 and 90/1000 in 1920) until 1939\textsuperscript{(Unterhalter, 1982, p631)}. The white infant mortality shows deprivation among whites, hidden under the flourishing mining, commerce and the affluence of the city’s upper class.\textsuperscript{35} As argued above, industrialization crystallized the differentiation in status and wealth– which had always characterized Boer society – into sharp class divisions.

There were other endemic diseases of deprivation and poor sanitation which blighted the poor whites and non-whites. For all groups, the greatest killers were pneumonia and other

\begin{itemize}
\item \textsuperscript{33} Between 1891 and 1904, infant mortality among blacks was 304/1000. Infant mortality among coloreds was 312/1000 for males and 276/1000 for females over the same period. It dropped by 50% by 1945, but remained between 120 and 140/1000 until the early 1970s coloreds (Simkins and Van Heyningen, 1989 p.108-109).
\item \textsuperscript{34} According to Unterhalter (1982 p.627 Table 6), demographic data of Africans in Johannesburg was notoriously incomplete making figures on African infant mortality difficult to get. However, up to 1939, Johannesburg combined coloreds and African infant mortality statistics. While this blurs the picture it provides a direction. The infant mortality rate among Africans and coloreds in 1909-1910 was 369/1000, 225/1000 in 1918-1919, dropping to 189.22/1000 by 1939-1940. The 1919 report of health focused on the high death rate of premature colored infants. The lack of a proper maternity or child health services and the alarming infant mortality rate among coloreds was discussed in a report of 1922-1923(p.630). In contrast to this, infant mortality among whites fell from 117/1000 in 1909-1910 to 89.79/1000 by 1918-1919 and 51.13 by 1939-40. That of Asians fell from 252/1000 in 1909/1910, to 212.7/1000 by 1918-1999 further dropping to 120.59 by 1939-1940. Trends in the later years are detailed in Tables 7, 8 and 9(pp.628-629).
\item \textsuperscript{35} Unterhalter (1982 p.631) shows that life was very different in the poor suburbs of Johannesburg and there was a very clear social class differentiation. For example in 1919, the infant mortality was 63/1000 in affluent northern suburbs, while in the white working class suburbs of Newtown, Mayfair and Fordsburg, it was as high as 113/1000. By the mid 1920s little had changed- northern suburbs has 60/1000 compared to between 94-107/1000 across the poor white suburbs. This difference became marked during the great depression.
\end{itemize}
respiratory diseases mainly tuberculosis,\textsuperscript{36} followed by diarrheal diseases-dysentery and typhoid- hookworm, measles, malnutrition. In Johannesburg, between 1903/1904 and 1913/1914, the average death rate of Africans and colores from diarrheal diseases was 2.68/1000, while that of whites was 2.2/1000 (Packard, 1989 p.57). According to Packard (1989 pp.126-146) and Unterhalter (1982 p.621) the small difference reflected the general level of sanitation up to the end of the First World War.\textsuperscript{37} However among whites, 90% of the deaths in 1913/1914 were in children under five and this represents gastroenteritis. In Africans and Coloreds only 57% of the cases occurred for those under five years. This reflects a higher incidence of other intestinal diseases particularly among poorly nourished black and colored children and adults.\textsuperscript{38}

Urbanisation, Relative Prices and Diets

Related to the above, were changes in dietary practices and nutrition that blighted the health of the poor both in urban and rural areas. In South Africa there is generally lack of statistical information on agricultural production, and relative changes in food prices during the early phases of industrialization. But what is clear is that during the first two decades, agricultural production was failing to keep up with demand as population grew and urbanisation expanded.\textsuperscript{39} Urbanization and coercive labor processes simultaneously led to

\textsuperscript{36} The trend of Tuberculosis among white quickly fell off, like that in Europe. However that for colores and blacks remained high until in the 1950s with the development of effective \textit{antitubercular} drugs in the early 1950. The death rate from tuberculosis among Africans and colores in Beaufort West in Cape Colony West in 1896-the first year of registration- was 8.7/1000, reaching 18.5/1000 by 1905. The average between 1903 and 1906 was 14.3/1000. Though there was now more registration, there is no doubt that TB in towns was rising (Packard, p.4 and p.41). From 1907 to 1909. TB mortality in Port Elizabeth, Cape Town and Durban rose in response to mining sector depression in the Rand and its ripple effects in shipping and related activities (Packard, 1989).

The 1914 Commission on Tuberculosis highlighted that tuberculosis was four to six times as prevalent among colores as among Europeans (Marais, 1968 p.259).

\textsuperscript{37} Unterhalter (1982 p.621) argues that even in the white areas of Johannesburg waterborne sewerage was limited until the 1920s.

\textsuperscript{38} While intestinal diseases continued to be a problem even among the whites until the early 1920s when water-borne sanitation to whites was completed, in African locations where such facilities were missing or inadequate, the rates actually rose in the 1920s(Packard, 1989 pp.126-146).

\textsuperscript{39} Urban population as a percentage of total population was distributed as follows: In 1904, whites-53%, colores-46% and African-13%. In 1911 the distribution was: Whites 51.6%, Coloreds 46%, Asians 46% and Africans 12.6%. In 1921 the distribution was follows: Whites 55.8%, Coloreds 45.8%, Asians 30.9% and Africans 12.5% (Welsh 1971 p.173).
the demise of African farming, starting late 19th century becoming quite evident everywhere by 1920s (Bundy, 1979; Keegan 1987; Feinstein, 2005 p.70-71). It would have been impossible for the rapidly urbanizing population to feed themselves from the rural food. By 1899, South Africa was no longer self sufficient in basic food requirements and was importing wheat, maize meat, eggs, milk and butter (Wilson, 1971, p.114). This was due to increased demand in urban areas and the fact that the railways enabled foreign producers to compete effectively for the new markets. A consequence of this would have been a steep rise in food prices. This was in part hacked back by successful expanding white agriculture. Farming remained dominant particularly in Orange Free state, but superficially promising until after world war one and with massive state intervention starting in the 1890s (Wilson, 1971, p114-116; Keegan, 1987 108-112; Feinstein, 2005).

It was not until the beginning of the twentieth century that productivity began to increase. Poverty towards the ends of the 19th century had forced many whites off the land, and those who remained were inefficient and faced unfavorable weather and disease conditions.

Unlike Africans, coloreds did not face big difficulties in adjusting to urban life (Hellman, 1963 p3; Hellman, 1968 p.10). Nevertheless, they still suffered from the coercive labor processes that crippled their established pre-industrial rural and urban survival strategies. The diverse and nutritious pre-industrial diets were replaced by urban diets, largely based on starch and lacked vitamins, fats and proteins (Packard, 1989; Wilson, 1971). The commodity-especially perishables-price wedge between rural and urban areas may have played an important part in urban rural food consumption patterns. Urban dwellers were further from the source of food supply, and, unlike the rural population, were not paying farm-gate prices for agricultural products. Town dwellers paid for the costs of transporting

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40 The contribution of agriculture to GDP rose from 21.5 percent in 1911 to 24.2 percent in 1918. Over the same period that of mining dropped from 27.3 percent to 24.2 percent while manufacturing rose from 5.9 percent to 9.7 percent (see Feinstein 2005, p129). While industry growth averaged 7.5 % per annum from 1910 to 1940s, commercial agriculture only grew by 2.2% per annum from 1910 to end of Second World War.

41 Before the minerals, agriculture was subsistence and food was very simple. According to Wilson (1971 p.113) the Boers only ate only two meals a day. Breakfast was the same as dinner and consisted of stewed meat, with homemade bread and rice, followed by soup with flour dumplings. Vegetables were seldom, while potatoes were only eaten by the English. For Africans, the stable diet was maize, and pumpkins, sour milk and meat. Sorghum, sweet potatoes and beans were common (Wilson, 1971p.113).
food and for the services of middlemen. At the start of the twentieth century mining and urban health officials lacked an understanding of non-white diets until studies in the 1920s began to show the consequences of poor diets and deprivation diseases.

Thus the early period of twentieth century South Africa witnessed drastic economic, social and political changes that were to shape the disease ecology of South Africa with lingering effects on the health and stature of the coloreds and the ‘poor whites’. And as we also show below, the problem of ‘poor whites’ confounds the easy stereotype of the affluent white population in South Africa that benefited from a system that was made to make life easy for them.

The Enlistment Data

Our data like that of any military samples is truncated due to a minimum and maximum stature requirement and therefore are deficient. We rely on South African World War One military enlistment records. This data contains both South African born white and colored and foreign born who migrated to South Africa in search of the riches from the mid-nineteenth century. The data holds a small number of variables on various body measurements. The main variable of interest is height and this was measured consistently. Height was measured to the nearest half-inch. Only few observations have weight and chest size measurements. But because body mass was measure inconsistently and possibly

42 Low wages and high food prices especially after the First World War, and a further drop in purchasing power with the depression increased the incidence of malnutrition among colored and Africans alike. The garden plots provided in early locations were later turned into house plots as population pressure increased. In the 1930s, the quality and quantity of body building foods consumed became more sensitive to income levels. For example, in 1936, the inspector of urban locations in Johannesburg is said to have noted that the demand for milk in one African high milk consuming location dropped to zero when the price rose from two pence to three pence (Packard, 1989, p.147-158).

43 The initial efforts (in 1905) by officials to provide rations for African workers were based on the assumption that Africans were used to living on mealie meal. The resulting rations were nutritionally deficient (Packard, 1989 p.146-158). But in the 1920s and 1930s the variety and nutritional value of foods provided in the mines improved, which led to a decline in scurvy deaths (Packard 1989 p.166-171.). Wylie (1989 pp159-199) shows that by 1920-30s the health and dietary effects (malnutrition, infant mortality, scurvy, rickets, kwashiorkor, tuberculosis) of industrialization, race and class separation, were beginning to alarm health officials.
incorrectly, we do not do it. The socio-economic data recorded covered general literacy, occupation type, and age at enlistment, place of birth/residence and province and race. A notable feature of the enlistment records is that all individuals were asked to give their ages at the time of enlistment, rather than their birth years. Also recorded for all conscripts was the month of enlistment. It is thus possible very accurately assign a year of birth on the basis of the current age down to the month of birth.

Following existing literature, we assume that genetic factors play an insignificant role across population averages but height is correlated with income/wealth, inequality etc (Steckel 1995, p.1903; Komlos and Kriwy, 2003; Clay and Troesken, 2006; Carson, 2006). The date of birth (age) variable is proxied for environmental and socio-economic conditions that possibly changed over time. For white adults and coloreds adults we created time dummies by decades. To avoid the confounding effect of small sample size, the first birth cohort spans from 1865 to 1880 and has 488 observations. Only 74 of the 488 observations from this cohort are between 1865 and 1870. The second birth cohort is from 1881 to 1890. This cohort has 1168 observations. The last cohort is from 1891 to 1897 with 1330 observations. In terms of the colored adults, the first cohort of 1865 to 1880 had 180 observations, of which only 14 are between 1865 and 1870. The second cohort of 1881-1890 had 505 observations and 1891 to 1896 had 614 observations. Among the white and colored sub-adults, we created three age dummies. In terms of white sub-adults, 34 observations from 16 and 17 year olds were discarded leaving 441 cases of 18 year-olds, 500 cases of 19 year-olds and 327 cases of 20 year-olds. As for colored sub-whites, there were no observations below 18 years giving us 65 observations for 18 year olds, 174 cases for 19 year olds and 223 cases for 20 year olds.

From the data it was also possible to identify the place of origin by province and rural/urban locality. These represent the socio-economic environment where the person was born and spent its childhood. Four dummies were created to represent provinces namely; Cape Colony, Natal, Transvaal and Orange Free State and one dummy capturing rural/urban location. Names of registered towns at the nineteenth century are obtained from Marais (1968). This data enabled use to get a detailed picture of the possible geographic
differences conditioned by economic activities, population distribution, pollution and diseases within the context of the discussion in Section 2 above.

Race is categorized as white and coloreds and we expect like in the literature (Steckel, 1995 p.1903; Bodenhorn, 1999.p985) that whites and coloreds to respond similarly to local environment conditions including nutrition, disease and sanitation. White and colored adults are first pooled and then estimated separately to get possible income inequality effects within race groups. This is more important to consider within the context of the ‘poor white’ problem that was to later dominate white public welfare policy in the twentieth century. We then run another regression of white sub-adults as a way to check on the effects of immediate changes in living and health conditions. In our case those below 21 years old(sub-adults) could have been more sensitive to changes in nutrition, diseases and other conditions that took place after 1910, while those between 21 and 50 years (adults), may have reflected more nutritional deprivation and diseases or otherwise during childhood.

In the data, literacy across races can be used as a proxy for parental background/the household’s earning power or household’s economic resources and their ability to access better food and provide better parental care. But because almost all adults and sub-adult whites are literate, we drop the use of ‘literacy’ in all regressions. Even among adult and sub-adult coloreds where 52% and 54% were literate respectively, the ‘literacy’ dummy variable tended to conceal possible differences within coloreds. Instead for all regressions, we capture the stature effect of household’s economic resources and ability of to take good care of their children using the occupation of the children. Granted, literacy level and occupational status may not be perfectly correlated, but occupation is more useful within the period of study. Fortunately, in the data, the types of jobs recorded were very specific, creating about 200 different occupations. Following Davies (1989)\textsuperscript{44} and Carson (2006) four occupation categories are created. First, the highly skilled and merchants are coded as white collar workers. Secondly, manufacturing, construction and related trades are

\textsuperscript{44} Davies (1976 p.68) provides a long list of skilled, supervisory and less skilled jobs that were reserved for whites under the 1904 Labor Importation Ordinance used in the South African mines.
classified as skilled workers. The third category is of farmers made up of workers in agriculture and related areas. The last group made up of unskilled general hands/laborers is classified as unskilled.

**Estimation and Results:**

Table 1 shows a breakdown of observations based on the restrictions we imposed on the data. Because our interest is on South African born men only, we lose 26.3% of the total sample to foreign born conscripts. Our minimum height restriction for the adult white sample ranged from 63 inches to 77.5 inches and 63 inches with a maximum of 76 inches for adult coloreds. The distribution for the sub-adults-sample ranged from 60 inches to 75 inches. The stature regression estimates are obtained using truncated regression in Stata with a maximum likelihood estimator.

![TABLE 1 HERE]

Table 2 provides descriptive statistics for the white adults and colored adults and the white sub-adults. Almost 45% of white adults were born between 1891 and 1900, while 63% of the adults grew up in Cape Province and 19% in Transvaal. About 55% of adult whites were domiciled in urban areas, while 97% were literate giving credence to policy of compulsory and advanced white education. The distribution by occupation is equal between white collar and skilled at 28%, and 22% among farmers and 17% for unskilled. The birth cohorts of adult coloreds follow those of whites. A majority of coloreds fall into the 1891 and 1900 cohort, while close to 90% of the colored groups were domiciled in the Cape Colony. The negative effect of policy on colored education is reflected by the relatively low literacy which limited their economic advancement. Only 52% of the colored sample was literate, while 62% were unskilled and 32% were in skilled jobs. Nevertheless, these were mainly low grade tasks. Since land ownership especially in the old Cape Colony was dominated by whites, it is not surprising that only 3% of coloreds were farmers. Save for Africans that possessed land of any scale, most coloreds did not own farms, and a few that did were confined to mission settlements, subsistence communities as pools of labor for white farmers (Simkins and Van Heyningen, 1989 p.100).
In terms of the sub-adult sample, most of the white sub-adults were domiciled in urban areas and in the Cape Colony. Approximately 99% of them are literate, and 36% engaged in white collar jobs, 29% involved in skilled jobs and 14% in farming. Even though they were still to achieve full height, their mean height was only 0.9 inches shy of the adults white average. Their relative socioeconomic advantage is more apparent because they were on average 1.4 inches taller than adult colores and 2.4 taller than colored sub-adults. The discussion below will show that this difference reflects and an improvement in the opportunities of white children in the twentieth century. On the contrary, the colored sub adults are shorter on average, that white sub-adults. Though 64% of them are domiciled in urban areas, their conditions and prospects for career advancement were restricted by lack of skills (67% unskilled) and other policy barriers.

[TABLE 2 HERE]

As discussed in Section 2 above the allocation of resources reflects the timing and average stature of individuals. To assess these effects, we plot the height distribution of adult white and colored heights by year of birth as shown in Figure 1. We then estimate the stature of whites and colores separately, before using the same procedure for sub-adults individually and together with white adults. Figure 1 shows two general patterns. The first is that whites are strikingly taller than coloreds by an average of 2.4 inches. The second is that colored stature declined at a faster rate than whites, particularly the sharp decline in the cohorts 1881 to 1890 and 1891 to 1896.

[FIGURE 1 HERE]

Estimating the determinants of Stature:

In this section we present the estimation results of the determinants of stature. Figure 1 shows that mean height for adult colores was 2.4 inches lower than adult whites, the causes remain to be identified. Tables 3, columns one to six present the coefficients and model statistics. The coefficient estimates of all the models are significant. The Wald Chi-
square used to test that all the model coefficients are jointly zero was statistically significant at the one percent level.

**White and Colored Adults:**
The pooled estimates of white and coloreds adults are presented in Table 3 column one. They show that holding all else equal, white adults are on average much taller than colored adults by 2.4 inches. This difference is statistically significant at the one percent level. Since race has no differential effect under similar socio-economic conditions, this height difference reflects the effects of racialized disparities in incomes, urban living conditions, access to health services and other conditions discussed in Section 2. This gives credence to the extant literature on the adverse effects of the disease environment and diets on body size (Komlos and Coclains, 1995; Bodenhorn, 1999; Carson, 2006; Carlton and Troesken, 2006; Coelho and McGuire, 2000; Steckel, 2000; Bassino, 2006).

Applying 1865 to 1880 as the omitted age cohort, the results show no significant difference between the cohorts. Since colored adult stature declined (see Table 3 Column 3), the lack of significance of any of the cohorts shows that the white sample has a confounding effect on the pooled sample. Using the Orange Free State as the reference province, Cape Colony and Transvaal dwellers had a height disadvantage of 0.65 inches and 0.59 inches respectively. This reflects the environmental penalty that varied across provinces. It was argued in Section 2 that industrialization led to the massive expansion of port cities leading to high population densities, spread of infectious diseases and diseases of deprivation in provinces of Cape and Natal around Cape Town, Port Elizabeth, East London and Durban. Packard (2001) discusses the ravaging effect of Malaria in Transvaal and how this hampered development. In addition, urban settlement is associated with a 0.44 inches disadvantage in height relative to rural areas. This not only reflects the importance of access to food and relative food prices as discussed in Section 2. Those in the rural areas had access to more nutrients relative to urban dwellers. However, improved communications, opening up of markets and increased productivity and efficiency in agriculture, increased food availability in urban areas later in the 20th century. Steckel also

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45 Margo and Steckel find that Southern whites were taller by up to 2 inches than southern blacks.
shows that rural areas had a height premium over cities and towns in the United States in the late nineteenth century and the urban height advantage is a recent phenomenon (Steckel, 1995 pp1921-1922). This result concurs with evidence showing height discrepancies across geographic regions due to economic and other factors (Bodenhorn, 1999 p.984; Bassino, 2006; Arcaleni, 2006).

In the pooled sample, there are also significant differences by occupation. Using farmers as a reference category, the unskilled adults were statistically and significantly shorter by 0.45 inches, white the skilled were shorter by up to 0.39 inches, but those in the white collar category were not significantly shorter. These observations are discussed in detailed under individual race categories below.

White adults:
Table 3 column two presents estimates for the white adults. While in general there was a stark income inequality between races, the results also show that height is also sensitive income distribution among whites themselves. In general, the affluence of whites grew with industrialization, but there was also deprivation among whites particularly the Boers whose failure to quickly respond to the vicissitudes of the industrial age- particularly acquisition of human capital skills- made them worse-off. Using white farmers as the reference category, unskilled whites were significantly shorter by 0.35 inches at the 10% level. Cross tabulations show that most of these unskilled were urban domiciled while those unskilled but rural domiciled may have suffered from limited access to a healthier lifestyle because of their poor background. Those in the white collar category were not significantly shorter than farmers. A majority of them may have been domiciled in the urban areas, but some also lived in the rural areas, where they began to form the backbone of the emerging rural businesses. The skilled tradesmen were significantly shorter than farmers by 0.40 inches at the 1% level. Thus farmers were significantly taller because they would have grown up on the farm and sparsely populated rural locations, increasing their access to nutrition and reducing their exposure to diseases. Section 2 underlined that fact that agriculture remained sluggish and farmers impoverished until the turn of the century with the onset of state assistance, those farmers who remained behind still could live a more healthier life with
less diseases as aggregate crop output increased particularly after the union of 1910. It could also be that more physically able whites selected into farming. In general, the occupational differences may have declined due to public policy later in the nineteenth century than it was earlier on. However during the period under study, this difference persisted as reflected through sub-adult white heights, which had to be tackled through the massive poor white social welfare programs into the 1930s.

However, there were significant differences across provinces and between rural and urban areas. Using Orange Free State as the reference category, those in the Cape Colony were shorter by 0.70 inches at the 1% level. Those in Natal were 0.61 inches shorter, but the Transvaal category was not significantly shorter. The urban penalty is also clear among whites. Urban whites were significantly shorter than rural whites by 0.47 inches at the 1% level. This perhaps explains the problem of poor whites in urban areas as well as across suburbs in urban areas as shown by Unterhalter (1982) in Johannesburg. Birth cohort is insignificant in explaining stature changes among whites. This reinforces the general progressive advantages of industrialization that accrued to whites as a group. At the same time, occupational height advantages/disadvantages expose the underlying growth of inequality among whites that created differential effects on their stature.

**Adult coloreds:**

Table 3 column three shows that stature also varied among coloreds but without the clear social gradient evident among the whites. Using the 1865 to 1880 cohort as a reference, the 1881 to 1890 cohort was significantly taller by up to 0.44. Unlike under whites, there is no significant stature difference across provinces and rural urban areas. The provincial distribution of coloreds where 93% of them were domiciled in Cape Colony and limited class inequality explains this pattern. The lack of the urban height penalty even though 44% of them observations were rural perhaps explains the lack of better conditions for coloreds in the rural areas where they largely served as farm labor (Katzenellenbogen et al, 1993).

Using farmers as a reference category, the white collar and skilled categories do not seem to be any different from the farmers. The unskilled category is significantly shorter by 0.86 inches at the 5% level. Contrary to the adult category where the social gradient is glaring,
the lack of clear social differences among coloreds reflects the abject lack of opportunities among coloreds. According to Golding and Joshua (1953 p.73) ‘the social status enjoyed by colored people depends upon the type of employment in which they are engaged, which in turn has a bearing on the amount of education which colored people are able to give their children’. Later in the twentieth century, coloreds became recognized for their aptitude in skilled/semi-skilled trades such as qualified bricklayers, plasterers, carpenters, mechanics, sheet metal workers, upholsterers etc, yet a vast majority remained as unskilled farm laborers and domestic servants etc (Golding and Joshua, 1953 p.70-73). In 1937, a commission of enquiry into the state of coloreds could report an influx of coloreds into urban areas for better working conditions, wages and educational opportunities for their children (Wilson, 1971 p.179).

**Sub-adult whites and coloreds:**

Table 3 columns four provides the estimates for the pooled sub-adult colored and white sample. Sub adults whites are significantly taller than sub adults colored by 1.86 inches at the 1% level. This not only reflects the longstanding socio-economic advantages of whites in general, but that industrialization and access to better health conditions had a positive impact on their stature relative to colored sub-adults. Like under the pooled white and colored adults, urban areas suffer from an urban penalty, but the provincial differences apparent among the adults diminish, perhaps reflecting continued reduction in regional disparities that may have accompanied industrialization.

There are however differences by occupation reinforcing the persistence of the racial and social divide in access to services and living conditions. This is both apparent in the pooled sample and the split samples. Using farmers as the reference category, unskilled individuals were significantly shorter by up to 0.99 inches and skilled ones by 94 inches. Even the white collar individuals are significantly shorter than farmers by 0.47 inches. If only considered for white sub-adults, the social gradient becomes even more glaring. The white collar, unskilled and skilled categories are significantly shorter than farmers by 0.47 inches, 0.96 inches and 1.0 inches respectively. Sub-adult whites particularly those poor still suffered from the urban penalty, which was a result of overcrowding and the diseased
environment, relative to the less diseased rural conditions. They were thus significantly shorter than their rural counterparts by 0.5 inches. Column six extracts the possible stature determinants among sub-adults coloreds. Again, reminiscent of the adult colored, economic and social conditions afflicted the welfare coloreds in similar ways resulting in a less clear social gradation. Urban residents were not significantly shorter than their rural counterparts. Even though results may suggest that provincial height differences persisted as the Cape Colony and Transvaal categories were significantly shorter than the Orange Free State, this is more a reflection of the distributional bias of coloreds-95% in the Cape Colony. Like under the adults, these differences reflect the poor white problems.

Conclusions:

This paper has provided the first evaluations of the quantitative health effects of the drastic socio-economic and racial ramifications of South Africa’s rapid industrialization and urbanization up to the First World War. Multivariate methods were used to estimate factors associated with the discrepancies in stature controlling for race and a number of socio-economic factors. Results show that the rise in income inequality and urbanization related differences in epidemiological environments between whites and coloreds were quite significant. The poor socio-economic environment and racial segregation in health care provision are strongly correlated with a declining stature of the colored population. The initial exposure of whites to Malaria and Tuberculosis was quickly curtailed as whites gained better access to advanced medical interventions as their socio-economic and political supremacy grew during the twentieth century. Indeed, the racial divide prevented policy makers from seeing the similarities between the forces that drove the country people of different races to the towns. The problem of the ‘poor whites’ and policies for its eradication reflect both this racialized bias and a nuanced socio-economic gradation among the whites. This confounds the easy interpretation of a white South African society that was teeming with affluence. Many of the processes that produced non-white impoverishment, proletarianization and ghastly social conditions also created a class of whites that lived only in slightly better conditions until well into the twentieth century, when their political
mobilization permitted significant changes in their circumstances, albeit usually at the expense of the non-white population. Later in the twentieth century, the general health of the non-white populations improved due to better health and economic conditions, albeit under apartheid. We have shown that early life conditions such as diseased environments and lack of access to nutrients and calories are reflected in adult stature.

These quantitative health effects of industrialization can be generalized to the poor urban Black South Africans who were in the majority. There are also important implications for these results among the marginalized groups in other Southern African countries, though the effects are likely to be conditioned by particular institutional contexts and circumstances. There is need to extend this analysis to looking at countries in which like South Africa, white settlers monopolized power like in Southern Rhodesia and those where white supremacy was more restricted such as Northern Rhodesia, Nyasaland and Swaziland.

References:


Burns, C. 1998. ‘A Man is a Clumsy Thing who does not know how to handle a sick person’: Aspects of the History of Masculinity and Race in the Shaping of Male Nursing. In South Africa,


Table 1: Breakdown of data:

<table>
<thead>
<tr>
<th>Description</th>
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</thead>
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<tr>
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<td>Observations foreign born</td>
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<tr>
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<td>1857</td>
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<tr>
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<tr>
<td>South Africans above 50 years</td>
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<tr>
<td>South Africans 21 to 50 years</td>
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</tr>
<tr>
<td>South Africans 21-50 and &lt; 5f.3”</td>
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</tr>
<tr>
<td>South Africans 21-50 missing height</td>
<td>17</td>
</tr>
<tr>
<td>All South African Adults</td>
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</tr>
<tr>
<td>All South African adult coloreds</td>
<td>1303</td>
</tr>
<tr>
<td>All South African adult whites</td>
<td>2988</td>
</tr>
<tr>
<td>All South African sub-adults</td>
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</tr>
<tr>
<td>All Sub-adults without missing</td>
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</tr>
<tr>
<td>Sub-adults coloreds only</td>
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<tr>
<td>Sub-adults whites only</td>
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Table 2: Full sample descriptive Statistics:

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<th>WHITE ADULTS</th>
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<th>COLORED ADULTS</th>
<th></th>
<th>WHITE SUB-ADULTS</th>
<th></th>
<th>COLORED SUB-ADULTS</th>
<th></th>
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<td>Mean</td>
<td>S.D</td>
<td>N</td>
<td>Mean</td>
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<td>0.346</td>
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<tr>
<td>1881 to 1890</td>
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<td>1303</td>
<td>0.388</td>
<td>0.488</td>
<td>-</td>
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<tr>
<td>1891 to 1900</td>
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<tr>
<td>18 years±</td>
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<td>0.497</td>
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<td>0.324</td>
<td>0.468</td>
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<tr>
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<td>0.521</td>
<td>0.500</td>
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<td>0.990</td>
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Notes:
*Variables omitted during estimation to avoid dummy variable trap
† Variable not used in all estimations
*All covariates except the dependent variable (inches) are dummy variables.
Figure 1: Average height trends among white and colored South Africans:
Table 3: Truncated regression results of the determinants of stature among South Africans. Dependent variable is inches:

<table>
<thead>
<tr>
<th></th>
<th>ADULTS</th>
<th>SUB-ADULTS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>WTE&amp;COL</td>
<td>WHITES</td>
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<td>CONS</td>
<td>67.0627</td>
<td>69.6198***</td>
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<tr>
<td></td>
<td>(265.150)***</td>
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<tr>
<td>1881 to</td>
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<td>-0.0829</td>
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<tr>
<td>1890</td>
<td>(0.230)</td>
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<tr>
<td>1891 to</td>
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<tr>
<td>1900</td>
<td>(-1.340)</td>
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<tr>
<td>19YRS</td>
<td></td>
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<tr>
<td>20YRS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPE</td>
<td>-0.649***</td>
<td>-0.703***</td>
</tr>
<tr>
<td></td>
<td>(-3.800)</td>
<td>(-3.930)</td>
</tr>
<tr>
<td>NATAL</td>
<td>-0.076</td>
<td>-0.610***</td>
</tr>
<tr>
<td></td>
<td>(-0.390)</td>
<td>(-2.590)</td>
</tr>
<tr>
<td>TRANS</td>
<td>-0.590***</td>
<td>-0.043</td>
</tr>
<tr>
<td></td>
<td>(-2.600)</td>
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</tr>
<tr>
<td>URBAN</td>
<td>-0.437***</td>
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<td>(-5.030)</td>
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<td>WCOLLAR</td>
<td>-0.214</td>
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<td></td>
<td>(-1.640)</td>
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<tr>
<td>SKILLED</td>
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<td></td>
<td>(-3.160)</td>
<td>(-3.020)</td>
</tr>
<tr>
<td>UNSKILL</td>
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<td>-0.345**</td>
</tr>
<tr>
<td></td>
<td>(-3.390)</td>
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<td>WHITE</td>
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<tr>
<td>Wald</td>
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<tr>
<td>Chi-square</td>
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<td>(10df)</td>
</tr>
<tr>
<td>N</td>
<td>4291</td>
<td>2988</td>
</tr>
</tbody>
</table>

***, ** and * denote statistical significance at one, five and ten percent levels. Z-statistics are shown below estimates.

Note standard errors in all the models were estimated using White’s heteroskedastic consistent standard errors.

The omitted birth cohort for adults is ‘1865-1880’ and 18 years for sub-adults. Omitted province is Orange Free State and occupation category is Farmers.