GOTHENBURG STUDIES IN ECONOMIC HISTORY 10

Social bodies

Family and community level influences on height and weight, southern Sweden 1818–1968

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ABSTRACT

Social bodies. Family and community level influences on height and weight, southern Sweden 1818–1968
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This dissertation consists of an introduction, four research papers and one paper describing the data I collected for the studies and how I conducted the study. I collected information on men from conscript inspection lists and linked this to a sample of men in the Scanian Economic Demographic Database (SEDD) born between 1797 and 1950. The four research papers analyze influences on height and weight in the 19th and 20th centuries using individual-level data with uniquely rich and detailed information on community context and family background.

Paper 1 investigates the long-term changes in socioeconomic differences in height. Sons of landholders were, on average, taller than others in the early and mid-19th century but lost this advantage in the late 19th century. Sons of fathers with non-manual occupations were always the tallest group in the population. The magnitude of the socioeconomic differences in height varied over time but became smaller over time.

Paper 2 investigates the association between the number of siblings present in the household and the height of the sons. I find that men with a larger number of siblings were, on average, shorter than others in the 19th and early 20th centuries. Dilution of parental resources is a likely explanation of this. The results show that, even if the parental resources were important, it is also important to consider the societal and historical context.

The average height of men in Sweden shows a closely mirrored development to the level of infant mortality. In Paper 3 I test the association between height and the infant mortality rate in the year of birth, first year of life and the adult death rate during pregnancy using a sibling comparison design. I find that both the influence of the risk of being sick as an infant and the selection effect of mortality on height are likely to be weak.

Paper 4 investigates the occupational differences in body mass index among men born between 1934 and 1950. Socioeconomic differences in body mass index and the risk of obesity are found almost universally in present-day high-income countries. Information on these differences prior to the most recent decades is scarce, for Sweden and internationally. I find that the occupational differences in body mass index were similar in the mid-20th century and in present-day Sweden.

KEYWORDS: height, weight, body mass index, demography, demographic history, anthropometry, anthropometric history, standards of living, socioeconomic status, socioeconomic differences, resource dilution hypothesis, infant mortality, early life.

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Gothenburg, February 2014
Stefan Öberg

Content

Introduction

1. Family and community level influences on height and weight

The living conditions for humans have changed dramatically over the last centuries. The changes have been especially drastic in now industrialized societies where, for example, average income per person in the early 21st century is at least twenty times larger than it was in the early 19th century (Maddison 2010).[1] Human lives have also been fundamentally changed in these parts of the world through the decline in mortality rates that has more than doubled the average human lifespan (Riley 2001; Deaton 2013). The radically improving living conditions in Europe and North America, especially during the last two hundred years, are also mirrored in bodily growth and development (Hauspie, Vercauteren, and Susanne 1997; Steckel and Floud 1997; Danubio and Sanna 2008). The debate on how the improving living conditions, economic growth, societal changes, and increases of average height and longevity are interrelated is still ongoing (Floud et al. 2011; Costa 2013; Deaton 2013; Easterlin 2013). For example, while it is clear that improving living conditions have influenced growth and achieved heights, opinions are more divided over what role improving living conditions have played, in particular, in the beginning of the mortality decline.

Humans and their bodies are fundamentally influenced by their surrounding environment. But they also shape their environment and have done so not least during the most recent centuries. A person's capacity to work and contribute to society is affected by her health, bodily strength and longevity (World Health Organization 2009, 14f, 31–34 and chap. 4; Floud et al. 2011, 20–24, 282–284; Costa 2013). The increasing life expectancy, increasing average height and, most likely, improving health of people during the past two hundred years therefore also have the potential of having contributed to the positive economic and societal developments. Robert W. Fogel and many others have forcefully argued the interrelatedness of economic, societal and bodily developments during the last centuries in a large number of articles

1 The focus in this overview will be the developments in the now industrialized countries in Western Europe and North America. The description of the development over the past centuries would of course be quite different if one considered other parts of the world.

and books (e.g. Fogel et al. 1985; Floud, Wachter, and Gregory 2006 [1990]; Fogel and Costa 1997; Steckel and Floud 1997). Roderick Floud, Robert W. Fogel, Bernard Harris and Sok Chul Hong have recently published a book, called *The Changing Body*, where they summarize these arguments (Floud et al. 2011).

Historical studies of human bodily growth and development have expanded rapidly during the last decades and have come a long way in describing the historical changes of, especially, human height (Steckel 1995; 2008; 2009; 2013; Komlos 2009; Ulijaszek and Komlos 2010; Inwood and Roberts 2010). The average height of people in Western Europe today is at least 12 centimeters, almost two standard deviations taller than it was two hundred years ago (Garcia and Quintana-Domeque 2007; Hatton and Bray 2010). The increases in average height have been too fast to have been caused by genetic factors and must therefore reflect environmental influences on growth (Steckel 1995; Cole 2000a, 321; McEvoy and Visscher 2009, 295).[2] This makes the average height of populations and groups a useful measure of their living conditions.

Information on the average height of population and groups therefore provide some insight into their standards of living and health status. By investigating trends in height it is possible to gain some knowledge about changes in living conditions and health for historical populations when this kind of information is scarce. Knowledge about historical heights also makes it possible to compare their developments with developments of mortality rates to discuss how improving living conditions have contributed to the mortality decline (Floud et al. 2011). By comparing the average height of groups we can also get otherwise rare insights into differences within populations of living conditions and health status.

While the secular trends in height are well-documented it is less clear which factors have been the most important underlying causes (for example, Hauspie, Vercauteren, and Susanne 1997, 24f; Malina 2004, 24). It is difficult to interpret any differences and changes in height because of the very large number of factors that can influence growth from the time in utero (or even before) until final adult height is reached (compare, for example, Steckel 2008, 136; Steckel 2009, 7f; Floud et al. 2011, 12f). We have no reason to expect the trend to be the result of any single cause but the relative importance of different causes has implications for how we should interpret the trend and its relation to other contemporary fundamental changes, such as the mortality decline. It is difficult to analyze the underlying causes of a trending variable,

2 The same goes for the increasing prevalence of obesity over the 20th century (Swinburn et al. 2011, Panel 4).

such as the average height in Sweden, Europe and North America during the last 150 years, since the number of factors that are known to influence growth and height is so large (the determinants of height are discussed further below in section 3). Societies experiencing the increasing average heights were changing dramatically in many ways during the same time with industrialization, increasing productivity, rising real wages, changing diets and falling mortality rates. The secular trends in average height have been shown to be very similar to trends in national income levels and the number of consumed calories. The secular trends also show closely mirrored developments to changes in levels of fertility and mortality.

The factors influencing growth and achieved height are relatively well-known from studies on present day populations (Section 3). What is still unknown is the extent to which the relative importance of different influential factors was the same historically as today. Different diseases, for example, affect and are influenced by the nutritional status of individuals differently. The changing patterns of diseases over time could therefore have resulted in changing the relative importance of diet and disease as influences on growth. The populations in present day high-income countries were also shorter in the 18th and 19th centuries than almost any population even in low-income countries during the 20th century (Floud 1989, fig. 11.1). We therefore do not know to what extent the knowledge on influences on growth today can be generalized in a historical context. Despite the large and rapidly growing literature there is still a need for more studies, not least ones combining the long time perspective of the studies that most often use aggregate data with the detailed background information of studies using individual level data. Several of the suggestions in the previous literature on associations between height and environmental influences, and the causes of the secular trend in height, can only be tested using individual level data covering a long time period.

The research theme of the dissertation is to investigate different determinants of height and weight. I have linked information from lists from universal conscript inspections to a sample of men in the Scanian Economic Demographic Database born between 1797 and 1950, who were inspected from 1818–1968. The combined data sets provide, for historical studies, uniquely rich information on family relations, socioeconomic background and community level context in combination with individual measures of height. The included papers study the determinants of height and weight by examining their associations with family and community level factors. Associations between height and weight and the socioeconomic status of the family and the number of siblings are well established for present day populations. My studies contribute by investigating if these factors influenced height and weight in this historical population. The long time period covered also enables me to investigate if the associations changed over time or not. Taken together this can contribute to our understanding of both why these factors are associated with height and weight and if the underlying causes of the associations have changed over time. The secular trends in height are mirrored by falling infant mortality rates. Exposure to disease around birth has also been shown to influence later life outcomes. I therefore test if height was influenced by exposure to disease around birth in individual level data by using the rich information on the family and community context of the men in the sample.

The dissertation consists of four analytical papers (Papers 1–4) and one paper describing the data collection and extracted variables (Paper 5). Three of the papers analyze differences in height of men with different experiences and backgrounds, examining the associations between height and socioeconomic background, sibship size and disease exposure. The fourth paper analyzes socioeconomic differences in weight. The main results could be summarized:

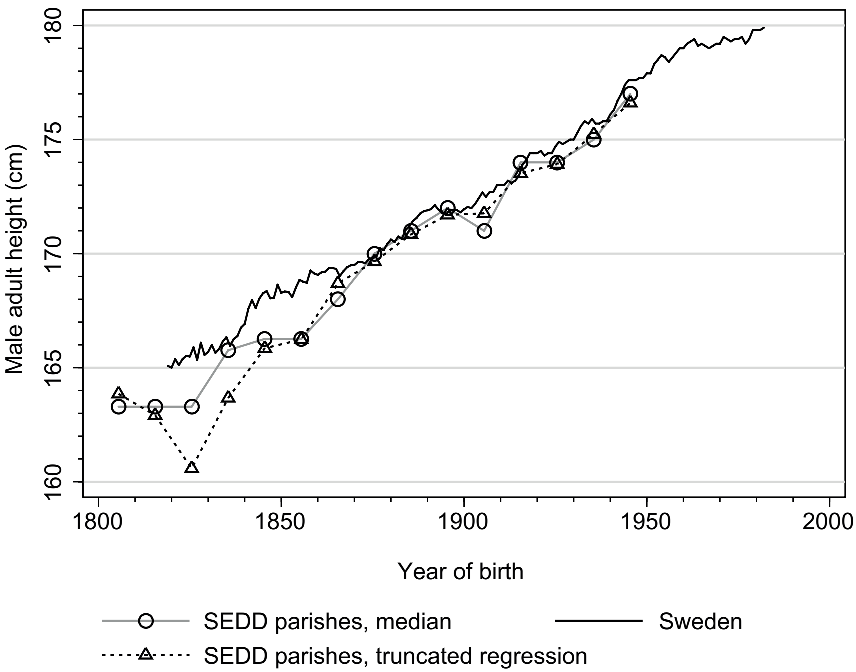
Most of the secular trend in height was shared by all groups in the studied society. There were still always socioeconomic differences in height in the population. The magnitudes of the differences vary over time but also show a tendency to become smaller. Economic and social changes along with improving conditions over time were important for reducing the socioeconomic differences in height. Improving conditions over time also reduced differences in heights depending on the number of siblings. Men with many siblings present during childhood were shorter than others during the 19th century and early 20th century but not by the mid-20th century. The association was also influenced by social differences in fertility behavior, and this influence changed as behaviors and the social patterning of behaviors changed. There is no doubt that disease influences nutritional status but the influence from disease on growth and achieved heights comes from frequency, severe and prolonged diseases, especially in combination with suboptimal nutrition. There was no consistent or significant direct influence from disease exposure around birth, as measured by community level mortality rates, on early adult height. Social differences in weight are found as consistently as differences in height. The occupational differences in the mid-20th century were very similar to the ones found in late 20th century Sweden.

The rest of the introduction is organized as follows. Section 2 presents the secular trend in height in Sweden during the 19th and 20th centuries. Section 3 presents some of the previous research on important determinants of heights. Section 4 presents the data and methods used in all four studies which are in turn presented in more detail in section 5. Section 6 concludes with a discussion of the results.

2. The secular trend in height and weight in Sweden

Lars Sandberg and Richard H. Steckel participated in the pioneering research on historical developments of heights in the 1970s by researching data on soldiers in the Swedish Provincial Army (Sandberg and Steckel 1980; 1987; 1988). Sweden was therefore among the first countries to have its historical height development investigated. Sandberg and Steckel did not find any clear trend in the average during the 18th century (Heintel, Sandberg, and Steckel 1998). What is known about the even earlier trend is based on estimating heights from skeletal remains. Even though the heights estimated from skeletal remains cannot easily be compared with measured heights, it seems that there was no clear trend in the average height in the nine centuries before 1700 either (Gustafsson et al. 2007).

FIGURE 1 The average height of conscripted men in Sweden born 1797–1982



Note: Sweden: Data from universal conscript inspections. Men born 1819–1906, median height (Hultkrantz 1927 tab. 6, 8, and 11), men born 1907–1910, average height (Kungl. Arméförvaltningens sjukvårdsstyrelse 1931, 19), men born 1911–1924, average height (Statistiska Centralbyrån 1933–1945), men born 1935–1949, average height (Statistiska Centralbyrån 1969, tab. 1.16), men born 1950–1982, average height (Pliktverket 2000). The average height for the men in the five sampled southern parishes was adjusted for the shortfall and was estimated using a truncated maximum likelihood regression utilizing only the observations above the minimum height requirement for being accepted as a conscript. The median for the five sampled southern parishes is the median of all height observations, above and below the minimum height requirement.

Figure 1 summarizes what is known about the development of the average height of men in Sweden born in the 19th and 20th centuries from conscript data. The Swedish national trend has been carefully investigated by Sandberg and Steckel using data on conscripts (Sandberg and Steckel 1997; see also Åkerman, Högberg, and Danielsson 1988). The secular increase in average height in Sweden started among men born in the second quarter of the 19th century. Universal conscription had started already in 1812 (Paper 5) but the published statistics unfortunately only start with the men born in 1819 onwards. We therefore do not know if the lack of a clear trend seen for the Scanian data for men born 1797–1818 is representative of the country in general. The average height started to increase at about the same time in southern Sweden as in the country in general. The large difference in average height among men born around 1850 in the SEDD parishes compared to the national trend is most likely a consequence of the differences in who is included in the data. The Scanian data include the height of men who were shorter than the minimum height requirement while the national series is then based only on men accepted for conscription.[3] The subsequent linear trends are very similar for the Scanian parishes and for Sweden. The slowing down or cessation of the secular trend in the late 20th century, that can be seen in the national series, has been observed also in Norway, Denmark, the Netherlands and Italy while heights otherwise continue to increase in today's still shorter populations in Eastern and Southern Europe (Larnkjær et al. 2006).

Some of the increase in average height was the result of earlier physical maturation of the inspected men. In adverse environmental conditions growth is slowed and this can result in shorter stature among adults (See section 3 below). This is why people were shorter in the 19th and early 20th century compared to today. But when growth is slowed during infancy and childhood people can also continue to grow for a longer time and reach their final adult height later (Eveleth and Tanner 1990, 192; Golden 1994). Today most men reach their final adult height in their late teens. In the early 19th century people continued to grow into their twenties (see section 3.5 below). Improving conditions for growth result in both taller average stature and faster physical maturation. Parts of the increase in the average height during the 19th century

3 Truncated regressions are the best method for estimating the average from a sample where we do not have data on heights below a minimum height requirement (Komlos 2004). The estimates are unbiased but simulations show that the variability of the estimates increase when the truncation point is close to the sample average and with small samples (results not shown). The temporary down-turn in height for men born in the 1820s in Figure 1 is not replicated in the median. It should therefore be tested in other, larger samples before we conclude too much from it.

are therefore a result of earlier maturation with an increasing share of the inspected men having reached their adult height at inspection. The estimated average is therefore not an estimate of the average adult height in the population (compare Hultkrantz 1927, 45f). The average adult height of the men is likely to have been one or a few centimeters taller than the average at the conscript inspections.[4] The increase still reflects an improvement among the factors influencing heights but might not reflect changes of the adult final height in the population.

Almost nothing is known about the long-term development of body weight in Sweden, or in other countries. The average body mass index[5] (BMI; kg/m^2) among conscripted men in Sweden born from 1934–1950 was constant at, about, 21 kg/m^2 (Paper 4, Figure 4.1). The average BMI started to increase among men born in the 1950s. The BMI increases with age during adolescence and early adulthood. Some of the early trend is, most likely, a result of a trend towards earlier physical maturation, as discussed above.

Floud (1998) summarizes about 1500 observations from published sources on the height and weight of men and women in Britain born from the 1810s and onwards. He finds no indication of any trend in BMI over the 19^{th} century. The average BMI was about 21–22 kg/m^2 among 22 year old men born in the 19^{th} century. Historical information on height and weight are, as mentioned, scarce but other sources also tend to find BMIs among young adult men in the 19^{th} century to be about 20–25 kg/m^2, with most observations around 22 (Arbo 1875, 77; Forssberg 1897, tab. 1, 144f; Costa and Steckel 1997, fig. 2.4, 55; Costa 2004, tab. 1, 8; Komlos 2006, fig. 5, 314; Hiermeyer 2010, fig. 3, 129; Staub et al. 2010, tab. 1, 336; Carson 2012, fig. 3, 205).[6] Much more research

4 During the early and mid-19^{th} century some men that were shorter than the minimum height requirement had to appear for inspection in the following year(s). Hultkrantz (1927, 7) judged that the published statistics on the average height of conscripts did not include these older men. I think he was wrong about this and that the inclusion of also some of the one (or several) year(s) older men is the explanation for the temporary shift in the trend for men born in the decades around 1850. It was only men who had grown since the last inspection that were accepted as conscripts so including them in the data could increase the average. The Scanian data on men born around 1850 include also the first measure of height of men below the minimum height requirement. This could explain some of the difference in height between the Scanian and national series for these decades.

5 The body mass index (BMI) is a measure of weight standardized for height calculated by dividing the weight in kilograms by the height in meters squared. There are standard cut-offs for judging a person to be under- or overweight based on their BMI.

6 These averages are somewhat higher than the lowest observations from present day low-income countries. The Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group (2013) has gathered data on average BMI for adult

is needed before we can conclude anything certain about the long-term trend in weights. It would be especially useful with representative samples since most of the previous results are based on selected, and thus possibly biased, samples.

3. Determinants of height

This dissertation relates to the discussion of determinants of height. In this section I therefore provide an overview of influences on growth and achieved height. This is done in five sections relating in turn to impacts from genetic factors, environmental factors in general, nutrition, disease and the timing of environmental influences. The section is also intended to provide a background for the papers to allow the reader to interpret the differences and changes found in the papers.[7]

3.1 Genetic influences

That height is highly heritable is easily observable and has been known for a very long time (Tanner 2010 [1981]). Genetic factors are important for determining differences between individuals in growth and achieved height. As much as 80 percent of the variation in height is judged to be heritable (McEvoy and Visscher 2009). The twin studies that are used to assess the amount of a trait that is heritable is not beyond critique (for an introduction to the critique, see Stenberg 2013). It is possible that the 80 percent heritability includes also other than purely genetic influences, both environmental and gene-environment interactions. Studies that evaluate the relative importance of genetic and environmental influences also risk underestimating the latter because the variation in environmental conditions is oftentimes so limited (Swinburn et al. 2011, Panel 4). Despite the dramatically increased possibilities for genetic research in the last decades the heritability of height (as with

men and women from 199 countries for the years 1980–2008 (see also Finucane et al. 2011). The five lowest values (from different populations) for average BMI among young adult men (age 20–24 years) are 18.5 kg/m2 (Senegal, 1981), 18.5 (Lao People's Democratic Republic, 1980), 18.6 (Chad, 1980), 18.6 (Ethiopia, 1980) and 18.7 (Zambia, 1980).

7 Most historical anthropometric research has been largely lacking theoretical foundations (but see Floud et al. 2011). The quantitative analyses are often descriptive rather than deductive. This goes for most of my studies here as well. Section 3 is therefore an introduction to previous research rather than a theoretical background.

most other traits and diseases) is still poorly understood. The (until 2011) 180 DNA sequences that have been found to influence growth and adult height explain only about 10 percent of the population variation (Lettre 2011). I see no reason to doubt that height is highly heritable and largely determined by genetic and other biological processes, but it is worth remembering that exactly how and why is to a large extent still not known (see e.g. Golden 1994 on possible epigenetic influences).

Despite the strong heritability it is very difficult to predict the height of a child from the height of a parent. Even if the average of the parents' height as standard deviation scores is the best available guess for how tall a child will become there is still large, yet poorly understood, individual variation. Ninety to ninety-five percent of children grow to be of a height that is within 1.5 standard deviation from the average of their parents (Luo, Albertsson-Wikland, and Karlberg 1998; Wright and Cheetham 1999). As a comparison we would expect 87 percent of the values of a *random* normally distributed statistic to fall within 1.5 standard deviations around the mean.

One way to conceptualize genetic and environmental influences on growth and achieved height is that each individual has a genetic potential. The full potential will only be reached under optimal conditions so that (almost) all observed heights are results of growth deficits (Werner 2007). A result of this way of conceptualizing growth is that we should expect that height is more highly heritable under favorable conditions than under worse conditions, so-called environmental suppression (of heritability) (Tanner 1990, 120; see also Floud et al. 2011, 188). With improving living conditions over time we should therefore expect estimates of heritability to increase over time. This prediction has, to the author's knowledge, only been tested once in samples of twins in Finland. Silventoinen and coauthors (2000) indeed find that the estimated heritability of height increased over the 20th century. Alter and Oris (2008) find that the heights of brothers from higher status families were more strongly correlated than for brothers from lower status backgrounds. They interpret this as being a result of environmental suppression. Mueller (1976) finds large variations in parent-child correlations for height in different samples. The correlations are somewhat stronger in high-income countries than in low-income countries, but the pattern is not very strong. Martorell and coauthors find similar parent-child correlations in Guatemala as in well-nourished populations (Martorell et al. 1977). I find no clear trend in the share of variation in height that could be explained by the men's socioeconomic background (Paper 1, Table 1.3). The evidence this far is therefore inconclusive and the question would deserve more attention in future historical anthropometric research.

While genetic variations are likely to be creating most of the variation around the mean within populations, the mean in itself is largely determined by the living conditions of the population and not by genetic differences (Steckel 1995; Floud et al. 2011, 23f). The World Health Organization (WHO) has developed growth standards for infants, children and adolescents that can, for example, be used to screen for children that are undernourished or ill (WHO Multicentre Growth Reference Study Group and de Onis 2006a; de Onis et al. 2007).[8] The growth standard data for children under age 5 years is based on children of high socioeconomic status background from Brazil, Ghana, India, Norway, Oman and the USA, while for older children and adolescents it is based only on data from the USA. There is only one international standard since the WHO has judged that there are no important differences in genetic growth potential between well-nourished and healthy populations (World Health Organization 1995, 29; WHO Multicentre Growth Reference Study Group and de Onis 2006b, 59f). Only 3 percent of the variance in growth was associated with the study population while 70 percent was due to variation among individuals. Not everyone accepts that it is altogether clear that there are no genetic differences, and also quite small differences in growth potential would affect conclusions about, for example, regional differences in undernutrition (Klasen 2008; McEvoy and Visscher 2009; see also discussion in Moradi and Baten 2005, 1234). Klasen (2008) concludes that people in southeastern, and possibly eastern, Asia might have a somewhat (1–3%) smaller growth potential than people in other regions of the world. He also discusses another potential explanation for the differences, namely other biological, but non-genetic, intergenerational influences on growth and achieved height.

The achieved height, and current weight, of the mother influence the health and height of her children (Baird 1965; Golden 1994; Victora et al. 2008; Özaltin, Hill, and Subramanian 2010; see also Cole 2000a, 322; The 1,000 Days partnership 2013). Shorter and lighter women have children that have a higher risk of dying and also grow up to be shorter and lighter than other children. Özaltin and coauthors (2010) show that this holds across a large number of populations also after controlling for other characteristics of the child, mother and household. This makes it possible for environmental influences on the parents, especially the mother, during their childhood and adolescence to influence the growth of their children. Venkataramani (2011) provides support for this in data from present day Vietnam. Young and coauthors (2008) provide an historical example where they find that Irish men and women whose maternal grandfathers worked in agriculture were on aver-

8 The growth references are freely available through the WHO website, http://www.who.int/growthref/en/ (Accessed: November 15, 2013).

age taller than others. Garn and coauthors (1984) also find some evidence of this kind of effect and call it the "recycling of socioeconomic effects". But they also demonstrate that its contribution to socioeconomic differences in height is likely to be minor (see also Rona, Swan, and Altman 1978). Galobardes and coauthors (2012) find differences in height of children depending on the occupation of the parents. But they find that these differences are fully removed once they control for the height of the parents.[9] Since we have no reason to expect systematic differences in genetic potential between social classes their result is most likely an illustration of "recycling of socioeconomic effects". Floud et al. discuss these non-genetic intergenerational influences on growth and they are incorporated in their model (Floud et al. 2011, 11f, 37ff). They stress that these intergenerational influences are likely to be both biological/physiological and cultural/behavioral.

These non-genetic intergenerational influences on growth and achieved height can influence analyses of the relative importance of genetic and environmental influences on growth (Stenberg 2013). The heights of the parents, or their average, are sometimes included when analyzing the height of their children to control for genetic potential and better assess influences from environmental factors. Strictly, this is only correct in situations where everyone has reached their full genetic potential and no one is shorter than they could have been because of, for example, suboptimal diet or disease. In other situations the height of the parents will also reflect their living conditions during childhood and adolescence (Spencer and Logan 2002). Controlling for the parents' height will therefore also capture parts of the social variation in living conditions.

3.2 Environmental influences

Heights are interesting for social scientists because they, to some degree, reflect nutritional status. *Nutritional status* must be "clearly distinguished from nutrition, which is the amount and nature of energy ingested in the form of food and drink" (Floud et al. 2011, 11, see also 41f). Nutritional status is not only a result of the intake of energy and nutrients but also the expenditure of these. The body needs energy and nutrients to function, maintain and repair itself (for example Steckel 1995). It also, quite naturally, needs energy and nutrients to be able to grow. It is intuitive that the body needs energy for growth and physical work but most energy is actually used in less obvious

9 It is more common to find influences from socioeconomic circumstances on growth and height also after controlling for parental height also in populations in high-income countries (Li and Power 2004; Wright and Parker 2004).

ways, such as for keeping organs working, keeping the body warm, digesting foods and for the brain.

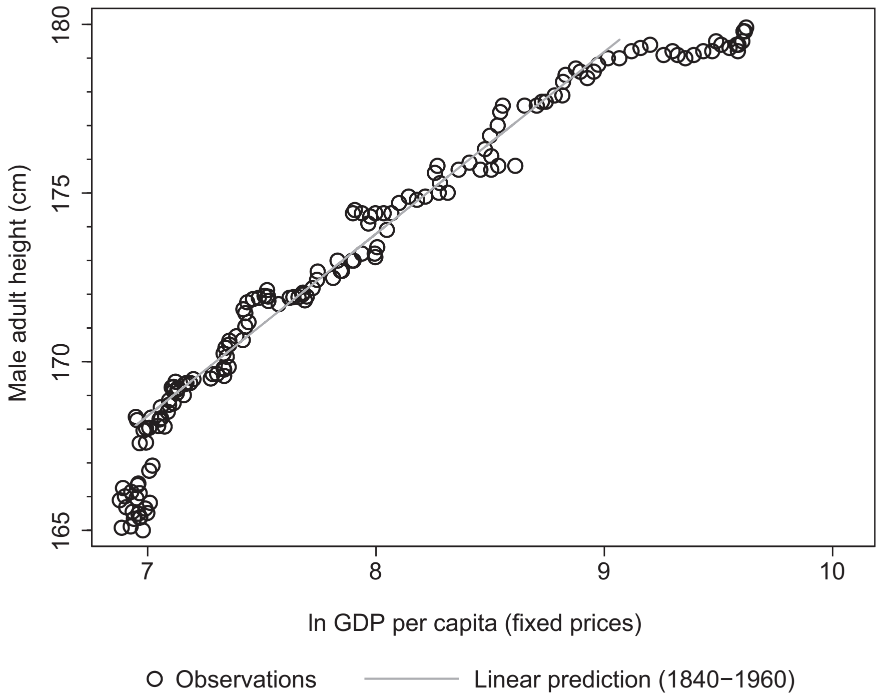
Heights are influenced by the cumulative net nutritional status of the mother and of the individual during infancy and childhood (Silventoinen 2003; Ulijaszek 2006; Özaltin, Hill, and Subramanian 2010; Floud et al. 2011, 11–19, 32–39, 129–131). *Net* nutritional status means that both the amount and quality of the food intake and the energy and nutrients needed, for example, for work, heat and fighting diseases are important as influences on heights (Steckel 1995; 2008; 2009). If the balance between inputs and requirements is not sufficiently positive the growth slows down and if the insults are severe or prolonged they will result in a shorter adult stature.

Environmental influences on growth and achieved height are not the least visible through systematic social variations in height. Social class background, family size, place of residence have all, for example, been shown to be systematically associated with average heights. All such distal factors must work through some or several factors influencing net nutrition, i.e. by influencing any of the proximal influences on growth. A large number of factors are known to influence growth and achieved height, including nutrition, disease, toxins and pollutants, altitude and stress (Eveleth and Tanner 1976; 1990; Tanner 1990; Steckel 1995; Boersma and Wit 1997; Hansen and Grubb 2002; Silventoinen 2003; Ulijaszek 2006). Matters are further complicated because the influence from environmental conditions can depend on the genotype, so called gene-environment interaction (Tanner 1990, 119f).

The environmental influences on growth and achieved height provide an illustration of how human bodies are, literally, shaped by their surrounding environment and living conditions. Because there are so many contributing factors influencing growth from before birth until final height is reached it is very difficult to capture these influences in a stringent way in statistical analyses. The large individual genetic variation is useful in the analyses but of course also leads to weak associations between environmental factors and height. Even if the measured influences are oftentimes weak and only explain small parts of the variation in height, the associations have substantial, both theoretical and practical, importance.

The environmental influences on growth are what have us expect an association between average height and economic growth (for example Floud et al. 2011, 262). Income can influence growth through, for example, diet, disease, work intensity and housing conditions (Steckel 2008, 136). There is a close log-linear association between income and average height historically in Sweden (Figure 2) and other European countries with representative information on the development of the average height (France: Weir 1997, fig. 5.9, see also fig. 5.8; Italy: Arcaleni 2006, fig. 1; Netherlands: Drukker and Tassenaar 1997, fig. 9.7; Norway: Sunder 2003, fig. 2; Spain: María-Dolores and Martínez-Carrión 2011, fig. 2).

FIGURE 2 Adult height (men born 1819–1982) and GDP per capita in the year of birth in Sweden



Sources: GDP per capita: Rodney Edvinsson (2013, tab. 1). The GDP per capita is in 1990 international Geary-Khamis dollars. Heights: see Figure 1. The linear prediction comes from an ordinary least squares regression including observations from 1840–1960. The association was: Height = 130.6 + 5.4 × ln(GDP/c), $R^2 = 0.98$.

There is an association between average height and average income also across countries globally (Baten and Blum 2012). Some of this association is driven by the difference in height and income between high- and low-/middle-income countries. There are no consistent associations between national average height and levels of national income or nationally available calories per person among low- and middle-income countries (Deaton 2007; Moradi 2010). Hatton (2013) questions the seemingly close association between average income and height historically in Europe and argues that the average height is better predicted by the infant mortality rate than the income level. We therefore do not know how much of the association between national income and population average height is driven by causal influences and how much is created by specific historical developments (compare Easterlin 2013). But since income is an important determinant of living conditions influencing growth, it is likely that at least some of the association is causal. In historical research, when we are stuck with less than perfect data, we should always be willing to consider the possibility that deviations to general patterns found could be created by measurement errors or biases in the data. But while it is likely that some of the association between average income and height is causal, the association is not deterministic. We can, for example, see that the log-linear association between height and GDP per capita in Sweden is not as close for all years. It is only for approximately 1840–1960 that the association is very close. Before and after these years there is not much association between the variables. It is therefore important to consider also other factors that can qualify or indeed override the association between average income and height, such as availability of protein-rich food, the relative price of food and behavioral factors (Steckel 2008, 132f).

Positive environmental influences have diminishing returns in achieved height (Martorell and Habicht 1986; Baten 2000; Steckel 2008). Nutrition, for example, has only a limited influence on adult heights once basic requirements are met. It can be seen in the non-linear association between height and national income where height is linearly associated with the logarithm of GDP per capita. This leads to the conclusion that heights are more influenced by lack of resources than by affluence. Generally improving conditions can therefore be expected to affect the least well-off more than richer groups (Martorell and Habicht 1986). Children in Sweden and, the then still somewhat poorer, Finland born in 1953 provide a good example of this (Cernerud and Elfving 1995). While there were no significant socioeconomic differences in heights among the children in Stockholm, children in less privileged families in Helsinki were shorter than children in more privileged families. At the same time children in the more privileged families were equally tall in both cities. We therefore expect reduced social differences in heights with rising income levels and improving standards of living.

This prediction has been tested but the results are mixed (Paper 1). One explanation of the lack of support for the hypothesis that improving standards of living lead to smaller social differences in height is that improving conditions are measured as growth of national incomes. National economic growth and rising household incomes can lead to reduced levels of under-nutrition (Haddad et al. 2003). But the influence from the average income level on the prevalence of undernutrition is not very strong (Boyle et al. 2006; Van de Poel et al. 2008) and it is uncertain if rising national income levels will influence the poor more strongly than others (Grosse, Harttgen, and Klasen 2008; Van de Poel et al. 2008; Subramanyam et al. 2011). We need to be aware of the possibility that there are other factors that can qualify or indeed override the association between average income and height, such as the level of inequality in society.

3.3 Nutritional influences

Nutrition influences growth and achieved height both through the amount of food consumed and through the composition of the diet. Intakes of energy and macronutrients, protein, carbohydrates and fats, need to be adequate for the body to function well and grow. But the quality of the food consumed seems to have an at least as strong an influence on growth as the quantity (L. H. Allen 1994; Hauspie, Vercauteren, and Susanne 1997). Some specific micronutrients are also important so that deficiencies can result in shorter height (Ulijaszek 2006, S282). Heights can therefore have increased historically, both because of an increased and more stable supply of food and because diet over time became more diverse with larger contents of animal products, fruits and vegetables. Children growing up in families with a more variable diet are on average somewhat taller than others (Arimond and Ruel 2004; see also Bielicki and Welon 1982). Monotonous, largely vegetarian, diets can be deficient in vitamins and minerals even when they provide sufficient energy (L. H. Allen 1994; Ulijaszek 2006; see also McMichael et al. 2007). This can be worsened as the diet can influence what nutrients are actually accessible for the human body. A diet consisting of coarse whole-grain cereals can limit the possibility to absorb micronutrients, such as zinc and iron. The monotonous, coarse and largely vegetarian diets consumed by the majority historically can therefore have contributed to their short stature even in situations where energy intake was sufficient.

The protein content of diets, especially from animal sources, is likely to be especially important for growth (Silventoinen 2003, 273f; Hörnell et al. 2013). Cow's milk also has a positive influence on growth, independent of being a nutritious food and source of protein (Hoppe, Mølgaard, and Michaelsen 2006). The seeming importance of intakes of animal proteins for growth can be a result both of the protein contents and the accessible micronutrients in these foodstuffs. That access to animal proteins, meat and milk, was also important for growth historically has been indicated in several studies. The spread of milk consumption has been suggested as an important factor behind the very rapid increase in height in Japan after World War II (Takahashi 1984). Koepke and Baten (2008) analyze regional variation in height in skeletal materials in Europe from the 1–18th centuries and show that the differences in height can be explained by regional variation in agricultural specialization. Regions with more cattle per capita also had taller populations. Baten (2009) finds similar explanations for regional variations in height in 19th century France, Prussia and Bavaria. Steckel and Prince (Steckel and Prince 2001; Prince and Steckel 2003) show that the indigenous population in North America, living on the prairies hunting buffaloes, were among the tallest in the world in the 19th century. Komlos (2003) comments on their finding and shows that tall stature was a common feature of populations with good access to foodstuffs, including meat and milk. Populations with good access to foodstuffs, including meat and milk, have historically also been living in less densely populated areas. This makes it harder to conclude that their taller stature was a result of better access to nutrients and not of the more favorable disease environment they lived in. Even if it is not possible to exclude an influence from disease there are several results pointing to the taller stature of people in less densely populated areas being a result of their better access to foodstuffs (Sunder 2004).

3.4 Influences from disease

The influence from diseases is also not uniform but can vary depending on the disease, its severity, duration and the living conditions and care provided for the person being ill (Tanner 1990, chap. 9). Disease influences growth in several ways (e.g. Saunders and Hoppa 1993; Stephensen 1999; Beard and Blaser 2002; Scrimshaw 2003; Crimmins and Finch 2006; Floud et al. 2011, 17, 71 324f). Disease can prevent or reduce food intake because of lost appetite. Some diseases, especially gastrointestinal, can lead to direct losses, impaired absorption or transportation of energy and nutrients in the body. The body's reaction to disease, through for example fever and other immune system responses, also requires extra energy. Most historical studies can only provide "strong circumstantial evidence" of the influence from disease on growth (Hatton and Martin 2010, 513). That even people from resource backgrounds were short by modern standards is an indication that diseases were an important influence on growth historically (Floud et al. 2011, 17). Studies on present day populations in low-income countries have shown convincingly that diseases in childhood slow growth in children (Adair and Guilkey 1997; Stephensen 1999; Scrimshaw 2003; Assis et al. 2005; Walker et al. 2013). They have also shown that any, even subclinical, infections worsen nutritional status and slow down growth (Beard and Blaser 2002; Scrimshaw 2003). Walker and coauthors (2013, 1408) report that about 25% of stunting among children in low- and middle-income countries can be attributed to having experienced five or more episodes of diarrhea before 2 years of age. Well-designed studies of the effects from improving water quality, sanitation and hygiene interventions also show positive effects on child growth even over short follow-up periods (Dangour et al. 2013 [1996]). The influence from disease on growth depends on the nutrition, general living conditions and care provided to the ill person (Tanner 1990, chap. 9; Golden 1994; Boersma and Wit 1997; Scrimshaw 2003; Silventoinen 2003, 273f; see also Sharpe 2012). The influence from disease on growth is therefore weaker in high-income populations but can still be shown (Dowd, Zajacova, and Aiello 2009). Children with serious illnesses, for example disabilities, on average become shorter also in high-income populations (Li and Power 2004).

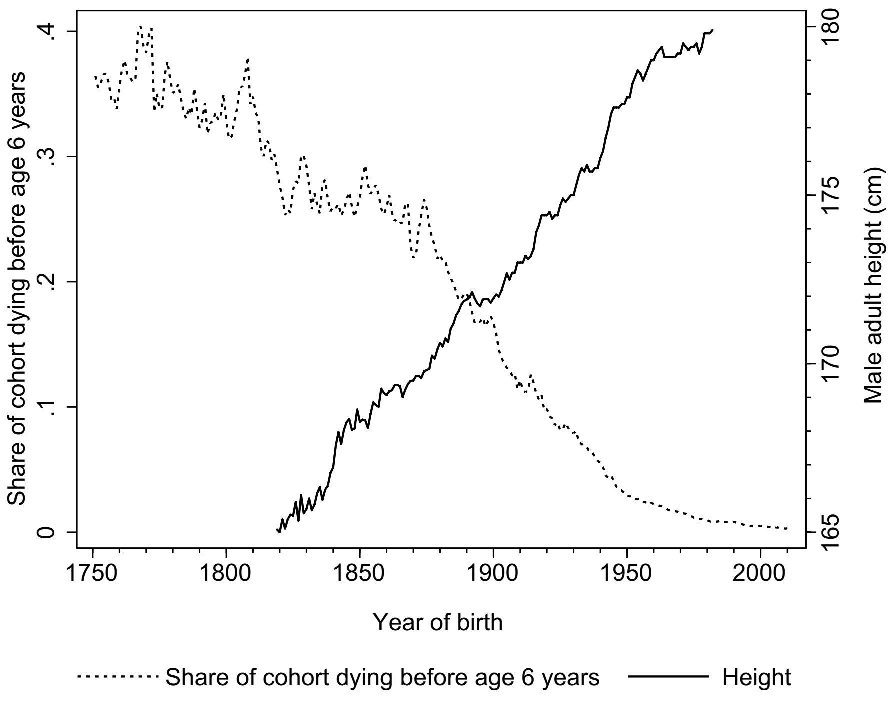
Growth and achieved height are negatively influenced by disease if these are protracted, serious and/or frequent (Golden 1994; Boersma and Wit 1997; Scrimshaw 2003). The negative influences can also be stronger in combination with suboptimal nutrition. Short spouts of disease can also affect achieved height if there is not enough energy or nutrients to allow catch-up growth. The time needed to reclaim lost growth can be more than a month and is most likely extended under worse conditions. If another disease episode occurs during the recovery period this increases the risk of a permanently reduced achieved height. Diseases are and were important causes of reduced growth and height but it is and was, most likely, especially diseases influencing nutrition and disease in combination with nutrition.

The sensitivity to and severity of infections is also influenced by nutrition (Chandra 1997; 2002; Scrimshaw 2003; Schaible and Kaufmann 2007) even if different diseases are affected differently by the nutritional status of the host (Bellagio Conference 1985; Rice et al. 2000; Chandra 2002; Scrimshaw 2003; Caulfield et al. 2004). Both inadequate intakes of energy and protein and deficiencies of micronutrients affect the immune system and thus consequences of infections. Since appetite, demands on and the ability to utilize foods are affected by disease this creates potential negative synergistic effects between disease and nutrition.

The influence from disease on growth and height caused a debate in the early research into the anthropometric history of Sweden. Sandberg and Steckel (1987; 1988; 1990) found that the average height was declining among men born in the 1840s, especially among those in Western Sweden. They interpreted this as a result of increased morbidity among children, also mirrored in rising child mortality rates during the mid-19th century. Söderberg (1989) thought this was an overly pessimistic interpretation and instead argued that the declining height was a result of increased workloads caused by land reclamations and increasing agricultural production. Fridlizius (1989) also expressed doubts about Sandberg and Steckel’s interpretation that heights declined and child mortality increased in the 1840s because nutrition was worsening. The discussion about the relative importance of the influence from disease on growth historically is still ongoing. But we can conclude that the decline discussed in the late 1980s was less pronounced in a later reanalysis of the data from the Provincial Army that used a better method to account for the minimum height requirement (Heintel, Sandberg, and Steckel 1998). The temporary stagnation or slowing down of the increase of the average height in the cohorts born in the 1840s can be seen also when analyzing the average height of conscripted men (Figure 1). But the decline is dwarfed by the overall increasing trend starting for men born from about the 1830s onwards.

The developments of the average height of conscripts and the share of boys dying during the first five years of life still show mirrored developments (Figure 3). Hatton (2013) finds that conditions that also affected the infant mortality rate were more important for the increasing average heights of European populations historically than, for example, the gross domestic product. The association between the infant mortality rate and adult average height is less strong in populations in present day low- and middle-income countries (Deaton 2007; Akachi and Canning 2010). We can therefore not conclude anything yet about the relative importance of disease for the historical secular trend in height. Different influences on growth, i.e. nutrition and disease, can have been more or less important in different places and times. There is, as discussed above, convincing evidence of the negative influence from frequent and/or serious disease, especially in combination with suboptimal nutrition, on growth.

Figure 3 Mortality before age 6 years (children born 1751–1982) and average height of young men (born 1819–1982) in Sweden



Note: Mortality data from the Human Mortality Database (2013). The share dying before age 6 years is the lx (l6) value from cohort life tables for each cohort of boys born 1751–1920. For boys born 1921–1982 the share dying is the sum of dx during ages 0–5 years. For sources of the heights data, see Figure 1.

3.5 Timing of influences

Growth and achieved height are influenced by living conditions up until the final, adult height is reached (Baten 2000; Ulijaszek 2006; van den Berg et al. 2009). The bodily growth of children is erratic, occurring in a stepwise fashion (Hermanussen et al. 1998). Suboptimal conditions, caused, for example, by a deficient diet or disease during any period of growth, cause growth to slow down (for an illustration see Stephensen 1999, fig. 1). If conditions improve, the body will start growing again and can overcome some, or all, of the growth lost by faster, catch-up growth (Tanner 1990, chap. 9). For this to be possible the body requires more energy and nutrients than usual (Golden 1994; Scrimshaw 2003; FAO/WHO/UNU 2004, 17f, 31f). A more secure access to foodstuffs, more diversity, and higher quality of the diet improve the ability of families to supplement the diets of the children after infections or times of food scarcity. A person who experiences several or prolonged environmental insults has a higher risk of being shorter as an adult as a result of environmental influences (Luo and Karlberg 2000). The body can require a long time to recover the growth lost because of disease or nutritional deficiencies. Repeated insults, especially if frequent, are therefore especially detrimental for growth and achieved height.

Even if growth is influenced by environmental conditions throughout growth, the first years of life, including time in utero, are the most important. Victora and coauthors (2010) analyze the timing and development of growth faltering in children under the age of 5 years, using data from the WHO Global Database on Child Growth and Malnutrition. They find that intrauterine retardation, resulting in low birth length, is a larger problem than was previously thought. They stress the importance of interventions during pregnancy and before the age of two years to prevent growth failure (see also e.g. Dubois et al. 2012). The importance of environmental conditions in the first year(s) of life could be a result of the fact that growth is so fast during this period. The share of energy and proteins that are used for growth is at its highest in the first months of life and then declines rapidly with age (Malina 1987).

The nutritional status of the mother influences the growth of the child while in utero (Özaltin, Hill, and Subramanian 2010). This works through the quality and quantity of the food consumed and through demands on the diet. Sickness of the mother during pregnancy, for example, also influences the birth weight of the child (Kramer 1987). The birth weight of children is a strong predictor also of their adult heights (Alberman et al. 1991; Rasmussen and Johansson 1998). Kramer (1987) reports some mixed results and gaps in knowledge on the influence from sickness during pregnancy and the birth weight of the child. But he concludes that a causal influence from maternal general morbidity and episodic illness during pregnancy on birth weight is "established and important" (Kramer 1987, tab. 16, 719, see also 703–708). A serious and protracted illness, such as pneumonia, during pregnancy can reduce the birth weight of the child (Chen et al. 2012). No such influence is found for women that had influenza during pregnancy (Ács et al. 2006).

Birth weight and growth in early life are more variable and less strongly heritable than later growth or achieved height (Dubois et al. 2012). This indicates that they should be more strongly influenced by shared and unique environmental factors than later growth and achieved height. Still there is no secular trend in birth weights similar to the one in adult heights (Abolins 1966; Steckel 1998). Birth weights are limited by the physiology of the woman as well. So even if women have also become larger as the average height and weight has increased the size, there are limitations as to how large fetuses can be to fit in the womb. The historical trends in birth weight, adult height and age at menarche (a measure of the tempo of physical maturation) show important differences (Cole 2000a; Floud et al. 2011, 337–340). Cole (2000a) therefore argues that these different aspects of growth and physical maturation are influenced by different factors. Costa (2013) questions if there were indeed differences in the trends of birth weight and adult height. She shows that the two trends are more similar if we limit the analysis to the average birth weight of first born children.[10] The lack of an increasing trend in birth weight among all births is also not a universal finding. Abolins (1966) cites a number of studies on European populations that have found average birth weights increasing by about 50–200 grams from the 19th to the mid-20th century. The data on Swedish newborns at the Allmänna Barnbördshuset, 1866–1905, show birth weights increasing from around 3300 grams in the years 1866–1870 to 3452 grams in 1901–1905 (Abolins 1966, 5, tab. 1). The increase in birth weights is still much smaller compared to the one in adult heights since adult height has increased much more (about 2 standard deviations) than birth weights (approximately 0.1–0.5 standard deviations). We therefore need to acknowledge that the factors influencing growth at different ages might be different and that the most important influences on growth probably are different in different circumstances.

Systematic socioeconomic differences in height, as mentioned, provide an illustration of environmental influences on growth. Previous studies differ somewhat in at what point socioeconomic differences emerge in children. Howe and coauthors (2012) find that the relative differences in height remained fairly constant from birth until age 10 years in present day Britain. Silva

10 The trends of average birth weights for all births and for just firstborn children have been very similar in Sweden since 1973 (Socialstyrelsen 2013, tab. 50). Costa (2013) argues that this was not the case in, for example, the 19th and early 20th century.

and coauthors (2012) find social differences in birth length in present day Netherlands but also find that children from the lower socioeconomic group grew faster in the first two years of life, overcompensating for their height deficit at birth. Matijasevich and coauthors (2012) in contrast find accumulating socioeconomic differences in height among children in Brazil. It is therefore likely that growth and social differences in growth depend on the social and environmental context.

The human body is very resilient and can overcome temporary insults and catch-up lost growth, as was discussed above. It is still not altogether clear to what extent there are critical periods during growth, such that slowed or lost growth during these times will always result in shorter achieved height (Golden 1994; Boersma and Wit 1997). What characterizes catch-up growth is that the body is trying to reclaim height potential that has been lost due to negative environmental influences.

The growth of individuals is erratic and occurs in irregular, short growth spurts (Boersma and Wit 1997; Hermanussen et al. 1998). The growth averaged over longer periods of time or within populations still shows very regular patterns. The growth of an individual tends to, on average, run parallel to a growth reference line. This “canalization” of growth is what makes it possible to use growth as an indicator of environmental insults and see if it is slower than expected (Tanner 1990, chap. 10; Boersma and Wit 1997). It is also this growth potential that the body tries to reclaim if and when conditions improve by growing faster than usual. The height potential is set very early in life and is, most likely, strongly influenced by genetic factors.

When growth is slowed during infancy and childhood people can continue to grow for a longer time and reach their final adult height later (Eveleth and Tanner 1990, 192; Golden 1994). Historical data on growth is scarce but results indicate that many men in the 19th century did not stop growing until, at least, age 22 or 23 years (Forssberg 1897, tab. 1, 144f; Hultkrantz 1927, 38f; Kiil 1939, chap. III; Rosenbaum 1988 tab. 1, 282; Johnson and Nicholas 1997; Baten and Murray 2000; Wilson and Pope 2003, fig. 5.1, 119; de Beer 2004, 51). A contemporary military doctor writes that some continued to grow until the age of 25 or 26 years (Arbo 1875). Still in the 1880s the average height of conscripts in southeastern Sweden increased by 1.03 centimeters on average between age 21 and 22 years (Hultkrantz 1927, 38).[11] The trend of increasing height has in general been paralleled with earlier maturation historically. Despite this the two trends also have different determinants and do not always follow each

11 Individuals who are past their adolescent growth spurt and increase by less than 0.5 centimeters in height in one year are regarded as having stopped growing (Luo, Albertsson-Wikland, and Karlberg 1998).

other closely (Cole 2000a). Earlier maturation is also on average associated with shorter adult stature on the individual level, at least among women, because of a shorter adolescent growth period (Onland-Moret et al. 2005).

4. Framework for the four studies

The academic study of how living conditions have changed historically has in itself a long history in economic history and related disciplines, both using height (Tanner 2010 [1981]; Steckel 1995; Steckel 2009) but especially using more conventional measures, such as GDP or real wages (Lundh 1983; Olsson 1986; Engerman 1997; Floud et al. 2011). The papers only indirectly investigate the long-term development of standards of living but because they investigate the long-term change of the influences they can contribute to our understanding of the consequences of improving standards of living. Two papers contribute to this by studying if and how improving living conditions over time lead to lower inequality in living conditions that are reflected in smaller social differences in height. This has been discussed with regards to more conventional measures of standards of living in relation to Kuznets' (1955) prediction that inequality will increase and then decline with economic development and growth. When it comes to height we expect that improving standards of living will lead to reduced social differences. This prediction is used and investigated in Papers 1 and 2 (see also Paper 4).

Differences in height and weight among people with different family backgrounds are one of the most straightforward illustrations that living conditions influence growth. This within population variation is used in the dissertation to investigate how living conditions influenced growth in an historical population and if these influences changed over time. I use individual level data to test the influence on height (and weight) from factors where the aggregate trends of height and possible influential factors are closely associated in aggregated data. While height is influenced by environmental factors also at the individual level most of the variation in height around the population average is a result of genetic influences.[12] If we take into consideration, for example, the within-family correlation of heights we can treat the genetic variation as random noise when estimating the influence from environmental factors on height. The individual level variation in height can therefore be used to reduce the risk of getting spurious results when we estimate the associations. The detailed information on family background and the long time period covered

12 Weight is also partly determined by genetic factors (for example, Dubois et al. 2012) so that a similar line of argument goes also for studying differences in weight.

make it possible for me to investigate if the associations with known distal influences on growth and achieved height, such as socioeconomic status and number of siblings, have changed over time or not. This can, as discussed above, contribute to our understanding of both why these distal influences are associated with height and if the underlying causes of the associations have changed over time.

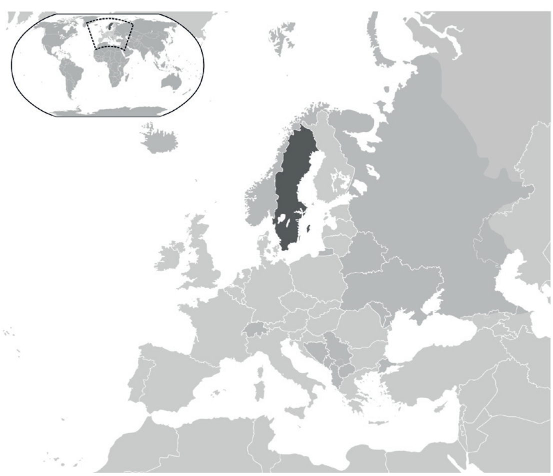
5. The data and methods used in all four papers

The data used come from the Scanian Economic Demographic Database (SEDD), which covers the population in five closely situated rural parishes in southern Sweden; Kävlinge, Hög, Kågeröd, Sireköpinge, and Halmstad. The database is a project that has been underway since 1983 (Reuterswärd and Olsson 1993) and is now administered by the Centre for Economic Demography at Lund University.[13] It includes information from the 17th to the 20th century. The demographic information in the database is longitudinal, meaning that all individuals are followed continuously over time through local population registers. Everyone born in or migrating into the included parishes are followed from birth or entry until death or out-migration. The database has been constructed from the catechetical examination registers ("husförhörslängder") and has been linked to tax registers ("mantalslängder" and "inkomstlängder") and checked against church books on births, marriages, migrations, and deaths (Bengtsson and Lundh 1991; 1993; Bengtsson and Dribe 1997; Dribe 2000). The data include all demographic events as well as information on occupations and landholding. The household structure, as well as moves into and out of households, is known from the catechetical examination registers. People moving into and marrying in the parishes before 1896 have been traced to their parish of origin to collect information on the socioeconomic status of the family at their birth (Dribe 2000). The populations in Kävlinge, Hög and Kågeröd are included for the whole time period. The populations in Sireköpinge and Halmstad after 1895 were not yet included in the SEDD at the time of the data collection.

13 The demographic data has been used for a large number of studies (for example Lundh 1995; 1999; Dribe 2000; Bengtsson 2009a [2004]; Bengtsson and Dribe 2005; 2006; 2010a; 2011; Dribe and Lundh 2005a; 2005b; 2005c; 2009). The SEDD is also a part of the Eurasia project which has produced several groundbreaking books in demographic history (for example, Bengtsson, Campbell, and Lee 2009 [2004]; Tsuya et al. 2010; Lundh, Kurosu, and et al. forthcoming). Luciana Quaranta (2013) has also recently written an excellent dissertation on the early life influences on mortality and fertility outcomes using the SEDD data.

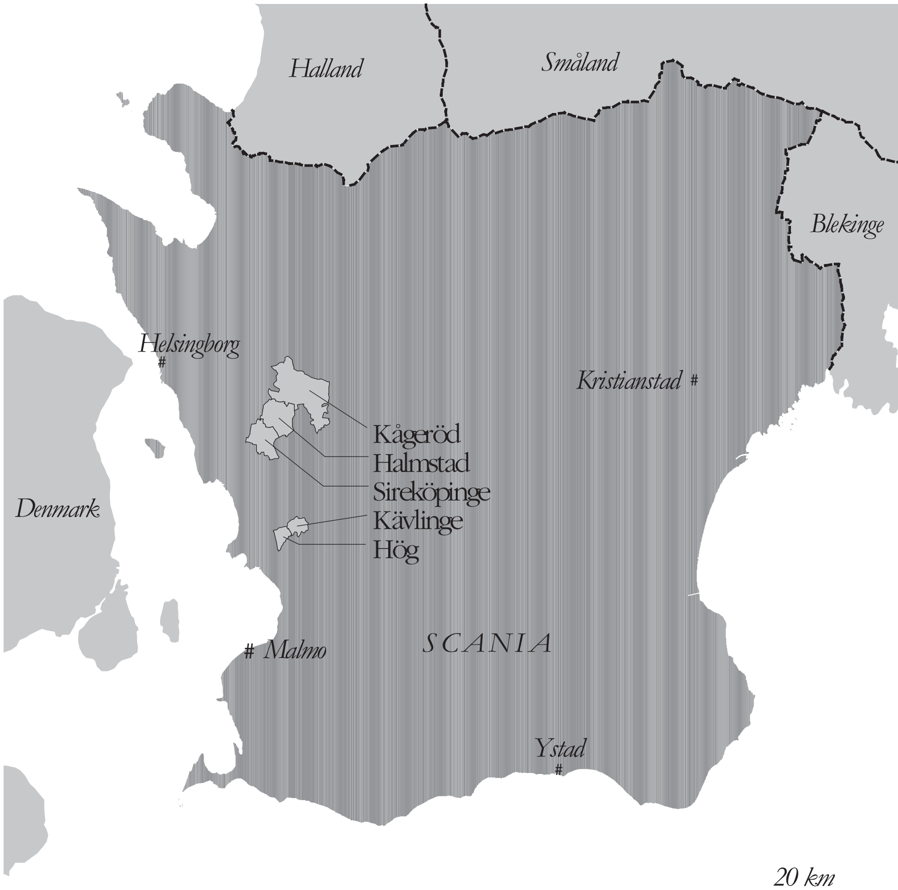
Scania, where these parishes are located, is the southernmost part of Sweden (Figure 4) and is dominated by fertile agricultural land, though some parts are more hilly and wooded. This description fits well with the five studied parishes as well (Dribe 2000; Quaranta 2013). The parishes are all situated some 10 kilometers inland from the western coast and 10–30 kilometers from Landskrona, Lund and Helsingborg which are the closest towns (Figure 5). The parishes were all agricultural areas during the 19th century. The social structure of the parishes differed somewhat in that in Hög and Kävlinge the farmers were freeholders while the other parishes were dominated by manorial lands (Dribe 2000; Bengtsson 2009a [2004]). Starting from c.1865 Kävlinge, and partly also Hög, developed into a small town with some industries and a railway station (Svensson 2006; Bengtsson and Dribe 2010b; 2011). The economic growth and transformation resulted in generally improving conditions in the population. Real wages in southern Sweden were relatively stable until c.1860 and then increased throughout the rest of the 19th century and first decades of the 20th century (Bengtsson and Dribe 2005; Lundh 2008). The different economic developments of the parishes are also reflected in very different developments of the size of the populations. While the population in Kävlinge increased rapidly from the 1880s onwards and continued to grow throughout the 20th century, the population of Halmstad, Sireköpinge and Hög actually declined from about the same time (Figure 6). The population in Kågeröd increased somewhat over time but only slowly.

Figure 4 The location of Scania and Sweden



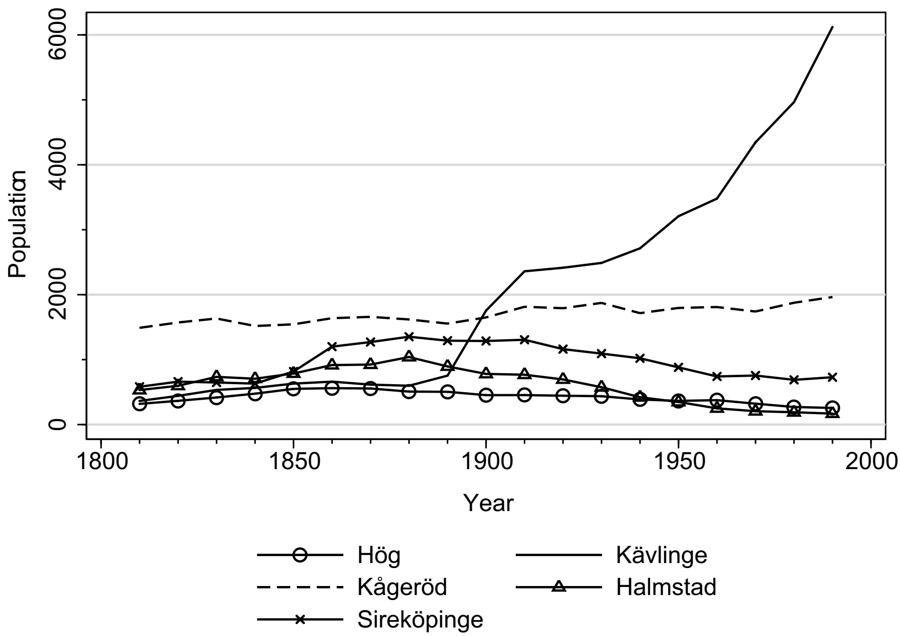
Source: Sweden: http://commons.wikimedia.org/wiki/File:EU-Sweden.svg and Scania: http://commons.wikimedia.org/wiki/File:Sverigekarta-Landskap_Sk%C3%A5ne.svg. (Accessed: January 8, 2014)

Figure 5 The locations of the parishes within Scania



Men born between 1797 and 1950, with a known family background and whereabouts around the time of conscription, have been traced in lists from universal conscript inspections. They were inspected from 1818–1968. Almost 8,000 men were searched for in the inspection records and about 75 per cent were linked successfully. About 80% of the men searched for in the lists were successfully linked. The conscript inspections were organized in a similar way throughout the studied period and always included a physical inspection and a height measurement. The men were then either accepted for conscription or freed from duty if they were deemed unfit.

FIGURE 6 Population in the five sampled parishes, 1810–1990



Source: Folkmängd 1810–1990, Demografiska Databasen (2013)

Up until 1860, there was a formal minimum height requirement to be accepted and an effective requirement was in practice until 1886. Men who were shorter than the minimum height requirement but otherwise healthy had their height recorded and were required to appear for inspection again in the following (up to four) year(s). However, the inspection records from before 1887 do not include the height of most men who were freed from conscription. Many of them were below the minimum height requirement, so there is a shortfall in the height data at the lower end of the distribution (Papers 1 and 5). There are also some observations missing information on height from 1887 onwards but no shortfall or other systematic pattern is visible in the distributions.

The age of conscription was 21 years from 1818 until 1914 (birth cohort 1893). It was lowered in 1914 (birth cohort 1894) to 20 years, in 1949 (birth cohort 1930) to 19, and in 1954 (birth cohort 1936) to 18 years. Some men appeared for inspection before or after the age of conscription. The men included in all four samples here were inspected between 17 and 25 years of age, but more than 90% were of the age for compulsory inspection or one year older in all the periods.

The file from the SEDD used for the analyses (SEDD, Bengtsson, Dribe, and Svensson 2012, file extracted 17 December 2012) is in the Intermediate

Data Structure (Alter, Mandemakers, and Gutmann 2009) and was changed into a rectangular episode file using a script for Stata written by Quaranta (2012).

The data I use for this dissertation come from universal conscript inspections. Every man who was not already employed by the military at the conscription age was summoned for inspection.[14] The collection of the conscript inspection data is explained fully in Paper 5. This paper also describes the variables that were collected from the inspection lists. The lists included a lot of information, especially in the 20th century, on, for example, education, chronic conditions and cognitive ability. This information has not been analyzed in the dissertation but is described in Paper 5 to allow future use. One of the variables that were collected consistently over time was height and this is used in all four papers. There was a minimum height requirement for being accepted and recorded in the lists during the 19th century which means I lack information on the height of some men (Papers 1 and 5). The data still includes almost everyone in the young adult male population. The data is therefore not subject to the possible problems of selection in the sample that has recently been discussed for historical height studies by Bodenhorn, Guinnane and Mroz (2013).

The height data only include men since it was only men who were conscripted. This is a common but unfortunate problem for historical studies of heights. The influences on the growth of the women were, almost certainly, similar as for men (for example Luo and Karlberg 2000; Li, Dangour, and Power 2007) but the social and behavioral aspects of the influences make differences more likely. The discussion of whether the relative difference in the height of men and women has been changing over time or not is ongoing. Some studies find constant relative differences, of about 7–8% (Hermanussen et al. 1998; Gustafsson et al. 2007), while others find that the relative difference has changed over time (Kuh, Power, and Rodgers 1991; Cole 2000b).

I use multivariate regression analyses to examine differences in height and weight in all papers. The minimum height requirement and recording procedures, as mentioned, create a shortfall in the lower end of the height distribution. I therefore also use methods developed for estimating regressions on truncated samples. Since family relations are known from the SEDD I can use a sibling comparison design in one of the papers to investigate if the exposure to disease in early life influenced their achieved height. The other studies utilize the variation among families within time periods. I then utilize the known family relations to weigh the observations to better compare families with a

14 The hired soldiers were employed either in the Provincial Army or as full-time soldiers in recruited regiments.

different number of sons being included in the data. In all papers I also adjust standard errors for the expected within-family correlation of heights.

To divide a population into relevant socioeconomic groups is a major challenge. It is further complicated if the groups need to be relevant over long periods of time and in different economical contexts. Occupation is one of the most common indicators of socioeconomic status used for both contemporary and historical populations. Occupational information has to be condensed to be used in analyses and it is preferable if they are grouped in ranked social classes. This is not an easy task but following the creation of the *historical international classification of occupations* (HISCO, van Leeuwen, Maas, and Miles 2002) several solutions have been proposed (For overviews see Zijdeman 2010, chap. 2; Zijdeman and Lambert 2010; van Leeuwen and Maas 2011, chap. 1). Two of these historical class schemes are the SOCPO (Van de Putte and Miles 2005; see also Van de Putte and Svensson 2010) and the HISCLASS schemes (Maas and van Leeuwen 2005; van Leeuwen and Maas 2011). Both are intended to be general solutions to measuring social class in historical populations and are meant to be useful also as the economic structure of societies change.

Socioeconomic status is an abstract and multifaceted summary of access to social and economic resources. The historical schemes acknowledge this and HISCLASS is intended to measure *social class* and SOCPO *social power*. Both classifications intend to capture differences in the ability to *influence one's life chances* and/or withstand economic shocks. Both provide sensible results in empirical research and the SOCPO scheme has also been confirmed to be correlated in the expected way to, for example, incomes, educational levels and heights (Miles and Van de Putte 2010).

The classification of different occupations is quite naturally similar in different class schemes but there are also differences. Correlations between SOCPO and the seven group version of HISCLASS (Maas and van Leeuwen 2005) were about 0.7 in historical data from the Netherlands (Zijdeman and Lambert 2010). The correlations in the Scanian data are of a similar magnitude (results not shown). The class schemes therefore most likely capture somewhat different aspects of socioeconomic status.

I use the HISCLASS classification of occupations in my studies. The reasons are that the creation of the classification has been more transparently reported and that it was possible to collapse the twelve categories in the scheme in ways that can be referred to one aspect included in the classification, foremost manual/non-manual occupation and level of skill required (van Leeuwen and Maas 2011). Both characteristics are advantageous when wanting to analyze the patterns found, and not just control for possible socioeconomic confounding (Bukodi, Dex, and Goldthorpe 2011).

The measure of landholding I use follows previous research on the SEDD population where it has been divided into groups with different access to land (Bengtsson 2009b [2004]; Bengtsson 2009a [2004]). It is also inspired by the classification in the rural adaptation of the SOCPO scheme (Van de Putte and Svensson 2010). The measure of landholding used is based on both the amount of land the households had access to and the ownership rights of this access. The amount of land is estimated from the "mantal". This was actually not a measure of land area but rather of production capacity (Dribe 2000; Svensson 2006). It is still possible to compare the "mantal" measures within this geographically confined area. The "mantal" required to be considered as a large-scale farmer is reduced over time as an, admittedly crude, way of compensating for the increased land productivity. The ownership rights are, as mentioned, also taken into account so that freeholders and similar groups are considered to have been in a better position than tenants.

Several different socioeconomic characteristics of the family, such as occupational status, level of education, and place of residence, influence growth and achieved height independently from each other (Goldstein 1971; Wingerd and Schoen 1974; Bielicki, Szczotka, and Charzewski 1981; Peck and Lundberg 1995; Silventoinen, Lahelma, and Rahkonen 1999; Silventoinen et al. 2001; Mascie-Taylor and Lasker 2005; Lawson and Mace 2008; Subramanian, Özaltin, and Finlay 2011; Zhang 2011). The crude social classes I use can therefore not be expected to capture all the socioeconomic variation there was in the population. The socioeconomic measures, based on both the landholding and occupational status of the family, is still better than has been possible in most previous historical studies.

There was very limited variation in the age of the men at inspection. All men included in the analyses are between 17 and 25 years but over 90% were of the age for compulsory conscription. I therefore use a changing reference category when I control for age in the models. The control variable is each man's deviation in age (years) from the age for compulsory conscription. I tested also other specifications but found that the linear variable works very well for adjusting for the small age differences within the birth cohorts. If I were to use a constant reference category in the models I would have extrapolated the height of the men at another age based on almost no empirical information. The changing reference category should be kept in mind when analyzing the results.

The small sample size for the long time period covered made it necessary to use coarse periodizations when analyzing changes of the associations over time. A more fine-grained periodization would have been preferable but was not possible given the data constraints. The small sample size per year also prevents me from investigating the influence from subsistence crises or short-term variations in living conditions. What I can, and do, study with my sample is the long-term trends and changes of influences on height and weight.

The sample is limited also by covering a rural population with limited socioeconomic variation. The generalizability of the socioeconomic differences in height and weight I find in my sample are reduced by the limited socioeconomic variation in the population (Papers 1 and 4). The sample covers a geographically concentrated population with similar ethnic background. The whole population therefore shared the same historical experience, even if this experience always included inequality and differences in living conditions. This makes it more likely that the socioeconomic differences I find were results of differences in living conditions that depended on the socioeconomic background and not, for example, regional or urban/rural differences in diet or disease exposure. The limited socioeconomic variation and geographically concentrated population also improve my possibilities to control for the socioeconomic background in Paper 2 and 3.

The population I study is not necessarily representative of Sweden in general or even southern Sweden. The sample is therefore not well suited for inferring much about the development of standards of living outside the studied area. The small number of observations per year, discussed above, also limits the possibilities to infer much about the effects of specific crises or short-term variations were we expect socioeconomic differences in the impact. The influences on height and weight that I study are generalizable to other populations because human bodies react in similar ways to living conditions.

6. Presentation of the four studies

6.1 Paper 1: The long-term changes of socioeconomic differences in height

The first paper examines the long-term changes of socioeconomic differences in height. Socioeconomic differences in height have been shown in numerous studies on both historical and contemporary populations. Spectacularly large socioeconomic differences in height have been found between disadvantaged and privileged groups in the 18th and 19th centuries. No such large differences are found today within populations. Socioeconomic differences in height within populations were therefore larger historically than today. Previous research has also shown that socioeconomic differences in height have been declining over time in present day high-income countries. It is not clear if we should interpret this as being a result of larger inequality historically or if the declining socioeconomic differences in height have been a result of generally improving living conditions favoring especially the poor. Paper 1 on the long-term trend in socioeconomic differences in height is an attempt to contribute to this question. It uses information on family background and measured height from similar sources over time for a geographically concentrated and ethnically homogenous sample which all together provides good preconditions for investigating the changes.

Most of the previous studies use cross-sectional data or information from different samples to infer the long-term changes. This is the first study of how socioeconomic differences in height have changed over time using a representative, ethnically homogenous and geographically confined sample with information from similar sources over time. The study utilizes the known family relations and longitudinal information in the SEDD and relates the height of the men to the socioeconomic status of their family of origin. It also makes use of the wide range of socioeconomic information available in the SEDD and uses both the landholding of the household and the occupation of the father as indicators of socioeconomic status. The sample for this paper includes men born 1797–1950 and the long time period covered is used to study how the socioeconomic differences in height changed from the early 19th until the mid-20th century.

The magnitudes of the differences vary over time but show a tendency for declining over time. The socioeconomic differences in height were, as expected, largest in the early 19th century and smallest in the mid-20th century. Sons of landholders were on average taller than others in the early 19th century but lost this advantage in the latter part of the century. The most consistent difference is that sons of fathers with non-manual occupations were taller than others in all time periods independent of landholding. They were 4.8 cm taller than the sons of lower-skilled manual workers in the first half of the 19th century, and 1.9 cm taller in the mid-20th century. The socioeconomic differences in height I find in the Scanian population in the 19th century are much smaller than those found between elite and destitute groups historically, in for example Britain. The differences are very similar in magnitude to the ones found in other historical studies investigating the complete cross-sections of the population and using information on family background.

The sons of skilled manual workers were the shortest group in the early 19th century being shorter also than sons of low skilled manual workers, again independent of landholding. The average height of sons of skilled manual workers increased faster than any other group making them the second tallest group in the mid-20th century. My interpretation of the results is that the magnitudes of the socioeconomic differences in height are influenced both by the economic growth leading to generally improving conditions and of economic and societal development changing the distribution and availability of resources.

6.2 Paper 2: Sibling competition over family resources

The second paper studies the influence from the number of children present in the household during childhood on the early adult height. Negative associations between sibship size, the number of children born to a family or present in the household, with various outcomes, including height, for children have been shown in a very large number of studies. The causes behind these negative associations are less well-known. The most used, implicitly or explicitly, explanation is that a larger number of children lead to increased competition over family resources. This explanation has been termed the resource dilution hypothesis and is a plausible explanation of why children from families with many children are shorter than others. If dilution of family resources is an important explanation we expect the association between sibship size and child height to become weaker over time. With improving conditions and rising incomes over time we expect that all families would be able to feed and care for their children similarly.

The SEDD and conscript height data combined provide a unique opportunity to test this prediction. Because of the long time period covered I can also investigate if the association changed with the fertility decline. I utilize the longitudinal information on the household composition in the SEDD to calculate the number of children present in the household during each man's childhood. I can also include a wide range of control variables, including birth order. The sample used in this study consists of 3879 men born 1813–1950. I derive a regression model from the resource dilution hypothesis and estimate this while investigating how the association between sibship size and the height of the sons changed over time.

There was a negative association in the 19th century which declines over time and disappears in the mid-20th century. The negative association I find is not a result of confounding by observable demographic or socioeconomic differences between families. The effect from the control variables changed over time as a result of changing social patterning of behaviors. Before the fertility decline, sons of fathers with non-manual occupations had more siblings present during their childhood than others. Because they were also on average taller than others this concealed some of the negative association. This changed with the fertility decline. The fertility behavior changed first in the upper class families so that they had smaller families than others. This temporarily reversed the social differences in family size and the direction of the socioeconomic confounding of the association between sibship size and height. Among men born 1920–1939 it is only the men with many siblings who are shorter than others (also after controlling for observable socioeconomic status). We cannot know if resource dilution was causing this pattern or if these families were different from others in some, in this data, unobservable way that is contributing to the negative association.

The results are in line with resource dilution being an important explanation for the negative association between sibship size and height. Resource dilution in larger families still does not seem to be a universal fact but is dependent on the societal and historical context. Large families could have contributed to reducing heights slightly during the 19th century. The fertility decline still, most likely, did not contribute much to the secular increase in height because the negative association between sibship size and height was by then very weak.

6.3 Paper 3: The direct influence from disease exposure around birth on early adult height

The third paper investigates if there is a direct negative influence from exposure to disease around birth on early adult height. It has been shown, not the least in studies on the SEDD population, that exposure to disease, as measured by the community level infant mortality rate, in infancy is negatively associated with later life mortality and fertility outcomes. Disease can reduce growth and frequent, severe or protracted diseases, especially in combination with suboptimal nutrition can reduce final height. Growth during the first year(s) of life is particularly sensitive. There are therefore reasons to test if exposure to disease in infancy leads to shorter adult height. I utilize the longitudinal information on all of the population in the geographically concentrated SEDD parishes to calculate infant mortality rates in the year of birth, first year of life and time in utero for each man in the sample. Because family relations are known I can use a sibling comparison model to estimate the influence from exposure to disease while controlling for all factors constant among all brothers from the same family. The brother sample consists of 1359 men born 1814–1950.

I don't find any consistent or significant influence from disease exposure on early adult height. Despite the closely mirrored developments of the infant mortality rate and the average height I do not find much association between the two variables when I control for decade of birth and age difference among brothers. The exposure to disease in the first year of life and during the pregnancy, measured as relative deviations from the trends, has negative influences, especially at high levels of mortality. None of these associations are statistically significant in the sibling comparison models but the coefficients are similar in size.

There are several reasons to expect that the estimated associations are lower-bound estimates. The influence from disease exposure, as measured by mortality rates, on height is, for example, the net effect of scarring effects, reducing height, and selective mortality, where shorter children have a higher risk of mortality. I can therefore not conclude that there is no influence from disease exposure on adult height. What I can conclude is that both the direct negative influence from disease exposure around birth on height and any possible effect from mortality selection on the population average are likely to be very weak.

6.4 Paper 4: Occupational differences in body mass index before the obesity epidemic

The fourth paper describes the occupational differences in body mass index (BMI; kg/m^2). The men were not weighed during the conscript inspections until the mid-20th so the sample in this study consists of 1173 men born 1934–1950 who were inspected 1953–1968. While the secular trend in height has been slowing down in Sweden in recent decades weights have continued to increase. This has led to rising average BMIs and increasing prevalence of overweight and obesity. The average BMI among conscripts in Sweden started with men born in the 1950s. The average BMI increases with age. Some of the earliest increase of the average BMI was probably caused by a trend towards earlier physical maturation.

In present day Sweden, as in other high-income countries, the prevalence of overweight and obesity, as well as the average BMI, is most often higher among people with low socioeconomic status or background. The present study contributes to the scarce information, for Sweden and internationally, on what the socioeconomic differences in BMI were before the "obesity epidemic" of recent decades. I relate information on both the occupation of the men's father at their birth and the self-stated occupation of the men themselves at the inspection to their BMI. I divide the sample in halves to investigate if the associations changed over time.

Men who had non-manual occupations or who were students always had lower BMI than others. The associations with socioeconomic background changed somewhat over time. Sons of farmers were heavier and sons of fathers were somewhat leaner than others among men born 1934–1942 but not among men born 1943–1950. These patterns are similar to what is found in present-day Sweden and also in the available historical studies on 19th century populations in other countries. I also relate the BMI to the occupation of the father and the men themselves simultaneously. Doing this among men born 1934–1942 did not reveal any additional information but among men born 1943–1950 the average BMI was associated with the difference in occupation between fathers and sons. Sons who had a lower ranking occupation than their father at inspection had on average a higher, and men with a higher ranking occupation than their father had on average a lower, BMI. The explanation of the occupational differences in BMI found must be multifaceted and must also have changed over time.

7. Discussion

The secular trend in the average height shows the improving living conditions in the population from about the second quarter of the 19th century (Figure 1). Differences in living conditions and/or health status within the population still resulted in social differences in height at all times. The magnitude of the socioeconomic differences in height indicates that the level of inequality in this Scanian population was at least as large as in other contemporary populations (compare the results in Paper 1 with the results from previous similar studies reported in Paper 1, note 1). This is in line with the finding that the inequality in access to land also was at least as large in the SEDD population as in other contemporary populations (Lee et al. 2009 [2004], fig. 4.1, 90).

The influence from living conditions and the families' resources on height is shown both by the social differences and by that the social differences declined over time. The magnitudes of the socioeconomic differences in height as well as the influence from sibship size on height were much smaller in the mid-20th than in the early 19th century. Improving living conditions reduced the social differences as we would expect if access to material resources were important causes of the differences.

Most of the increase in height over time was shared by all social groups. There are, for example, only minor differences in the secular trends of sons of lower skilled manual workers and farmers (Paper 1, Figure 1.4). That the secular trend was so similar in all groups shows that everyone got some share in the improving conditions over time. This could point to the most important determinant of the height increase being the disease environment or something else that was shared was everyone. I do not think that we can rule out incomes and access to foodstuffs being important for determining the secular trend or socioeconomic differences despite this. If calories were relatively equally distributed, which we have reason to believe (Floud et al. 2011, 49–57), and everyone got a share of increasing products, this could lead to largely parallel trends in different groups. Environmental influences, such as access to food, have a strong influence on growth. Still, social differences in height as a result of unequal access to resources, such as food, will be reduced by the genetic within-population variation since there are no reasons to expect systematic differences in genetic potential among social classes.

The results in Paper 1 indicate that access to foodstuffs was a limiting factor for growth in the early 19th century since sons of landholders were then taller than others. Sons of landholders also lost their height premium in the late 19th century. By then it seems to have been possible to have just as good access to foodstuffs through the market instead of from the household's own production. The tallest group also in the early 19th century was the sons of fathers with non-manual occupations who were taller than others even if their fathers did not have access to land. It was therefore possible to create a favorable environment for the children also by relying on marketed food if incomes were high enough. The sons of skilled manual workers were in contrast the shortest group. Many of the skilled manual workers had access to some land but they also had to buy parts of their foods through the market. One interpretation of their shorter stature is therefore that their incomes weren't high enough to be able to secure a stable access to foodstuffs. The rising agricultural productivity and economic growth and development do seem to have led to a more secure and equal access to food over the 19th century. Other aspects of living conditions can also have contributed to the differences in height through, for example, influencing the sensitivity or exposure to disease or the demands on the diet.

There were socioeconomic differences in height also in the late 19th and during the 20th century when landholding, and thus close access to foodstuffs, was no longer important. Differences in income can have been important then as well and could affect things, such as, diet or housing conditions. There were socioeconomic differences both in the number of calories consumed and the diet in southern Sweden in the early 20th century (Lundh 2013). Families with higher incomes, especially where the man had a white-collar occupation, consumed more diverse diets with more refined foods.

There were also differences in the quality of housing among rural groups in Scania in the first decades of the 20th century (Lundh and Olsson 2011). The differences in housing standards corresponded to differences in the income levels. Artisans, farmers and industrial workers had better housing than agricultural workers and smallholders. Differences in housing standards might have contributed to the disadvantaged situation of the small-scale farmers found here for the early 20th century. Other aspects of the living environment could of course have contributed to differences in height through systematic differences in the place of residence, access to clean water, the quality of housing, or differences in child care practices. The most consistent difference was that sons of fathers with non-manual occupations were taller than others. Differences in working conditions for the children are therefore another possible influence. Sons of non-manual working fathers might have been more likely to go to school instead of working physically. This could then have contributed to their taller stature.

If the different favorable and unfavorable factors were clustered within certain families this would have created small highly privileged and disadvantaged groups. A clustering of unfavorable living conditions could be the explanation for that it was only men with many siblings who were shorter than others in the early 20th century. It could also be a possible explanation for the short height of sons of small-scale landholders around the same time. Small highly privileged and disadvantaged groups also explain why we find smaller socioeconomic differences in height in historical studies analyzing complete cross-sections than when comparing extreme groups (Paper 1).

The inability to conclude much about the causes of the differences found relates also to some degree to the study on the influence from sibship size on height. Material resources do seem to have been important since the association becomes weaker over time, but the decline of the negative association is also paralleled by declining numbers of children present in the households. It is therefore possible that time constraints or the parents' care for the children were important too. Nutritional status can be influenced by the care and patience of the parents, for example as a result of feeding practices (Engle, Bentley, and Pelto 2000).

The well-established associations for present day populations, between height and weight and socioeconomic circumstances, were present also in this historical population. Still the associations were also shaped by specific historical developments. Analyzing the social differences in height and their changes further reveals that the differences and changes of these over time seem to be caused by interplays between both economic and social conditions in society. The landholders lost their advantage with rising agricultural productivity and improving possibilities for storing and transporting the surpluses from the early 19th century onwards (Bengtsson and Dribe 2005). The position of the skilled manual workers also changed over time. Their sons caught up with other groups and surpassed the sons of lower skilled manual workers in the mid-20th century. This development is also not easily explained as a result of rising income levels in general but was rather a result of incomes rising more rapidly in this group compared to others. The long-term changes of the social differences in height in the SEDD population therefore seem to be the results of, at least also, changes in the distribution of resources, the economic structure, expanding markets for foodstuffs and possibly societal changes with the creation of social security systems rather than of rising income levels in and by themselves. The interplay between resources and social processes is also shown by the complex determinants of the occupational differences in BMI (Paper 4).

Many different factors contributed to the secular trend in height. Even if improvements of other living conditions, such as housing standards and working conditions, might have contributed it is likely that the most important factors were changes of nutrition and disease. I think that we need to move beyond the averages and crude trends with regards to both developments.

Increases of the quantity of food consumed probably contributed to rising average heights and also to reducing mortality rates, but the quality of the diets could have contributed just as much. Rising dietary diversity, refinement and share of animal products in the diet could have contributed to improving nutritional status both through more adequately providing nutrients and by making them more easily accessible to the body. Reduced deficiencies of micronutrients could very well have contributed to both the secular trends in height and declining mortality.

Declining morbidity, in and by itself, most likely also contributed to both trends but I think we also here need a more refined understanding of the exposure to disease and the interactions between nutrition and disease (compare Harris 2004). Different diseases are affected differently by the nutritional status of the host. Changing patterns of disease can therefore have changed the influence from nutrition on the health of the population. Diseases can in themselves also be influenced by the nutritional status of the host population. The virulence of diseases can change over time and influence how lethal and contagious they are. Changes of the virulence of diseases can therefore have contributed to the mortality decline (Fridlizius 1984).[15] The virulence of diseases can change through random mutations but it can also be affected by possibilities for transmission and the resistance of the host population which, in turn, are affected by economic and social conditions in society (S. R. Johansson 1994, 118). A more systemic understanding and framework is therefore probably needed for analyzing trends in nutrition, morbidity, mortality and height.

The influence from disease on the secular trend in height was not a result of scarring effects from being ill once or a few times. The effect from disease on achieved height works through frequent, severe or prolonged diseases especially in combination with suboptimal nutrition. We have yet very little information on this non-lethal morbidity historically (but see for example Harris et al. 2011; 2012; Floud et al. 2011) but the subject warrants further investigations.

The results indicate that the influences on growth, height and weight were similar in this historical population as in present day populations. The influences were multifaceted and complex then as now. The important influence from nutrition was not just a matter of the number of calories consumed. The quality of the food and diets also played a role. The influence from disease came from common and frequent infections interacting with the nutrition.

15 For an introduction to the literature on how changing virulence can have contributed to the mortality decline see K. Johansson (2004, chap. 1–2).

Also other influences, for example housing conditions and behaviors, are likely to have played a role for the heights and weights.

The multitude of influences on growth and achieved height and the long time period while the body is sensitive to these influences make achieved height a good summary measure of overall life experiences but a poor measure of separate influences, such as exposure to disease during infancy. While the environmental influences are consistent and theoretically and substantially important, the associations are all quite weak when measured empirically in individual level data. The multitude of influential factors, the long growth period and genetic variation always work to reduce the associations between separate environmental exposures and achieved height. Height can therefore not be used as a measure of single or specific experiences, such as exposure to disease around birth. It is, for the same reasons, a very poor measure of health status or human capital at the individual level.

Both nutrition and exposure to disease contributed to the secular trends in both height and mortality. The two trends therefore share causal underlying causes. Still, I think that we also need to investigate the two trends separately. Nutrition is likely to, at least, have had a stronger influence on growth than resistance to disease influencing mortality rates. Diseases also, most likely, had an important influence on growth and achieved height, but mortality is influenced also by the exposure and virulence of diseases that are likely to have left little mark on growth (see for example Steckel and Prince 2001; Prince and Steckel 2003).

Because mortality and height are influenced by different factors they are not interchangeable measures of human health or living conditions. We should therefore not be expecting to always find the same results when we analyze the two different outcomes. The results in my studies are, for example, quite different from what has been found analyzing mortality in the same population. Socioeconomic differences in mortality emerged only by the time when the socioeconomic differences in height declined substantially (Paper 1 and Bengtsson and Dribe 2011). The sibship size was negatively associated with height but the share of children in the household had no strong influences on the mortality risk of children in the mid-19th century (Paper 2 and Bengtsson 2009a [2004]). Infant mortality in the year of birth had no direct influence on achieved height but has been shown to influence later life mortality (Paper 3 and Bengtsson and Lindström 2000; Bengtsson and Broström 2009; Quaranta 2013) and also, for example, the fertility outcomes of women (Quaranta 2013).

Growth and achieved height are influenced by living conditions. Studies of heights can therefore contribute important insights into changes of and differences in living conditions over time and between groups. I still think that it is important to acknowledge that human growth is a specific process with unique influencing factors and that it is capturing some more general changes and differences better than others. By combining detailed demographic data with individual level information on height it is possible to take some of these specific influencing factors into consideration, as I try to do in the papers. And while I hope that the studies I have done show the potential of using this kind of data there is much more that could and should be done. This research could provide further insights into, for example, inequality, household behavior and labor market dynamics, but also of how human bodies are influenced by their social and economic contexts. While the long time period covered in my data was useful for investigating the long-term changes of these influences, the data collection and linking is very time-consuming. I therefore had to collect a small sample with few observations per year. Larger samples per time period would have been useful for investigating small but interesting subgroups, such as sons of the nobility, lower skilled non-manual workers and different groups of skilled manual workers. Samples from other areas would also have enabled informative comparisons, such as sons of skilled manual workers and non-manual workers in urban as compared to rural areas.

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Paper 5

Information from conscript inspections linked to the Scanian Economic Demographic Database – a description of the data

1. Background

The purpose of this paper is to describe the data collected from conscript inspection lists and linked to a sample of the men included in the Scanian Economic Demographic Database (SEDD, Bengtsson, Dribe, and Svensson 2012). I collected the data in 2010–2011 as a part of my dissertational work and while employed by the Centre for Economic Demography, Lund University. The text also describes the linking with and information added from Skånska Knektregistret, a database on the hired militaries in Scania created by genealogists. This text is intended to describe the collection process and the included variables to enable the further use of the data and therefore describes also variables that are not used in the dissertation. The text highlights problems and discusses limitations of the information that might not be obvious without knowledge of the inspection and linking procedures. Despite the focus on limitations and potential problems, it is the author's opinion that the data are useful and of high quality. The inspections present rare and valuable insights into the health status of almost complete cross-sections of the young adult male population. The value of conscript inspections as surveys of public health was, most likely, realized from the start. The aggregated outcomes from the inspections were published in the annual reports of the national authorities for public health from 1838 throughout the 19th century (see also, for example, Berg 1853).

Universal conscription was introduced in Sweden in 1812 with the so-called "beväring".[1] There had been attempts with conscription and

1 The Swedish system of conscription is described in Ericson Wolke (1999). Some additional information on the historical background can be found in Creutzer (1975) and Tirén (1976). Törnquist (2002) places the Swedish system in an international context. The organizational development is thoroughly described by Personne (1970). Personne is an essential resource

militias before 1812 as well. However, the "beväring" was the first universal conscription and it was maintained, though renamed and modified on many occasions, until 2009. More important, for the use of information from conscript inspections as a source for scientific research, is that the inspections show a large degree of organizational continuity and uniformity over time (Personne 1970). Sweden was not the first country to have universal conscript inspections. However, it is one of the few countries where the inspection lists have been kept for the whole time period. The Swedish data also have the advantage that, even if it were possible to be exempted from duty, this was in practice rare.

2.The collection and linking of the data

2.1 The sample frame

The earliest inspection lists from Scania kept in the archives are from 1817. Men born in 1796 were therefore the first birth cohort looked for in the archives. The hired militaries in Skånska Knektregistret are sometimes born before 1796. For individuals born after 1950, inspected from 1969 onwards, the inspection results are digitized and available from "Rekryteringsmyndigheten" (formerly "Pliktverket" and before that "Värnpliktsverket"). Data were thus collected for cohorts born 1796–1950, inspected in 1817–1968.

Data were collected for men in the five parishes Kågeröd, Kävlinge, Halmstad, Hög and Sireköpinge for the period 1817 until 1915. For inspections held from 1916 onwards (cohorts born 1895 and later), only men in Kågeröd, Kävlinge and Hög were searched for. At the time when the archival work was carried out, the database had not yet incorporated information for Halmstad and Sireköpinge for people born after 1895.

The data collection was designed to analyze the influence of childhood conditions on height achieved at the age of inspection. The sample was therefore limited to men with known family backgrounds. Known family background was operationalized as having a non-missing value for the first

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when using the material from the Swedish conscript inspections. The materials kept in the Military Archives are also described in Söderberg (1989). The procedures for conscript inspections are further described in Creutzer (1975) and Lundström (1993, 86–119), Hultkrantz (1927) is also useful. The procedures for the inspections after 1968 are thoroughly described in Otto (1976). The regulations of conscript inspections, especially the physical examinations, were carefully catalogued by Gunnar Olofsson in two unpublished manuscripts (Olofsson 2012c; Olofsson 2012b).

name of the father. This was chosen as an easy condition to implement in the file used during the archival work. The condition had the unfortunate side effect that illegitimate children were excluded from the sample. For unknown reasons I also looked up some individuals without a known name of the father in the conscript inspection lists. Information on hired militaries was also gathered from Skånska Knektregistret. This linking was not conditioned on having a known name of the father in the SEDD even though this information was used in this linking when available.

For the birth cohorts 1796–1921, it was necessary to know the place of residence around the age of inspection since the lists were organized geographically. The sample was therefore limited to men with any presence in any one of the five (three after 1916) SEDD parishes between ages 17 and 24 years. For the birth cohorts 1922–1950, it was enough if the man was inspected in Scania to find him. Information on some of the birth cohorts 1924–1945 could be found even if they were not inspected in Scania.

At the time when the archival work was carried out, individuals were not linked if moving between parishes in the SEDD. If an individual or family moved from one of the database parishes to another, they appeared as different individuals or families. I therefore linked men who moved between the parishes or had the same (or very similar) names and birth dates in the sample frame. The linking was important to ensure that the links were accurate. Men with the same (or very similar) names were often present in the parishes. By linking movers, it was possible to utilize as much of the available information as possible to get the links right. By using all the available information, it was also possible to find migrants who would otherwise have been lost. Altogether, 1521 observations were found for 908 of the men included in the sample frame that I judged to be the same individual. After I had collected the data all individuals were linked between the parishes in the SEDD. Not all of the links I made within the sample frame were judged to be accurate in the later linking of the SEDD. It is therefore uncertain if these links are accurate or attributed to the wrong individuals. There is a variable indicating 586 uncertain links and thus potentially problematic observations in the file available from the SEDD. These observations have always been excluded in the studies presented in this dissertation.

The criteria described above resulted in a sample frame of 9432 men. In total, 1521 (16%) of these were judged by Öberg as appearing more than once in the file, leaving 7911 men to look for in the archives.

2.2 The archival sources from the conscript inspections

The main source material used for the data collection was the lists created at the inspections. These lists were set up in collaboration between the civil registration authorities and the military. The priest or the parish office was obliged to set up lists each year of the men who had to appear for inspection based on the catechetical examination registers ("husförhörslängder") and later on the local population registers ("församlingsböcker") (Personne 1970). The men consequently appear in the inspection lists sorted by parish and were also inspected together by parish. Until 1886, the lists were set up by parish within each civilian administrative area ("härad") and after 1886 by parish within military administrative areas based on the recruitment areas of the regiments.[2] Over time, attempts were made to make each parish part of only one military administrative area. There were many minor changes to the borders of the administrative areas, but overall the underlying principle of the inspections and inspection lists remained the same (Personne 1970; Tånneryd 2002). From 1953, the inspection lists were set up by larger military regions, approximately corresponding to civilian provinces ("län"), and these lists were sorted by personal id numbers.

The inspections were led by a board consisting of military officers and civil representatives (Tånneryd 2002; Personne 1970). During the 19th century, the board included the regional governor ("landshövding") or a representative of the governor. Several versions were made of the inspection lists. The lists of all men who had to appear for inspection, as discussed above, were used during the inspections. These included information on all men, regardless of the outcome of the inspections. After the inspections, lists of all men who had been accepted as conscripts were set up and sent to the regional military offices and to the general command in Stockholm. These lists are kept in the Military Archives ("Krigsarkivet") but, as mentioned, only include the accepted men. Before 1861, only the lists set up at the inspections include information on all the inspected men. Two copies were made of these lists, one of these was kept by the governor's office ("landskonteret"), and these have often been preserved in the regional archives (Table 5.1). From 1861 onwards, complete lists have been kept in both the regional and the military archives. The lists in the regional archives cover the civilian administrative regions and are organized differently from the military lists. Since the civilian administrative areas, mostly province ("län"), were larger than the military areas used for the military's lists, I used the civilian lists when available.

2 Some of the changes to the borders of the military administrative areas in Scania can be seen in Kjellqvist (1994). Directories stating to which military area each parish belonged are available in the Military Archives ("Krigsarkivet").

Table 5.1 Summary of the contents in the different 19th century inspection lists

	Year of inspection	
Source	–1860	1861–
Civilian inspection lists (Archive: "Landskontoret")	Everyone summoned and inspected	Everyone summoned and inspected
The military's inspection lists (Archive: "Krigsarkivet"	Only the accepted men	Everyone summoned and inspected

The men who could not be found in the inspection lists were looked for in other sources when possible. The navy and coastal artillery had a centralized registration of conscripts before the other branches of the military, and thus conscripts not found in the inspection lists (born 1921–1930) could be looked for in these archives. For the cohorts born between 1931 and 1945, the cards set up at the physical examinations, at the universal inspection and at the beginning of the training have been archived by the central conscription authority (Värnpliktsverket med värnpliktskontoren – Bergslagens värnpliktskontor, Centrala läkarhandlingsarkivet). These archives consist of thousands of boxes with cards in envelopes sorted by personal id number. By using these archives, it was possible to find almost everyone looked for born between 1931 and 1945.

Information from Skånska Knektregistret was also linked to the men in the SEDD. Skånska Knektregistret is a registry of (almost) all hired militaries in Scania created by genealogists.[3] The inspections of the hired militaries also included a physical examination and these men also had their height measured (Sandberg and Steckel 1987).

2.3 Ethical review

Access to the 20th century inspection lists was tested and approved through the Military Archives (Dnr KrA 43-2011/389). This data collection was carried out as a part of the project Economic Demography in a Multi-Generational Perspective ("Ekonomisk demografi i ett flergenerationsperspektiv"). The project was approved (date of decision Dec. 8, 2010) by the Regional Ethical Review Board in Lund ("Regionala Etikprövningsnämnden, Lund").

3 Information on the Skånska Knektregistret can be found at http://www.sgf.m.se/knektar.htm (Accessed: March 6, 2012).

2.4 Quality of the sources

Until 1950, most inspections were held during spring. The lists were created around New Year and thus they contain the men who were noted as living in the parish at that time (Kjellqvist 1994). There are sometimes notes in the lists about moves taking place after the creation of the lists. Moves were sometimes missed or unregistered and some men therefore appear twice in the lists. In the aggregated statistics from 29 inspections in Malmöhus province between 1824 and 1872, on average 0.7 percent of the names in the lists were due to administrative errors. Comparing the aggregated statistics of the total number of listed men with the figures of men in the relevant age group (Human Mortality Database 2012) shows that the problems with the excess coverage of the lists might have increased between 1838 and c.1880 (results not shown). After 1880, the probable over-coverage remains more or less constant. The average over- and under-coverage is close to zero but in a few years is as large as 10 percent.[4]

The inspection lists are missing in the archives for some years. Inspections were not held in all years during the first half of the 19th century (Berg 1853; Hultkrantz 1927, 12). The inspections were, for example, sometimes cancelled because of epidemics. There were no inspections in northern Scania in the years 1827, 1832 and 1836. The cohorts were also not always inspected in the year they were supposed to. These cohorts were instead summoned in the following year. In northern Scania, only one cohort, men born in 1816, was never summoned and inspected. Inspection lists are also missing in both the regional and the Military Archives for the cohort born in 1832. There can still be a few observations for these cohorts on volunteers for earlier conscription or hired militaries inspected in other years.

A few groups were exempted from the inspections. Hired militaries were exempted from conscription. Some of them were found through Skånska Knektregistret but it is likely that some of the men who could not be found were hired militaries without this being known. Approximately 5 percent of the men successfully linked were hired militaries around the age of conscription even if the share changed over time (Paper 1, Table 1.1). The share in the sample is similar to the estimates reported by Hultkrantz (5% : 1896a; 7% : 1927, 36f). Hultkrantz (1896b, 17) writes that Scania was the province with the largest share of young men employed by the military (8.5%).

Some other groups were also exempted from conscription (Larsson 1999). According to Hultkrantz and Personne, some public servants, such as

4 For evaluations of this issue for cohorts born after 1950 see, for example, Otto (1976) and Neovius and Rasmussen (2008).

postmen, were exempted (Hultkrantz 1927, 12; Personne 1970). The share exempted is reported in unpublished aggregated statistics for 74 inspections in the Malmöhus province, 1824–1872. The share exempted increases from the early 1860s to reach 3–5 percent. Before 1860, the share is very small, only once reaching 1 percent.

Criminals and individuals who had lost their civic trust ("medborgerliga förtroende") were also exempted. This group is only included for less than half of inspections with an average of about 2.5 individuals per year in the entire Malmöhus province, 1824–1872.

Until 1860, it was also possible to hire a substitute to take one's place in military service (Törnquist 2002). This was not allowed after 1860 but until 1872, it was still possible to pay a fee to be freed from duty. This does not seem to have been very common. In the data collected for the SEDD, there are only six cases where someone hired a substitute. In the Malmöhus province, only on average 1.3 percent of the men hired a substitute during the years 1824–1872. Men who paid the fee seem to have been inspected before doing so and are included in the lists.

Severely handicapped men did not have to present themselves at inspections. They could be rejected based on attestations from the parish priest or a doctor. This information was included in the inspection lists. It was not always clear in the lists if the man had been present at the inspection or not. Unfortunately I also did not indicate which men that had not appeared for inspection even when this was stated in the lists.

Some men appeared for inspection before they reached the age for compulsory conscription. The number of volunteers for earlier conscription increased in the years preceding increases in training time. This can be seen in the published statistics from inspections (results not shown). During the years 1902–1914, on average 9 percent of the relevant age group had already been inspected and accepted. One could not be inspected and rejected being below the normal age of inspection. Men who were not tall or fit enough for training still had to appear for inspection once they reached the ordinary conscription age. Accepted volunteers for earlier conscription were therefore on average taller and healthier than the overall average population.

Foreign citizens were exempted from conscription duty in the 19th century. In a few cases, it was noted in the inspection lists that the man was a foreign citizen and he was then struck from the list. It is not known if such men had to appear for inspection later if they became Swedish citizens before the end of conscription age. In the mid-20th century, immigrants had to appear for inspection in the year after they gained their citizenship if they were still within the age of conscription (Anonymous 1961, 2). By then, the age of conscription had been extended to 47 years.

Some men just skipped coming to the inspections. They could be forced to come by the civilian authorities, and these men were looked for during all the years when they were in the age of conscription. During most of the 19th century, this meant five years (ages 20–25 years). About 4 percent of the listed men did not show up for inspection in the aggregated statistics from Malmöhus, 1824–1872. A parliamentary investigation in 1891 concluded that across Sweden, 13–15 percent of the listed men had been missing from inspection during the last few years (Tånneryd 2002, 30) . Most of these had appeared in another place or came to inspections in some of the following year(s); thus, only about 5 percent were never inspected by the military.

One group that did not show up for inspections was emigrants. In the SEDD sample, 124 men were noted in the inspection lists as having moved out of the country. The share of the sample was always quite small, but in some years, it reached almost 5 percent. The share increases for the years when emigration from Sweden was at its highest (Bohlin and Eurenius 2010). It was sometimes rumored that men emigrated to escape conscription. This seems unlikely but it could be that some said they were going to emigrate to avoid conscription (Tirén 1976).

In addition, internal migrants were harder to find (both for the contemporary authorities and for me in the archives). For the birth cohorts 1796–1921, it was only possible to find the men if they had moved into or out of the database parishes during the ages 17–24 years. Moreover, they could only be found if they were staying in the parish of origin or destination at the age of inspection.

Another group that was not exempted from conscription duty but which were still hard to find information on was seamen. From 1886, seamen, defined as being registered in any one of the non-geographical parishes called "sjömanshus", were to serve in the navy (Personne 1970). Naval pilots, lighthouse workers and lifeguards were also enlisted to the navy (Tånneryd 2002). Assignment to the navy could be carried out without inspection. Seamen were still exempted from inspection in 1961 (Anonymous 1961). Moreover, since these men were quite often away working on a ship or maybe because they knew they could be exempted, they were oftentimes missing at inspections. They could be inspected, and rejected, at the "sjömanshus". In cases where the men were included and found in the ordinary inspection lists or in the lists from the "sjömanshus", some information, such as height, is oftentimes missing.

Students are another group that were hard to find in the lists. They were not exempted from service but could be inspected and could conduct their training in the town where they were studying (Tirén 1976; Larsson 1999). In Lund, the university town closest to the SEDD area, this was possible until 1869.

The men who did not want to participate in military training always had an incentive to shirk or to simulate health problems. The extent of shirking is of course impossible to estimate. There are always examples with universal conscription of how men tried to simulate sickness or disability to be freed from duty (Lundström 1993; Ericson Wolke 1999). The military has always tried to counteract this and see through the fraud. However, it is not certain whether they always had an incentive to force these men to participate in the military training since they might cause problems and would anyway not become well-motivated soldiers. The possibility of shirking is important to remember when using the data but it is not certain that this would cause any systematic bias.

2.5 The linking procedure

A similar method was used for linking almost all cohorts (Table 5.2).[5] Linking was carried out based on name, date or year of birth and place of residence. Information on moves from the SEDD was also used to check the places of residence and to find men having moved outside the database parishes. Until 1860, no date of birth was given in the inspection lists. From 1861, the inspection lists include a date of birth, which was then used in the linking. Some discrepancies between dates of birth or names were accepted. These links were checked carefully and they required the man to live in the expected place and have the right date of birth or name. All uncertain links from before 1861 were checked using the catechetical registers, which contain dates of birth. Uncertain links from 1861 onwards were also sometimes checked to see if any discrepancies in names or dates of birth could be confirmed. The SEDD contains different names and dates of birth for many individuals. The sample frame only included the most certain ones. All men found outside the database parishes were looked for in the catechetical registers (and later, parish books) if there were any uncertainties. Altogether, 491 men were searched for in catechetical registers or parish books. Of these, 430 (88%) of the links were confirmed, 42 (8%) were discarded as erroneous and another 19 (4%) could not be found and confirmed and were therefore discarded.

Individuals who were supposed to be inspected in 1878–1882, 1888–1892 or 1898–1902, who could not be found using the method described above, were searched for in the published databases of the censuses of 1880, 1890 and 1900. Searches were made for 125 individuals. Of these, 99 individuals

5 Instructions on how to find a conscript in the Military Archives can be found in Söderberg (1999, 80) or the in instructions available at the Military Archives (Schneck 1976) or at their website (Anonymous 2012).

could be found with certainty. In five cases, the results were uncertain and 21 individuals could not be found at all in the censuses. The information from the censuses was then used to find the men in the inspection lists.

Men born in 1922 or later could be searched for in a printed version of a previously computerized administrative database of military personnel, mostly hired militaries and conscripts. The lists primarily contain individuals born 1922–1954. Some hired militaries and other personnel, as well as men in the voluntary militia ("hemvärnet"), born before 1922 are also included. Some individuals born 1955–1959 are apparently also included. It is not exactly clear from the description of the creation of the register who was included or excluded from the register. The most important exemption from the register is that men who were rejected at first inspection not are included. The register, as available in the Military Archives, consists of bound printouts of the data file where the entries are sorted by Swedish personal id number ("personnummer"). Except name and personal id number, the lists holds a 3+3+1 digit code primarily stating the unit or branch of the military where the individual was registered, and until 1953 a military id number ("värnpliktsnummer"). The code stating the troop and/or the military id number can be used to find the man in the inspection lists. This also made it possible to find the men when the place of residence at inspection was not known from the SEDD.

Linking information from Skånska Knektregistret was carried out cautiously including only men with exactly the same date and parish of birth and name. Names of the father and date of death were also used when available. Many hired militaries changed their surnames. Both the old and new names are given in Skånska Knektregistret, which also proved to be helpful.

Table 5.2 Summary of the procedure for linking information from conscript inspections with the Scanian Economic Demographic Database

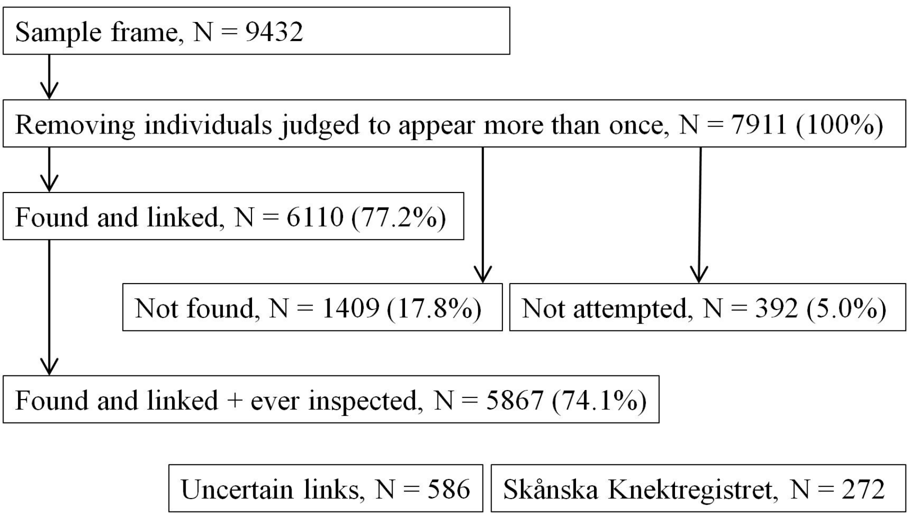
Birth cohorts	Materials used	Requirements; Required information besides name and date of birth
1796–1921	Inspection lists + census material from 1880, 1890 and 1900.	Known place (parish) of residence at the time of inspection.
1922–1930	Inspection lists + "Lokalregistret"	Known place (parish) of residence if not included in the "Lokalregistret". (The men were also looked for in the navy and coastal artillery registers.)
1931–1945	Inspection lists, "Lokalregistret" and registry cards ("Centrala läkarhandlingsarkivet")	Known place of residence if not included in the "Lokalregistret" and missing from the "Centrala läkarhandlingsarkivet".
1946–1950	Inspection lists	Residence within southern Sweden (approximately Scania) at time of inspection.

3. Outcome of the linking

3.1 Linking the conscript inspection materials

I could link 6110, or 77.2%, of the 7911 men looked for to an observation in the inspection lists (Figure 5.1). For 31 men, the inspection lists did not provide any useful information. Altogether, 5867 men were found and had been inspected at least once, corresponding to 74.1 percent of the sample frame.

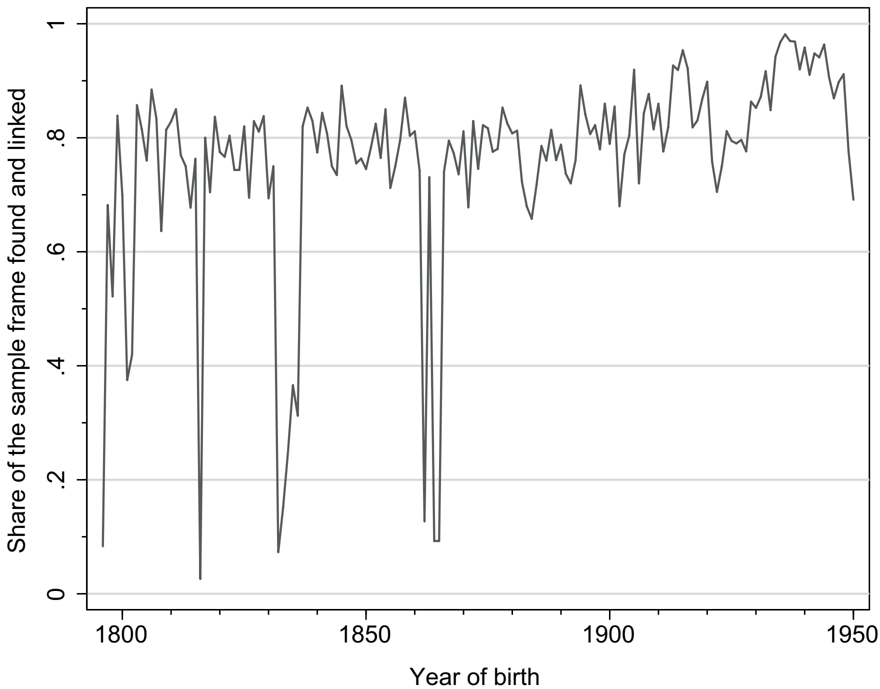
Figure 5.1 Summary of the outcome of the linking of conscript inspection data to the Scanian Economic Demographic Database



During the first half of the 19th century, the inspection lists were sometimes missing in the Regional and/or Military Archives. This of course lowered the share linked. There are only a few observations available for some birth cohorts for this reason.[6] For most years, about 80 percent of the men searched for in the archives could be found (Figure 5.2). There are no drastic changes in the share successfully linked over time save for the years when the inspection lists are missing from the archives. Figure 5.2 also includes 1817 for which lists of accepted men from a few of the administrative areas were found in the Military Archives.

6 The cohorts with only very few linked observations are: (1791), 1796, 1800–1802, 1816, 1832–1836, 1862, 1864–1865.

FIGURE 5.2 Successful links as a share of the sample frame by year of birth

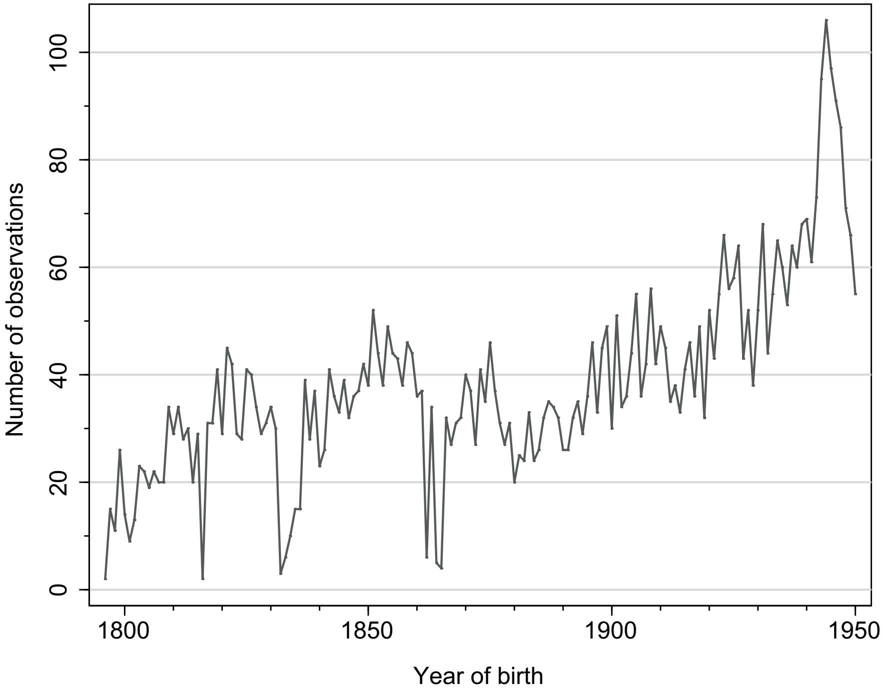


Note: Calculations based on the file delivered to the SEDD.

The introduction of the conscript army in 1902 (men born 1881 onwards) led to a stricter enforcement of the rules and improved the organization of the inspections. This led to somewhat better possibilities to find the men in the inspection lists. Because the requirements for finding the men were reduced with the birth cohorts 1922 onwards, the share successfully linked increased a bit after that. The armament in Sweden during World War II led to many volunteers for earlier conscription and some men being inspected at extra inspections. It was more difficult to find the men in the inspection lists during these years. For men born after 1945, it was no longer possible to look for them in the centralized archive with medical records. This lowered the share successfully linked for the last cohorts. It is likely that some of the men not found in the lists from 1968 were inspected in the following year.

The number of observations per birth cohort increases over time, especially with the fast population growth in Kävlinge from the 1880s onwards (Figure 5.3 and Introduction, Figure 6). The reasons for the spike in the number of observations on men born in the mid-1940s and inspected in the early 1960s are unknown but it was easier to find these men in the lists (Table 5.3).

Figure 5.3 Number of observations per year of birth



Note: The figure is based on the file extracted from SEDD (Dec. 17, 2012).

3.2 Skånska Knektregistret

Altogether, 272 matches were found and these are included in the SEDD. These men were inspected between 1811 and 1919. Some of the men enlisted as hired soldiers were quite young at enlistment. It is therefore necessary to check the age at inspection when using, for example, information on height. In two cases where heights were available both from Skånska Knektregistret and the inspection lists, the difference between the two measures was too large to be plausible for the given time span. These links were therefore discarded.

3.3 Systematic patterns in the outcome of the linking[7]

Logistic regressions were used to look for systematic patterns of who in the sample frame was found in the inspection lists. The background information used in this analysis was the place and year of birth, parish and socioeconomic status of the family. Men born in any of the five SEDD parishes were compared to men born outside these parishes. The other parish variables were defined based on the first digit in the database identification number indicating the parish where the men first appeared in the database area. The men moving from one database parish to another were indicated as internal migrants.

The socioeconomic background of the family is based on the occupation of the father at the birth of the inspected man (see Paper 1 for more information). The change over time in the likelihood of finding the men in the lists was investigated using dummies for men born in different periods of years. The periodization follows the changes in the information required to find them in the lists (Table 5.2) and in the sample frame (Section 2.1). Healthy and fit men born before 1840 could be asked to appear for inspection in the following year(s) if they were shorter than the minimum height required. This regulation did not affect the first four cohorts but this group was too small to indicate separately. Since the men in Halmstad and Sireköpinge were not looked for in the lists from 1916 onwards, the outcome was investigated by splitting the sample for men born in or before 1895 and 1896 onwards.

The results from the logistic regressions show that there unfortunately are some systematic patterns in who was found and inspected (Table 5.3). The dependent variable is dichotomous with one indicating that the man was found in the lists and had been inspected. Odds ratios above one therefore indicate a higher chance of the man being found and ratios below one a lower chance.

7 The following section is based on analyses of the file with conscript inspection data available from the Centre for Economic Demography, Lund University. There are 6073 observations in this file. This file was linked to the SEDD Version 3.1 (Bengtsson, Dribe, and Svensson 2012, extracted Dec. 17, 2012). A sample frame was generated following the steps presented in Section 2. The men were chosen conditioning on having a SEDD identification number for the father instead of having the first name of the father. The sample frame in this version of the database consists of 7985 individuals. In total, 5506 (69.0%) of these men were found in the lists and ever inspected in the strict sense of ever having been accepted, rejected or temporarily rejected (to grow or recover from illness) at a conscript inspection or having been inspected as a hired military (at a conscript inspection or otherwise). Another 420 men not in the SEDD Version 3.1 sample frame also have information from the inspections.

Table 5.3 Systematic patterns in who was successfully linked and inspected

			Men born:	
			1796–1896	1897–1950
Variable		Share of sample (%)	Odds ratio	Odds ratio
Not born in a SEDD parish		46	ref.	ref.
Born in a SEDD parish		54	0.78 **	0.90
Parish				
	Kävlinge	29	ref.	ref.
	Hög	8	0.72 **	0.72 **
	Kågeröd	36	1.04	0.98
	Halmstad	7	0.51 ***	–
	Sireköpinge	10	0.41 ***	–
	Internal migrant	9	0.60 ***	0.46 ***
Occupation of father				
	Missing	42	0.62 ***	0.64 ***
	Low-skilled worker	45	ref.	ref.
	Skilled worker	12	0.90	1.27 *
	Farmer	16	1.15	1.84 **
	Non-manual occ.	7	0.69 **	0.94
Landholding				
	Landless	78	ref.	ref.
	Small-scale	7	1.52 ***	1.78 **
	Large-scale	15	1.05	1.10
Year of birth				
	1796–1839	18	ref.	–
	1840–1865	16	1.12	–
	1866–1915	34	0.73 ***	–
	1916–1921	4	–	ref.
	1922–1930	18	–	0.79 **
	1931–1945	7	–	2.53 ***
	1946–1950	3	–	1.14
Constant			2.95 ***	4.50 ***
N			4470	3515

Note: Statistical significance is indicated as follows, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Migrants were always harder to find. This can be seen from the lower chance of finding internal migrants. Men born in the parishes were also somewhat harder to find, especially in the earlier period when it was important to know where the men lived. The sample frame for these men was conditioned on presence in the database parishes at some point between ages 17 and 24 years. The men born in the five parishes had a longer time during which they could move away than men who only appeared in the parishes later in life. Men in Hög, Halmstad and Sireköpinge were harder to find than men in Kävlinge and

Kågeröd. There were fewer people living in Hög, Halmstad and Sireköpinge so this probably worked to increase the probability of these men migrating across a parish border (see Introduction, Figure 6).

There were also differences depending on the men's socioeconomic background. Men for whom there is no information on the occupation of the father at their birth were found less often than others. Having a father with a non-manual occupation also lowered the probability somewhat in the earlier period. This might be because they were more often students and therefore harder to find in the lists.[8] Sons of farmers were found more often than others. A possible explanation could be that they had a lower propensity to move out of their parents' households than other groups (Dribe 2000; Dribe and Stanfors 2005). Sons of skilled manual workers were also found more often than other groups from 1916 onwards. There was no difference in the likelihood of finding sons from landless households and households with access to large amounts of land. Sons in households with access to small amounts of land were found more often than other groups.

It was easier to find the men inspected from 1936 onwards (born 1916 and later). It was apparently more difficult to find the men born 1866–1915 than men born before 1866. The possibility of using the register of all inspected men ("Lokalregistret") for men born from 1922 onwards did not improve the chance of finding them compared with men born 1916–1921 when it was necessary to know their place of residence. The possibility of using the centralized register ("Centrala läkarhandlingsarkivet") for men born 1931–1945 increased the chance of finding them a lot. The last five cohorts were back at similar levels to the other men born in the mid-20th century.

3.4 Checking the links

As mentioned above, uncertain links were checked using the catechetical registers and parish books. Besides this, and the search for individuals appearing more than once in the SEDD, one other method was used to check the links. From 1887 to 1952, conscripts were assigned a military id number. A search for individuals with identical military id numbers was also conducted after finishing the archival work and two collection errors were found. In these cases, it was possible to determine which link was accurate, so the errors were corrected and the false links discarded.

8 Students were harder to find both because they migrated to study and because they were inspected at separate inspections during the 19th century (see Section 2.4).

TABLE 5.4 Overview of the information from conscript inspections linked to the Scanian Economic Demographic Database

Years of inspection	**1811–1860**	**1861–1886**	**1887–1901**	**1902–1941**	**1942–1948**	**1949–1952**	**1953–1968**
Years of birth	**1790–1839**	**1840–1865**	**1866–1890**	**1891–1921**	**1922–1928**	**1929–1933**	**1934–1950**
Name	Yes*	Yes	Yes	Yes	Yes	Yes	Yes
Place of residence	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Date of birth	Only year	Yes	Yes	Yes	Yes	Yes	Yes
Date of inspection	Approximate	Approximate	Mixed	Exact	Mixed	Exact	Exact
Place of inspection	Geographical area	Geographical area	Military area	Military area	Military area	Military area	Military area
Height	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weight	No	No	No	No	Some	Yes	Yes
Chest circumference	No	No	No	A few	A few	Yes	Some
Inspection outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Military position	No	No	A few	Yes	Yes	Yes	Yes
Diagnoses, causes for rejection	Often, but rudimentary	Yes	Yes	Yes	Yes	Yes	Yes
Inspection group	No	No	No	Yes, from 1929.	Yes	Yes	Yes
Cognitive ability	No	No	No	No	Yes, from 1944.	Yes	Yes
Psychological evaluation	No	No	No	No	No	Yes, from 1951.	Yes
Occupation	Often	Yes	Yes	Yes	Yes	Yes	Yes
Career	No (rarely)	No (rarely)	No (rarely)	No (rarely)	No (rarely)	Yes	Yes
Education	No	No	No	No (rarely)	Yes	Yes	Yes
Skills	No	No	No	Some, from 1928.	Yes	Yes	Yes
Certificates	No	No	No	No	No	Yes, from 1952.	Yes

* Sometimes only the first name was given in the inspection lists. These links were checked.

4. Information available from conscript inspections

Both the organization of the inspections as well as the inspection procedures remained relatively unchanged over time. The inspection also consisted of at least a physical examination and a listing of personal information. The inspections became more thorough and extensive over time, thus widening the information available in the inspection lists. An overview of the data linked to the SEDD from conscript inspections is given in Table 5.4. This also provides an illustration of both the continuity and the extensions of the inspections. The years in the table heading indicate when the information available changed.

4.1 Name and place of residence at inspection

The men were identified by name, date of birth and place of residence in the lists. Little new information could naturally be gained from the identification since the linking is based on this being the same in the lists as in the database. Here, I just mention the cases where identification information available from the SEDD could be updated or complemented. The place of residence was, for example, recorded for men if they lived outside the database parishes at the time for inspection.

One of the parishes, Kävlinge, developed into a small industrial town during the late 19th century. The inspection lists 1908–1941 are separated between the municipality and the rural area of Kävlinge. During this period, I collected the places of residence for men living in Kävlinge which can be used to separate rural and urban residents more carefully.

Until 1886, the geographical organization of the inspection lists was conducted based on parish and "härad". The "härad" were administrative areas consisting of several parishes or parts of parishes. Three of the database parishes, Kågeröd, Halmstad and Sireköpinge, belonged to more than one "härad". Before 1887, the information on the place of inspection in *InspPlace* can therefore be used to divide the places of residence of the men by "härad". From 1887, the information on the place of inspection refers to different military inspection areas and is probably not very useful for analyses. Information on place of inspection and inspection area were collected throughout the linking to facilitate going back to the inspection lists for checks and further collection.

4.2 The results of the inspection

The inspections were carried out to determine which of the men were fit for military training. The military only wanted to accept men who could complete the training and become useful as soldiers. Men who did not have the physical or mental capacity to complete the training created problems during the exercises and increased costs without adding to the military capacity. In

1867–1871, over 6 percent of the accepted men were rejected and sent home during the training (Arbo 1875, 101). Even larger shares, 10 percent or more, were rejected during training in the 1960s (Tirén 1976, 611). That some men had to be sent home from the training was perceived as a problem in both the 19th and the 20th centuries (Arbo 1875; Lundström 1993). The aim of the inspections was thus to reject some of the men and accept some. The decision taken based on the inspection is available for all the inspected men (for further discussion on this, see Larsson 1999).

4.3 Overall decision

The 11 values used in the variable, *InspOutcome*, on the outcome of the inspection are listed in Table 5.5. Some describe the outcome of the inspection and others indicate the reason why no outcome is stated. The actual outcomes from the inspections are discussed here and the others are discussed in the sections describing the result of the linking and the quality of the sources. The most common values are the four inspection outcomes, accepted, rejected, temporarily_rejected and togrow. There is also useful information, on for example height, also for men with other outcomes, such as military and seaman.

Some of the outcomes are rare. The contents of the variable were created inductively during the archival work before I knew how common they would be. In the later cleaning and adjusting of the data I judged that it was unnecessary to omit the information. The file available from the SEDD includes only the successfully linked observations where the lists contained information not included in other variables in the database. There are a few observations on men with the values missing, notfound or notattempted. Missing means that the man was found in the list but that he was not present at the inspection. notfound means that the man was not found at this inspection but was found at another. The same goes for notattempted. This means that the man was found in the inspection lists but was indicated as having moved from southern Sweden and was thus not looked for any further.

The men could, most straightforwardly, be either accepted or rejected at the inspection. It can be assumed that the military's preferences were unchanged over time (see discussion in Lundström 1993). Being accepted as a conscript thus means being fit and apt for participating in the conscript training and taking part in Sweden's military forces. Being rejected means not being fit or apt for this. In many cases, the outcome is likely to have been the same regardless of the year of the inspection. However, in other cases the outcome would have been different. Political and economic considerations and, similarly, the number of conscripts available compared with the number needed sometimes affected the outcomes, most likely for borderline cases (Lundström 1993; Hultkrantz 1927, note 1, 47; Berg 1853, 207ff; Flensburg 1910). Some changes in the overall rate of rejection can be seen over time when analyzing the published aggregated statistics from the inspections (results not shown). The rejection rate varied around 20 percent throughout the 19th century before starting to fall in the 20th. In the 20th century, it became more common to be accepted for training but with qualifications. Some of these qualifications can be seen in the variable *InspPosition* described further below.

Table 5.5 Values of the variable *InspOutcome*

Content of variable	Meaning	Prevalence*
accepted	The person was judged to be fit and apt for military training.	71.1%
rejected	The person was freed from conscription duty because not deemed fit or apt for military training.	12.4%
temporarily_rejected	The person was given respite from conscription, most often because of temporary health problems, and was to appear for renewed inspection. Many, but not all, among this group were later rejected.	2.8%
togrow	The person was given respite from conscription, because of being shorter than the minimum required height, and was to appear for renewed inspection. One could only be given respite because of short stature, "på tillväxt", if deemed otherwise fit and apt for military training. However, many among this group were later rejected.	4.2%
military	The person was a hired military at the time of the inspection and was thus exempted from conscription. Some of the men were hired at the inspection, were inspected despite being hired militaries or have information from inspections of hired military personnel from Skånska Knektregistret.	5.5%
stand_in	The man hired a substitute to fill his position in the conscript training and he was thus not inspected.	0.1% (6 cases)
seaman	Seamen were during some periods freed from the duty of serving in the army. They were then to be inspected at separate inspections and were often not found. Some still have useful information and they should be considered as being accepted.	0.4% (28 cases)
missing	The person is listed in the inspection list but he was missing from that inspection. Some were found or appeared at subsequent inspections.	2.3%
foreigner	Foreigners were exempted from conscription duty. From the mid-20th century, one had to appear for inspection when receiving citizenship.	0.1% (4 cases)
notfound	The person was looked for in the archives but could not be found.	1.0%
notattempted	The person was not looked for in the archives because of moving from southern Sweden.	0.1% (5 cases)

* The prevalence was calculated as the share of all the 6892 linked inspection outcomes in the file available from the SEDD. Since there are up to five outcomes for each individual, the prevalence would of course be different if calculated per individual. The shares were also different in the file in which I collected the data. This explains the lower share of persons not found reported here than in Section 3.1.

It was possible to receive respite from inspection and/or military training. From 1821 until 1860, men who were deemed as otherwise fit for military training but who were shorter than the minimum height requirement were given respite from conscription (Hultkrantz 1927, 7). They were indicated in the lists with “to grow” (“på tillväxt”) and had to appear for inspection again in the upcoming year(s). They could be accepted, rejected or receive a new respite at the next inspection. The conscription age was 20–25 years, and if the man had not grown enough during these five years, he was rejected (Personne 1970). Men could also be given respite if they were sick and absent from the inspection or considered to be temporarily sick or recovering from sickness at the inspection. This group was indicated in the lists with “to recover” (“på förbättring”) and they also had to appear for inspection in the upcoming year. It is not always clear in the lists if the man was receiving respite to improve from sickness or to grow taller so it is not possible to separate these cases in the SEDD data. The minimum height requirements were repealed in 1860 and from 1861 (men born 1840 onwards) no one was given respite just to grow taller. A minimum height requirement was re-introduced later and it was in practice a reason for rejection at least until 1887.

It was also possible to get respite from the inspection and/or training for social reasons (Creutzer 1975). If the man had heavy social or economic responsibilities, he could apply for respite. Exemptions for social reasons were always rare. No indications of this were found in the inspection lists covering the present population.

The outcome of the inspection can only be considered to be an imperfect proxy of the health status of the inspected men (compare Arbo 1875). However, it is reasonable to assume that the men accepted for military training were on average in better health than the men rejected or given respite. Analyses of similar data from Sardinia from 1866–1925 show that being given respite or rejected at the conscript inspection increased the risk of mortality during the next 10 years by about 50 percent (Breschi et al. 2011). Being conclusively rejected increased the risk more than receiving respite, as expected (Breschi et al. 2008).[9]

9 Campbell and Lee (2003) investigate classifications of disability in northeast China in 1749–1909. They conclude that while it is clear that different institutional and political considerations influence the decisions, the decisions still seem to carry genuine information about, especially poor, health (Campbell and Lee 2003).

4.4 Assigned position of the conscript after inspection

It was not until after 1887 that the military rank or position of conscripts became more varied, creating a need to indicate it in the inspection lists. The conscripts' military position was only rarely indicated before the introduction of the conscript army in 1902. Nine values were used in the variable on the conscript's position, *InspPosition* (Table 5.6). The contents can be used to refine the assessments in the outcome variable. Some of the values indicate that the man was judged to be less well suited to military training. From 1915 onwards, it was indicated if the man was deemed to be fit for training as an officer. Only 6.3 percent of men are indicated in this way in the data.

Table 5.6 Values of the variable *InspPosition*

Content of variable	**Meaning**	**Observations**
befriad under fredstid	The man was rejected but only freed during times of peace. This should thus be considered to be an indication of the man being less fit or apt for military training. Used 1926–1942. See comment in text.	27
ej vapenför	The person was deemed not to be suited to armed service. Indication of the man being less fit or apt for military training. Used 1887–1939.	87
vapenför bara i viss tjänst	The person was judged to be suited only to some forms of armed service. Indication of the man being less fit or apt for military training. Used 1902–1925.	29
ersättningsreserven	The person was placed in the army reserve. Used 1926–1940. See comment in text.	154
vapenfri	The person had applied for, and was granted, unarmed service during his conscript training. Possible from 1920 onwards. See comment in text.	2
underbefäl	Low ranking conscript non-commissioned officer. Indicated from 1915 onwards.	330
befäl	Low ranking conscript non-commissioned officer (hierarchically above *underbefäl*). Indicated here 1922–1953.	25
underofficer	Conscript non-commissioned officer (hierarchically above *befäl*). Indicated here from 1946 onwards.	26
officer	Officer with a contract to serve as a commissioned or reserve officer after the training. (Hierarchically above *underofficer*.) Indicated here from 1954 onwards.	5

Between 1925 and 1941, some men did not have to participate in conscript training (Creutzer 1975). There was often no medical or other cause for rejecting them from the military. The military could only train a set number of men each year and those who had been accepted that could not be summoned for training were placed in the army reserve ("ersättningsreserven") (Tirén 1976). The system was called "kategoriklyvning" and it was intended to save on military spending.

Some of the men who had been rejected, or freed from duty during times of peace ("befriad under fredstid"), were inspected again during World War II and those accepted at these later inspections became conscripts (Tirén 1976). The data includes some observations of men who were re-inspected in 1942.

It was not until 1920 that it was possible to ask to be exempted from conscript training for religious reasons (Tirén 1976; Ericson Wolke 1999). When this was extended to also include ethical objections, the number of men asking to be exempted increased. In 1935, new rules were introduced requiring much more thorough investigations of the reasons behind these applications. This quickly reduced the numbers exempted for ethical reasons. There are only two cases where the man received an exemption from armed conscript training because of religious or ethical reasons in the SEDD data: one inspected in 1928 and the other in 1960.

4.5 Height

The height of the men was always measured at Swedish conscript inspections. In total, 5922 height measures were found for 5388 men in the data available from the SEDD.

The men were measured in bare feet or in their socks (Sandberg and Steckel 1987). There seems to have been no changes in measuring procedures over time. Until and including 1863, heights were given in feet and inches ("verktum" = 2.4741 cm), where there were 12 inches to a foot (Carlsson 1997). Between 1864 and 1886, measures were given in feet and decimal inches ("decimaltum" = 2.969 cm), with 10 inches to a foot. From 1887 onwards, heights were given in centimeters. All heights stated in the inspection lists were translated into centimeters according to the rules above. The heights recorded in Skånska Knektregistret are given in centimeters. In 15 of these 272 cases, it seems the individuals excerpting the data made rounding errors when converting from inches. They seem to have used the right type of inch for the conversions.

There were minimum height requirements to be accepted for conscript training (Hultkrantz 1927). Between 1840 and 1860, the required height was 5 feet and 5 inches ("verktum"), equaling 160.8 centimeters. There was no formal height requirement in the years 1860–1886 but in practice the requirement seems to have been similar to the previous one (Paper 1).[10] A formal

10 The published aggregated statistics on inspection outcomes also show that men in practice were rejected for short stature and/or weak constitution throughout the 19th century (results not shown). The men rejected for being too short are listed as "inadequate" ("undermålig"). After 1918, however, it became rare for men to be rejected for this reason.

minimum height requirement was reintroduced from 1887 and was then 157 centimeters. From 1902, this was lowered to 154 centimeters even if the requirements were then different for different branches of the military. The minimum height requirements seem to have been enforced in the sample population but there are also observations of height for some of men that were not accepted for military training from these periods.

The inspection lists used to collect the data for the SEDD include the heights of the men being accepted for conscription or being given respite to grow or to recover for all years. The heights of the men being rejected are most often missing before 1861. After 1861, the heights were supposed to be stated for all men including the ones being rejected. However, the heights of the rejected men were sometimes missing after 1861 as well. Table 5.7 shows the share of the inspected men that were ever listed with a height.

Table 5.7 Share of the linked inspections including information on height

Birth cohort	1796–1839	1840–1865	1866–1893	1894–1921	1922–1934	1935–1950
Inspection year	1817–1860	1861–1886	1887–1914	1914–1941	1942–1953	1954–1968
With height (percent)	79.4	78.9	98.3	97.4	94.8	98.0

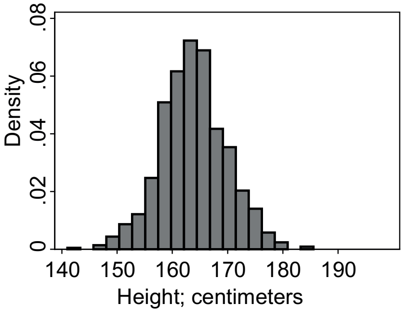
Note: The inspection years refer to the usual inspection years for the birth cohorts, not the actual inspection years of the men.

Heights are approximately normally distributed in a population if all heights are included (Komlos 2004). The distributions of the heights available from the SEDD show that the heights are approximately normally distributed (Figure 5.4).[11] The lower, left side of the distribution is thinner than the upper, right side in the upper four distributions. The distributions of the heights of birth cohorts 1796–1839, 1840–1865 and 1866–1914 indicate that heights are systematically missing from below the minimum height requirement. The pattern is not very clear since there are also heights for men below the minimum height requirement. Men who had not gone through their adolescence at the inspections can be expected to be on average shorter than others. This can create right skewed distributions such as the ones for men born 1894–1921 and 1922–1934. Another explanation could be that there are heights missing from the upper end of the distribution.

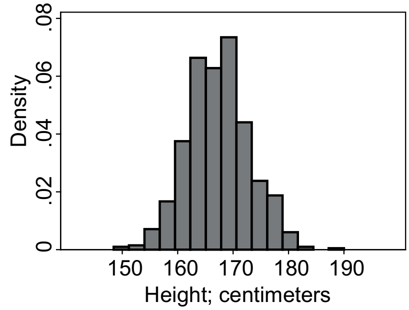
11 The figures include only the first available observation of height for each individual within the age span 17–25 years.

FIGURE 5.4 Distribution of heights

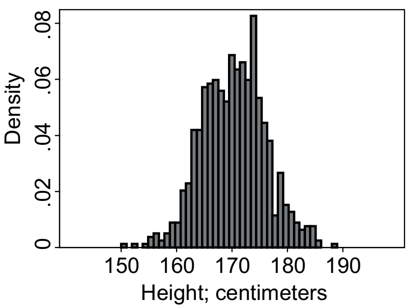
Inspection years 1817–1860
(cohorts 1796–1839) N = 879[12]



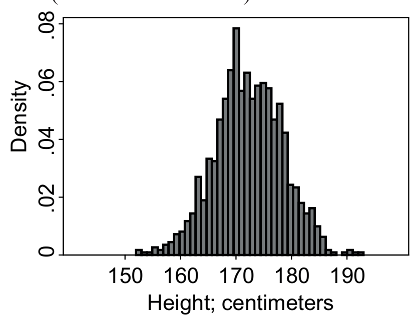
Inspection years 1861–1886
(cohorts 1840–1865) N = 712



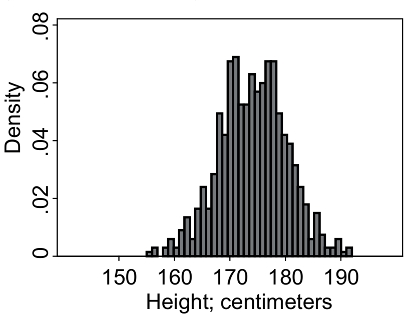
Inspection years 1887–1914
(cohorts 1866–1893) N = 807[13]



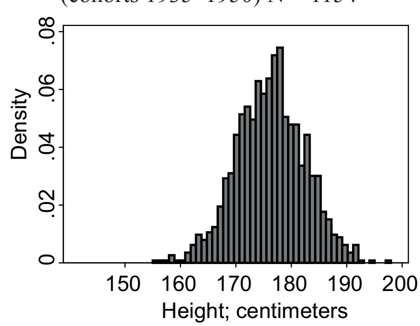
Inspection years 1914–1941
(cohorts 1894–1921) N = 1136



Inspection years 1942–1953
(cohorts 1922–1934) N = 685



Inspection years 1954–1968
(cohorts 1935–1950) N = 1154



Note: The inspection years refer to the usual inspection years for the birth cohorts, not the actual inspection years.

12 The distribution excludes one measure below 120 centimeters.

13 The distribution excludes four measures below 140 centimeters.

Changes in the units of measurement can be seen through the width of the bars in Figure 5.4. The reported heights were usually rounded to the closest full centimeter or inch. No indications of changes in the rounding practices can be seen in the data (compare Hultkrantz 1927). Changes in the units of measurement and rounding to the closest full unit of measurement meant changing precision in the measurements over time. The measures given in centimeters are more accurate than the ones in inches because each unit step is smaller. The introduction of the decimal inch in 1864 meant decreased accuracy since each inch is longer.

There are some signs of heaping of heights on particular values, as seen by the spikes in the histograms in Figure 5.4. However, this does not seem to have been a big problem in general. For the birth cohorts 1914–1941, too many men are 170 centimeters tall. Heaping on 170 centimeters was also noted by Backman (1919) when analyzing the aggregated Swedish statistics from the early 20th century. Backman finds only marginal changes in the measures of dispersion and averages when adjusting for the heaping and rounding in the data.

There could of course also be typos in the lists or errors by me when excerpting the data. For the birth cohorts 1887–1914, too many individuals are 174 centimeters tall and too few 178 centimeters. This could indicate errors, but it affects at most 17 measurements. Six men shorter than 140 cm were also indicated in the lists with notes on them being of short stature. The measures have therefore been judged to be accurate.

Not all of the men had stopped growing at the age of inspection. Historical data on growth are scarce but the results indicate that many men in the 19th century did not stop growing until age 22 or 23 years or even later (Introduction, Section 3.5). The men inspected in the mid-20th century were also growing at the inspections (then at age 18 or 19 years, see Paper 1). The observed heights should therefore not be regarded as necessarily reflecting final adult heights.

Some men were inspected more than once during the 19th century and from the 20th century a source was sometimes used that provided one height from inspection and one from the first day of conscript training. There are 454 men in the dataset with more than one height observation. Some men were measured up to five times but most only twice. Repeated measures can be used to evaluate the accuracy of the measuring procedures.

In 86 percent of cases, men were of the same height or taller at the subsequent inspection, as expected, which indicates stable and accurate measuring procedures. In 26 cases, the man had grown by 5 centimeters or more. This is a large increase but it is plausible to grow 5 centimeters in a year or more during adolescence. The practice of stating heights in full inches could also work to increase the estimated changes. In the other 14 percent of cases, the man was shorter at the subsequent inspection. This could be due to rounding or measurement errors at one or both inspections. Some could be a result of the man crouching at the later inspection or not being able to stretch to full height. In some cases, there are indications in the inspection lists of the man having deformities or back problems. There is only one case where the man was 5 centimeters or shorter at the subsequent inspection. A decrease in height by 5 centimeters or more is less plausible and is probably an indicator of a typo, measurement or rounding errors during one or both measurements.

The histograms (Figure 5.4) and available repeated measures indicate that measures were taken in a consistent way over time and that measurement or rounding errors rarely were larger than one unit.[14] The small share of problematic cases overall indicates that most heights were measured, rounded and noted in a consistent way.

4. 6 Weight

The men were weighed at inspection from 1949 onwards. (There were also 11 observations from inspections between 1944 and 1948.) The weights were given in kilos and were most often rounded to full or half kilos. There were 1342 men with an observed weight in the data and for 185 men, there was more than one weight.

4.7 Chest circumference

Chest circumference was also sometimes measured from 1909 until 1964. Most observations refer to inspections during 1949–1960. Eveleth and Tanner (1990, 38) discuss the many ways of measuring chest circumference and that the method can have a substantial impact on the outcome (see also Arbo 1875, 41ff). It is not known which method was used at the inspections underlying the collected data. Since the measures could differ quite a lot depending on the method, they should probably only be used as rough indicators. There are 356 measures of chest circumference for 207 of the men in the file available from the SEDD.

14 Sandberg and Steckel (1987) reach the same conclusion when analyzing heights from inspections of soldiers from enlisted troops and the Provincial Army.

4.8 Diagnoses and causes for rejection

The medical conditions used to decide on the outcome of the inspection were stated in the inspection lists. These diagnoses are often general, sometimes vague and occasionally missing altogether.

During most of the 19th century, the physical examination was carried out by a medical doctor. Until 1873, it was most often a doctor with a public position ("provincialläkaren" or "stadsläkaren") that participated in the inspections (Arbo 1875, 75; Lundström 1993). After 1873, examinations were carried out by military doctors. The Norwegian military doctor Arbo writes in 1875 that it wasn't easy to put the right diagnosis in the "uproar and chaos" ("tumult og røre") of the conscript inspection meetings (Arbo 1875, 124, see also 166). In Sweden, physical examinations were standardized at least from 1843 onwards (Lundström 1993). In the 20th century, diagnoses were assessments by doctors based on self-reported conditions and ailments, attestations from medical doctors, an examination by another doctor or assistant and a brief examination by the responsible doctor himself (Otto 1976; Lundström 1993). The regulations of the conscript inspection, especially concerning the physical examination, from the start of the early 19th century until 1968 are catalogued in Olofsson (2012b; 2012c).

National aggregated statistics were created of the inspection outcomes, and the terms used in the inspection lists most often refer to one of the categories used in these statistical tables. During the 19th century, three of the most common were general weakness ("allmän svaghet"), short stature ("undermålighet") and weak constitution ("klen") (see also Arbo 1875). Other diagnoses most often concern chronic diagnoses or conditions. In the first half of the 19th century, many men were missing limbs or had disabling scars from accidents. The cause for being temporarily rejected to recover from disease is most often stated only as sick ("sjuk").

The stated conditions and diagnoses are not a complete list of all conditions and diagnoses that affected the men. If one was enough for rejection, it may be that only this is stated in the list. However, up to four diagnoses were given in the lists. From 1918, diagnoses were stated as codes in the lists. These codes were translated into text following keys found in the Military Archives. The codes correspond to a specific diagnosis but most often to a group of diagnoses. The key to the codes used between 1926 and 1941 had not been found when delivering the data to the SEDD (Sept. 2011). During this period, the codes are included as given in the lists. These keys have been recovered through careful archival work by Gunnar Olofsson and can be found using the information in Olofsson (2012b). The regulations, categories and codes were often published in *Tidskrift för militär hälsovård;* an example can be seen in Medicinalstyrelsen (1895).

A key from 1982 was used to interpret the codes from 1942 (Försvarets sjukvårdsstyrelse 1982). No differences were found between this key and that used from 1942 that was found after the data had been delivered (Anonymous 1969a). The 1969 (Anonymous 1969b) and 1982 (Försvarets sjukvårdsstyrelse 1982) tables use both the inspection group and the diagnosis code to differentiate the severity of the conditions. The diagnoses were also important for assigning the men to different inspection groups[15] in 1961 (Anonymous 1961). The text in the variables *Diagnosis_A–D* includes the differentiations of inspections based on the inspection group through slightly different wording in describing the conditions. The text was copied from the tables from 1982 (Försvarets sjukvårdsstyrelse 1982) but it is probably safe to assume that the anachronistic decoding is reasonable. However, the differentiation between levels of the severity of the conditions should still be used with caution.

The contents in the variables *Diagnosis_A–D* are not standardized and are given as stated in the sources or code keys. Some of the texts describing the diagnoses are long. It might therefore be necessary to process and encode the text in, for example, Access or Excel before using them in Stata or other software for analysis.

4.9 General physical fitness

The men were assigned to inspection groups ("besiktningsgrupper") from 1929 onwards (see also Olofsson 2012b on the predecessors). The value was assigned after the physical examination and it describes the general fitness for military training. The value was decided by the responsible medical doctor but covered both physical and mental fitness (Anonymous 1961). No psychological evaluation was made by the doctor. The evaluation of mental ability was probably made based on self-reported problems and diagnoses, any disabilities obvious at the physical examination and the test result from the cognitive test. The assessment of physical ability was based on the self-reported conditions and ailments, attestations from medical doctors, an examination by a doctor or assistant and a brief examination by the doctor himself.

There were six groups, as described in Table 5.8, but the values were used in the lists in combination with plus and minus signs. The "+" and "-" next to the numbers are not included in the key used for interpreting the groups. A "+" seems to mean that the inspected was at least as good as the requirement for the inspection group. A "-" seems to mean less qualified than the

15 The inspection groups are ranked assessments of the man's physical fitness for military training described further below.

corresponding group. The combination of values for groups and signs results in 10 values in the variable *InspGroup*.

TABLE 5.8 Values of the variable *InspGroup*

Value	Meaning	Share of values
Gr0.	rejected; "Odugliga till krigstjänst"	3.5%
GrT.	temporarily rejected; "tillfälligt odugliga till krigstjänst"	2.3%
Gr4.	accepted; "Dugliga till krigstjänst i väsentligt begränsad omfattning. Ej användbara i fält."	3.6%
Gr3.	accepted; "Dugliga till krigstjänst i begränsad omfattning. Användbara i vissa befattningar i fält."	7.8%
Gr2-. / Gr2. / Gr2+.	accepted; ”Dugliga till krigstjänst men mindre lämpliga vid viss försvarsgren eller visst truppslag."	27.5%
Gr1-. / Gr1. / Gr1+.	accepted; ”Dugliga till krigstjänst vid samtliga försvarsgrenar och truppslag."	54.9%

Source: Anonymous (1969c, 57)

Groups 3 and 4 were most often used for assisting tasks ("handräckning") or desk duties (Militärpsykologiska institutet 1964). Lundström (1993, 106f) includes values on the shares of the inspected in his table on the different inspection groups. These values are close to those presented in Table 5.8. It is not clear in Lundström (1993) if the values were general guidelines or if they were calculated from actual outcomes. An instruction for inspection personnel from 1961 includes the distribution of the outcomes from 1960 (Anonymous 1961, 3). These values are also similar to the values in Table 5.8. Regardless of the instructions for assigning the values, the inspection group values should be useful as ranked assessments of physical and mental fitness, at least within cohorts.[16]

Between 1926 and 1931, many inspected men were assigned a letter E–H. This was before the inspection groups that were in use from 1932. The letters have a similar meaning to the later inspection groups but they also separate students from other groups of conscripts (Olofsson 2012b). Table 5.9 shows how the letters should be interpreted. The classification systems were changed often during these years (Olofsson 2012b). In the collected data, the

16 The ranking of the values from best to worst fitness is Gr1+., Gr1., Gr1-., Gr2+., Gr2., Gr2-., Gr3., Gr4., GrT., Gr0.

system of ranked inspection groups 1–4 plus O and T was introduced from 1932. Until 1942, this classification also included the codes SV and SB. Some observations in the SEDD include this among their diagnoses. SV meant that the conscript was a student with a good physique and SB a student with a less good physique (Olofsson 2012b).

Table 5.9 Inspection groups, inspections 1926–1936.

Letter	Meaning, English	Meaning: Swedish
A	Rejected	Odugliga till krigstjänst
B	Not fit for armed service	Icke vapenföra
C	Students and similar groups; fit only for some positions.	Studenter och likställda: dugliga till krigstjänst endast i viss befattning
D	Fit for armed service, but only in some positions due to short stature or any of a list of physical and psychiatric diagnoses.	Vapenföra; men förmågan att delta i vapentjänst är inskränkt p.g.a. kroppslängd eller de i besiktningsreglementet angivna kroppsfel eller lyten.
E	Fit for armed service, height ≥157 cm with a good physique, none of the specified diagnoses.	Vapenföra; kroppslängd 157– med god kroppskonstitution ej behäftade med något av de i besiktningsreglementet uppräknade kroppsfel lyten eller sjukdomar som föranleder hänförande till någon av grupperna A–D.
F	Fit for armed service, height ≥160 cm, a very good physique, none of the specified diagnoses.	Vapenföra; kroppslängd 160– med mycket god kroppskonstitution ej behäftade med något av de i besiktningsreglementet uppräknade kroppsfel lyten eller sjukdomar som föranleder hänförande till någon av grupperna A–D.
H	Temporarily rejected.	För tillfället odugliga till krigstjänst.

Source: Olofsson (2012b)

4.10 Cognitive test

Cognitive tests for conscript inspections were developed from the 1930s and introduced generally in 1944. There are 1656 men in the collected data inspected from 1944 onwards with information on the outcome from a cognitive test.

The tests were modeled on German predecessors that were considered to provide useful results (Lundström 1993). Husén (1946, 25) writes that the early tests were somewhat too easy for a normal population but that the primary purpose was to differentiate downwards (“differentiera nedåt”). The tests were continuously tested and developed, and the stated purpose of the test in 1955 was to differentiate among both the least and the most gifted (Militärpsykologiska institutet 1955). The design of the test thus changed over time but tests were always meant to divide the men into groups according to a normal distribution. Minor revisions were made in most years in 1944–1953 (Militärpsykologiska institutet 1947; 1950). Major revisions of the tests were made in 1947, 1948 and 1954.

The variable *cognitive_test* includes the outcome from the cognitive test performed by the men at the inspections. The values have different meanings at different times. For the inspections held in 1944–1953, the value is the total number of correct answers. The conscripts were also assigned to a group (A–E) corresponding to an approximate level of cognitive ability (Table 5.10). Group A was the highest performing group and E the lowest. The exact number of correct answers corresponding to each group changed over the years. The cut-offs were most likely set to create groups corresponding to a five-group binned normal distribution within each cohort.

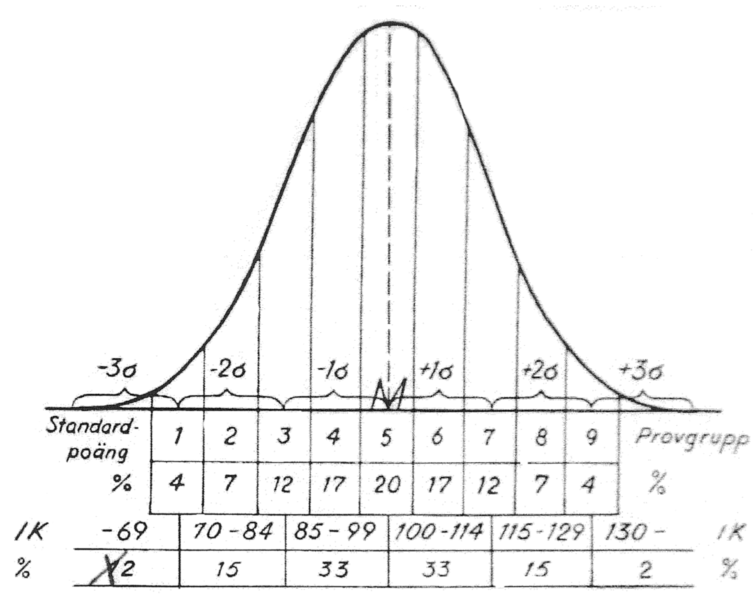
Table 5.10 The assigned levels of cognitive ability, 1944–1953

Correct answers (1944)	**Group**	**Cognitive ability**	**Share of men to be placed in the group, 1944 (percent)**	**Share of men to be placed in the group, 1947 (percent)**
117–157	A	Very good, "Mycket god"	5	4
91–116	B	Good, "God"	20	25
56–90	C	Average, "Genomsnittlig"	50	42
30–55	D	Below average, "Under genom-snittet"	20	25
0–29	E	Low, "Låg (efter-blivenhet)"	5	4

Source: Militärpsykologiska institutet 1944, 13; 1947

From 1954, the men were divided into nine groups (1–9), with higher values corresponding to a higher level of cognitive ability. The created groups corresponded to a nine-group binned normal distribution, as seen in Figure 5.5. Everyone placed in group 1 had to go through a psychiatric evaluation to evaluate if they had the capacity to participate in any training.

Figure 5.5 The principle for dividing the inspected into cognitive ability groups from 1954



Notes: IK stands for "intelligenskvot", intelligence quotient. Militärpsykologiska institutet (1959, 15)

The tests were continuously evaluated to check their validity and reliability. The results from the second inspection in 1949 onwards (birth cohort 1930 onwards) were supposed to be comparable over time (Militärpsykologiska institutet 1963). The cut-offs for being assigned to a test group were based on the results from previous years (Otto 1976). The cut-offs for earlier tests were updated in later editions of the instructions to make the results more comparable over time. The anonymous writer of an instruction on how to interpret the results writes in 1963 that the tests in 1959 generated too low values (Militärpsykologiska institutet 1963). In addition, the test in 1948 was later deemed to have been too difficult (Militärpsykologiska institutet 1948). The results included in the inspection lists, and thus in the variable in the database, were not updated with later revisions. The values can therefore not be used for comparisons over time without standardizations. The test results presented in the variable *cognitive_test* should, with appropriate qualifications, work to rank the cognitive ability of the men within cohorts.

The tests before 1950 were judged to reward men with some familiarity with using pen and paper and theoretical over practical intelligence (Militärpsykologiska institutet 1950). Later evaluations reached the conclusion that the tests held in 1944–1947 were carried out with too tight time limits, so that not only the ability to answer the question, but also the speed in which the men were able to answer the questions was tested (Militärpsykologiska institutet 1947).

The accuracy of the outcomes was evaluated on a few occasions. The standard error of the total score was estimated to be 5–6 points in 1949 (Militärpsykologiska institutet 1950). This is approximately one-third to one-half of the point intervals used to assign the men to cognitive groups. The standard error ("medelfel") of the assigned cognitive group was similarly estimated in 1954 to be c. 0.4 on a nine-point scale (Militärpsykologiska institutet 1955).

Between 1954 and 1958, the standardized results from five tests were presented along with a standardized summary number. The first two digits corresponded to the standardized results from tests of linguistic talent (Militärpsykologiska institutet 1955; 1958). The headings of the two first tests were instructions ("instruktioner") and selection ("urval") (Olofsson 2012a). The third digit was a math test (multiplication, "multiplikation"), while the fourth (levers, "hävstänger") and fifth (technical understanding "teknisk förståelse") digits are the results from the tests of technical and mechanical talent. From 1959, there were only four parts in the test. The first two corresponded to the standardized results from the tests of linguistic talent (instructions and selection) and the third and fourth digits to technical and mechanical talent (joining, "sammansättning" and technical knowledge, "tekniskt kunnande") (Olofsson 2012a; Militärpsykologiska institutet 1959; 1963, 4; 1964; 1968; 1971a; Lundström 1993, 103).[17] A detailed description of the four-part test used from 1968 can be found in David and coauthors (1997). They also provide estimates of the corresponding IQ for the nine levels used from 1954 (tab. 2–3, 1316). David and coauthors (1997, tab. 4, 1317) also include correlations between the results on the different subtests for men inspected in 1969–1970.

The results from the cognitive tests were evaluated by a psychologist or inspecting officer at an interview. They were then compared with what could be expected from the background of the inspected man. An officer complains in a report from the inspections in southern Scania in 1952 that the inspected, especially men with higher education, were consciously underperforming on the tests (Anonymous 1952). One of the stated goals of the interviews with the psychologists was to try to see through this kind of conscious under-

17 A detailed description of the four-part test used from 1968 can be found in David and coauthors (1997). They also provide estimates of the corresponding IQ for the nine levels used from 1954 (David et al. 1997, tab. 2–3, 1316). David and coauthors (1997, tab. 4, 1317) also include correlations between the results on the different subtests for men inspected in 1969–1970.

performing (Militärpsykologiska institutet 1957a; 1957b; 1967). From 1960, the results were also compared to a table giving the average outcomes of groups with different levels of schooling (Militärpsykologiska institutet 1961; 1964). Men who received very low results on the cognitive tests compared with the average in a group with the same level of schooling were referred to further evaluation by a psychologist.

4.11 Psychological evaluation

From 1951 onwards, some of the inspected men were also evaluated by psychologists in an interview. At least until 1968, mostly men with average or above average cognitive ability were interviewed. Men with very low test scores in the cognitive tests were also evaluated to assess if they had mental disabilities. Men who were suspected of having consciously underachieved in any of the tests were also referred for further evaluation, as mentioned above.

The psychological evaluation was based on the interview, the results from the cognitive test and, at least in the 1960s, self-reported answers to a questionnaire included with the cognitive test (Militärpsykologiska institutet 1964). There were five stated goals for the interviews (Militärpsykologiska institutet 1957a; 1957b; 1967). The primary goal was to assess how the man could be useful to the military. His stated education, occupation, skills, interests, social background and wishes were reviewed and complemented when needed. The results from the other tests were checked and the interviewer tried to see through conscious underachievers. The interviewer also asked about the interviewed man's social circumstances to see if this meant any hindrance against long training. Another of the goals of the interviews was to create goodwill for the military and motivate men who were likely to be proposed for any of the longer training programs.

The results from the psychological interviews were presented in two variables: *psyk_skattning* and *psyk_explorator*. There are 645 men in the data that have non-missing values for either variables and 641 with non-missing values for both. The keys to interpreting the contents of the variables have not been found as of yet. The contents of the variables vary over time.

The assessment in *psyk_skattning* was presented as a three-digit number in 1951, two digits 1952–1955 and one digit 1956–1968.[18] The interviews

18 It is possible that parts of the contents in a variable called greenpen (containing numbers written with a green pen in the inspection lists; not included in the file available from the SEDD) in 1950 are results later presented as the psychological estimate of leadership aptitude. One part of the contents in greenpen in 1950 is a three-digit number similar to the results presented in psyk_skattning in 1951.

were at least partly meant to assess the aptitude for officer training (Militärpsykologiska institutet 1957a). Only men with average or above average cognitive ability (5 or higher) and good physiques were considered for officer training (Militärpsykologiska institutet 1957a; 1967). Persons in cognitive group 9 were assessed carefully since some of the inspected in this group were highly theoretically oriented and thus less suited for officer duty (Militärpsykologiska institutet 1957b; 1963). The rating of the aptitude was correlated with the result from the test of cognitive ability. The suggested distributions of assessments lead to a correlation between cognitive ability and aptitude for officer training of r = 0.5 (Militärpsykologiska institutet 1964). However, the men were also evaluated regarding their emotional stability, interests, ability to lead/relate to people and motivation for military training. Men were also rated on the different aspects of their personality, but the number of digits in the values presented in the inspection lists does not correspond to the number of aspects evaluated.

At least from 1957, the aptitude for officer training was expressed as a number (1–9) with higher values corresponding to a better aptitude (Militärpsykologiska institutet 1957b; 1964). Men with values 6–9 were deemed to be fit for training as conscript non-commissioned officers ("befälsutbildning") (Militärpsykologiska institutet 1963, 4). Men with values 3–5 were deemed to be fit for training as low-ranking conscript non-commissioned officers ("underbefäl"). Men with values 1–2 were deemed not to be fit for officer training. At least from 1956, this assessment is very likely to be the values in *psyk_skattning*. The assessments were relative, not absolute (Militärpsykologiska institutet 1964; 1973, 3; 1971b). The men were assessed in comparison with the other men inspected in the same year.

The assessment in *psyk_explorator* was (usually) presented as a two-digit number in 1951–1953, 1956–1957 and 1960–1968. In 1954–1955, it was a three-digit number and in 1958–1959 a one-digit number. This might be an overall evaluation of the man's aptitude or usefulness to the military. No instructions on what was presented by this variable in the lists have been found. The instructions to interviewers do not include clear instructions on what to present in the inspection lists or any keys to understanding the underlying meaning of the numbers presented. I have looked though the instructions from 1950 onwards kept in the archives from the military's psychological institute ("Militärpsykologiska institutet (MPI)", series: F II, volume: 1 and Militärpsykologiska institutet 1967) but have not gone through the confidential instructions also kept in the Military Archives.

4.12 Occupation

The information on occupation stated in the inspection lists was also excerpted. Up to three occupations were stated for the men in the inspection lists but most often it was only one. In the 19th century, it seems as though priests often included occupation from the catechetical registers among the information they sent to the military. These occupations were checked at the inspections and sometimes corrected. From 1950, and maybe before, occupations were checked during the interview with the psychologist (Militärpsykologiska institutet 1957a; 1964). In the early 1950s, the military also asked employers to send in reports on their employees grading the craftsmanship and leave general remarks regarding their character and social situation (Anonymous 1951). However, few employers seem to have sent any assessments (Anonymous 1952).

4.13 Careers

There are 1234 observations available on the careers of the men in the SEDD sample. From the 19th century, these are mostly information on military careers for men hired by the military. Information on civilian careers was included in the inspection lists from the 1940s and is almost universal from the 1950s. This information is included in the variable *IndivCareer*. From the 1940s onwards, the variable contains the occupations held before inspections along with the durations of these employments. The self-stated careers were checked at the interview with the psychologist from the 1950s (Militärpsykologiska institutet 1957a; 1964).

4.14 Education

The educational levels of the men were noted in the inspection lists. Both current and completed schooling was included. The first observation is from 1911 but the notes are common only from the late 1940s. The information was self-stated but was checked at the interviews.

The information on education is available in two variables, *IndEdu* and *education_code*. *IndEdu* contains information on the schools and educational programs that the man had participated or was participating in. There are many abbreviations but the contents should be possible to understand. There are 712 observations with non-missing values in this variable. *education_code* contains codes of the current educational levels of the men. Both completed and current schooling is included. There are 1380 observations with non-missing values.

Codes were used to summarize the education from 1945 onwards. The code system changed on two occasions during the studied period. The first system was in use between 1945 and 1952. It consists of a two-digit number in the range 10–62. No key to these codes has been found in the archives.[19] Eight observations had information on education in both the codes and the text in the inspection lists. All eight were high numbers (50–62) and all were students with above average education. The men with codes 50 or 52 were at least students at a "gymnasium" and the men with codes 61 or 62 were students at a university. The most common code is 10 (72%). The most common level of education in 1945–1952 can be expected to have been basic education ("folkskola"). It is therefore likely that the codes were ranked with a lower number corresponding to a lower level of education.

The codes in use between 1953 and 1955 consist of a number with four digits. The first two digits represented the general level of schooling and the last two digits the orientation of the schooling (Centrala Värnpliktsbyrån 1953; 1955). The last two digits include also some types of schooling that could not be included in the first two digits. The included codes for educational orientation reflect orientations of special interest to the military. The highest code was chosen if the man had more than one education. If there were still more than one possible choice of code, it was chosen to reflect the man's main occupational orientation and activity.

4.15 Skills

Skills considered to be potentially useful to the military were noted in the inspection lists. Technical skills were especially interesting (Militärpsykologiska institutet 1964). Skills are presented as text as appearing in the lists in the variable *IndSkills*. There are 785 observations on skills. There are a few from the late 19th century onwards but the notes are more common from 1928 onwards. Among the most common are indications of being able to drive and handle a car or tractor, being used to (or not used to) handling horses or being suited for desk duty. The skills are self-reported but were checked and complemented at the interviews.

4.16 Certificates

From 1924, it was also indicated if the man held any certificates. Some certificates were indicated in the text, such as if the man had a driver's license. However, most certificates were indicated by a one-digit code. No

19 Swedish Military Archives, Archive: Militärpsykologiska institutet (MPI), Section: F II, Volume: 3.

key to the codes has been found in the Military Archives. The first key found is from 1975 and it seems as though the codes might have changed on at least one occasion before this (Värnpliktsverket 1975). The self-stated skills were checked at the interviews.

4.17 Date of inspection

The date of inspection was not included in the lists until the late 19th century. The exact date was always collected when stated in the lists. All missing dates were imputed based on the information in the inspection lists. The lists were signed by the inspection board after the inspections were completed and after adjustments and additional inspections had been held. A date before this date was chosen to estimate the approximate date of inspection. The same date was used in consecutive years if no indications were found that the practices had changed. The inspections were held in the spring until 1949. From 1950 onwards, they were instead held in the autumn. In 1914 and 1949, there were two inspections, one in the spring and one in the autumn. The imputed dates should not create any systematic bias since they were used for all observations when the exact dates are missing.

4.18 Age at inspection

Until 1914, the age of inspection was 21 years. Every man was obliged to appear for inspection in the year he turned 21 years. Since inspections were held in the spring, only some of the men had turned 21 years of age before inspection or before participating in training. The age of inspection was changed from 21 to 20 years in 1914 (Personne 1970). Two inspections were held in 1914, one in the spring and one in the autumn. The younger cohort was not summoned for training until 1915. The age of inspection was lowered again in 1949, to 19 years, and in 1954, to 18 years (the changes in the age of conscription are nicely summarized in Söderberg 1989, tab. 2, 303). From 1949, there were separate lists for the two cohorts. In 1954, everyone seems to have been inspected at the same time and there is no separation of cohorts.

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Appendix. Archives used

Regional Archives, Lund:

Archive: Malmöhus läns landskontors arkiv (del 2)
Series: G I cc. Rullor över beväringsmanskap

Volumes:		Inspection year
1– 2	:	1820–1821
3–16	:	1824–1839
19	:	1841
21–30	:	1842–1852
31–34	:	1858–1861
37	:	1862
39	:	1863
42	:	1864
45	:	1865
48	:	1866
53	:	1867–1868
60–61	:	1869–1870
68	:	1875

Military Archives, Stockholm:

Archive: Norra skånska infanteriregementets arkiv
Repository list, ”arkivförteckning”: 129A
Section: Malmöhus norra inskrivningsområde
Series: D. Rullor, liggare, journaler
Volumes: 390–404 Inskrivningslängder (inspection years 1887–1901)
Volumes: 417–436 Beväringsmönsterrullor (inspection years 1817–1886)

Archive: Södra skånska infanteriregementets arkiv
Repository list, ”arkivförteckning”: 130A
Section: Inskrivningsavdelningen
Series: D. Rullor, liggare, journaler
Volumes: 442–450 (inspection years 1861–1886)

Archive: Norra skånska infanteriregementets inskrivningsområden
Repository list, ”arkivförteckning”: 473
Section: Inskrivningsområdesexpeditionen
Series: D I. Inskrivningslängder
Volumes: 1–45 (inspection years 1887–1901)

Archive: Södra skånska infanteriregementets inskrivningsområde
Section: Inskrivningsområdesexpeditionen
Series: D I. Inskrivningslängder
Volumes: 1–37 (inspection years 1887–1901)

Archive: Malmöhus norra inskrivningsområde (Io6)
Repository list, ”arkivförteckning”: 473
Section: Inskrivningsområdesexpeditionen
Series: D1. Inskrivningslängder med inskrivningstilläggslängder
Volumes: 1–196 (inspection years 1902–1968(1969))
Section: Landskrona rullföringsområde (Ro 5)
Series: D4a. Inskrivningslängder
Volumes: 1 (inspection year 1926) (Location: Military Archives, depot 21/231:26)

Archive: Malmöhus södra inskrivningsområde (Io7)
Repository list, ”arkivförteckning”: 473
Section: Inskrivningsområdesexpeditionen
Series: D 1a. Inskrivningslängder
Volumes: 1–173 (inspection years 1902–1968(1969))

Archive: Hallands inskrivningsområde (Io16)
Repository list, ”arkivförteckning”: 473
Section: Inskrivningsområdesexpeditionen
Series: D1. Inskrivningslängder
Volumes: 1–136 (inspection years 1902–1968(1969)) (especially volumes 45–81, inspection years 1926–1938)

Archive: Värnpliktskontoret
Section: Datakontoret
Series: Lokalregistret / Lokaliseringsregistret
Volumes: 1–31 (mainly birth cohorts 1922–1950)

Archive: Marinstaben
Repository list, ”arkivförteckning”: 550
Section: Kustartilleriets truppregistreringsmyndighet
Series: D Ia. Stamkort och läkarhandlingar, avregistrerad värnpliktigpersonal
Volumes: 1–219 (birth cohorts 1921–1930)
Section: Flottans truppregistreringsmyndighet
Series: D Ia. Stamkort och läkarhandlingar, avregistrerade
Volumes: 1–518 (birth cohorts 1921–1930)

Archive: Värnpliktsverket med värnpliktskontoren – Bergslagens värnpliktskontor
Repository list, ”arkivförteckning”: 495E
Section: Centrala läkarhandlingsarkivet, redovisningssektionen (CLA)
Series: F II. Läkarhandlingar, avregistrerade
Volumes: 1–9868 (birth cohorts 1931–1945)

Series: F Ia. Läkarhandlingar, frikallade
Volumes: 1–3014 (birth cohorts 1928–1970)
Series: F Ib. Läkarhandlingar, avlidna
Volumes: 1–205 (birth cohorts 1902–1971)
Series: F Ic. Läkarhandlingar, vapenfria
Volumes: 1–67 (birth cohorts 1935–1963)

Archive: Militärpsykologiska institutet (MPI)
Repository list, ”arkivförteckning”: 210
Series: F II. Instruktioner mm.
Volumes: 1 – instructions for psychologists and inspecting personnel, memos etc.
2 – instructions for the inspecting personnel, cognitive tests
3 – codes for educational level
4 – instructions, memos etc.

Sociala kroppar
en populärvetenskaplig sammanfattning

Vi vet alla att människor är olika långa, och vad de skillnaderna beror på i vår nutid är väldokumenterat. Jag har i min avhandling undersökt vad skillnaderna berodde på hos tidigare generationer. Det mesta av skillnaderna i längd mellan människor vi idag möter till vardags beror på genetiska faktorer, men hur lång en person blir påverkas också av levnadsvillkoren under uppväxten. Om en person inte kan äta tillräckligt mycket eller tillräckligt allsidig mat, så kommer hen inte att bli lika lång som vuxen som hen skulle ha kunnat bli. Sjukdomar kan också påverka växten, speciellt om man är allvarligt sjuk, eller är sjuk ofta eller länge. Om en sjuk person dessutom inte får i sig tillräckligt med mat är det extra allvarligt. Andra levnadsförhållanden, som bostadsförhållanden och hårt arbete under barndomen, kan också påverka växten.

Levnadsvillkorens inflytande på hur långa personer blir är den viktigaste orsaken till att människor idag är olika långa i olika delar av världen. Det är också orsaken till att människor i till exempel Sverige var kortare för 100 eller 200 år sen än idag. Medellängden för män var minst 12 centimeter kortare i Sverige i början av 1800-talet än idag. Det var då väldigt ovanligt att uppnå dagens medellängd. Det går också att se hur levnadsförhållanden påverkar hur lång en person blir genom att grupper med olika familjebakgrund har olika medellängd. Föräldrarnas yrke, inkomst och utbildning, liksom barnens antal syskon, med mera, har visat sig påverka hur långa barnen blir.

Mellan ungefär mitten av 1800-talet och mitten av 1900-talet ökade medellängden för män i Sverige med ungefär en millimeter per år. Denna utveckling är inte unik för Sverige, utan ägde rum i flera andra länder i Europa och Nordamerika. Vi vet att den ökande medellängden var ett resultat av att levnadsförhållandena förbättrades över tid, så att varje årskull med barn fick det lite bättre än tidigare årskullar. Medellängden i Sverige ökade samtidigt som landet började industrialiseras, nationalinkomsten växte och lönenivåerna höjdes. Människor i Sverige kunde också äta mer och bättre mat när produktiviteten i jordbruket förbättrades och produktionen av animalier och handeln med matvaror generellt ökade. Under samma period sjönk också dödligheten. I Sverige började den sjunka redan under 1700-talet, och nedgången fortsatte under 1800- och 1900-talen. I början av 1800-talet dog mer än vart tredje barn innan det hade fyllt sex år. I mitten av 1900-talet var det bara ungefär tre barn per hundra. En annan drastisk förändring under perioden var att antalet barn per familj minskade. Efter mitten av 1800-talet, men framför allt i slutet av 1800- och början av 1900-talet minskade antalet barn från ungefär sex till två barn per familj.

Det finns alltså flera dramatiska förändringar av levnadsförhållandena som är samtida med ökningen av medellängden i Sverige. Därför är det svårt att veta vilka förändringar som var de viktigaste bakomliggande faktorerna. Även om det är väl undersökt vad som kan påverka hur lång en person blir, vet vi mindre om vilka av dessa faktorer som var viktigast, historiskt sett. Det är också svårt att analysera dessa faktorer på ett bra sätt med hjälp av statistik om medelvärden och storskaliga trender. Det är lättare att analysera olika faktorers påverkan om vi har uppgifter på individnivå. Då kan vi utnyttja den genetiska variationen hos dessa individer för att minska risken att få felaktiga resultat.

Genom att vi får veta mer om de sociala skillnaderna i längd och orsakerna bakom att medellängden ökade med tiden, kan vi lära oss om hur levnadsstandarden skiljde sig mellan olika grupper och hur den utvecklade sig över tid. Vi kan därigenom också lära oss mer om till exempel hur sambanden såg ut mellan förbättrad levnadsstandard och fallande dödlighet.

I min avhandling har jag samlat in uppgifter om längd från protokoll som upprättades vid mönstringar av män inför deras värnplikt. En allmän, obligatorisk värnplikt infördes i Sverige redan under början av 1800-talet. Jag har därför kunnat samla in uppgifter från 1818 och framåt. Man har alltid mätt hur långa männen var vid mönstringen och resultaten finns bevarade i olika arkiv. Jag samlade in uppgifter om ett urval av män i Skånes Ekonomisk-Demografiska Databas (SEDD). SEDD är en forskningsdatabas med uppgifter om alla personer som levde i fem landsbygdsförsamlingar i Skåne från 1600-talet till idag. Det finns till exempel information om när dessa personer föddes, när de gifte sig och med vem, när de fick barn och när de dog. Det är därför möjligt att veta vem som är släkt med vem, vilka som bodde tillsammans och vilka yrken personerna hade, med mera, med mera.[1]

När jag samlade in mitt material så sträckte sig SEDD fram till år 1950. Jag kunde därför samla in uppgifter om personer födda mellan 1797 och 1950 som mönstrades mellan 1818 och 1968. Jag valde ut nästan åtta tusen män för vilka det fanns information om deras föräldrar i SEDD och letade efter dem i mönstringsprotokollen. Jag hittade och samlade in information om fler än sex tusen av dessa män. Från SEDD har jag kunnat få fram information

1 När jag samlade in materialet hade jag tillgång till männens namn för att kunna matcha dem med namnen i mönstringsprotokollen. Efter att jag var klar lämnade jag ifrån mig allt material, så att de uppgifter jag har analyserat blev helt anonymiserade. Jag presenterar bara statistik om männen och deras familjer, aldrig uppgifter om enskilda personers liv. All forskning med hjälp av denna databas görs på detta sätt.

om vad männens föräldrar jobbade med, om de ägde jord, hur många syskon männen hade och ett mått på risken att männen var sjuka när de var spädbarn. Jag vet också vilka män som var bröder, så att jag har kunnat ta hänsyn till detta och använda det i mina analyser. Det finns idag inga andra historiska material som har så mycket bakgrundsinformation om personer tillsammans med uppgifter om längd.

Min avhandling består av en introduktion, fyra artiklar och en text som beskriver det material som jag har samlat in och hur jag gick tillväga. Introduktionen är en bakgrund och en översikt av tidigare forskning, ungefär som den jag har presenterat här. I de första tre artiklarna undersöker jag påverkan på männens längd från en faktor i taget: föräldrarnas (pappans) yrke och jordägande, antalet syskon i familjen och sjukdom under spädbarnstiden. Den fjärde artikeln undersöker om män med olika yrken och familjebakgrund hade olika BMI-tal (BMI står för ”body mass index”, kroppsmasseindex, och är en metod för att med utgångspunkt i en persons vikt och längd beräkna om personen är över-, normal- eller underviktig).

Artikel 1 – Långsiktiga förändringar av sociala skillnader i längd

Barn till personer som har yrken med hög status, höga inkomster eller lång utbildning är i genomsnitt längre än barn till personer som har yrken med lägre status, lägre inkomster eller kortare utbildning. Skillnaderna är små i Sverige idag, men var mycket större under 1800-talet. Jag undersöker hur de sociala skillnaderna ändrades från början av 1800-talet till mitten av 1900-talet. Detta är den första studie som undersöker detta med information om familjebakgrund för (nästan) alla i en viss befolkning.

Jag undersöker om pappans yrke och familjens eventuella tillgång till jord påverkade barnens längd. Det jag kommer fram till är att söner till jordägare, i genomsnitt, var längre än andra under början och mitten av 1800-talet. Söner i familjer med mycket jord var också längre än söner i familjer med mindre jord. Detta visar att det var en fördel att ha möjlighet att producera sin egen mat. Det var på denna tid i Sverige svårt att få tag på tillräckligt mycket och tillräckligt bra mat genom att köpa den. Söner till pappor som arbetade som hantverkare var den kortaste gruppen under början och mitten av 1800-talet. Många hantverkare hade tillgång till lite jord, men de behövde också komplettera med att köpa mat. En förklaring till att just deras söner utgjorde den kortaste gruppen kan vara att hantverkarna hade för låga inkomster för att alltid kunna skaffa sig tillräckligt med mat. Fördelen för jordägare försvann i slutet av 1800-talet, när produktiviteten i jordbruket hade ökat och marknaden för livsmedel fungerade bättre.

Söner till pappor med olika tjänstemannayrken var längre än andra och utgjorde den längsta gruppen under hela den tid mitt material behandlar. I början och mitten av 1800-talet utgjorde de överklassen i befolkningen jag studerar. Deras söner var i genomsnitt längre än andra även om familjen inte hade tillgång till någon jord. Om familjens inkomster var tillräckligt höga kunde de få tillräckligt med mat genom att köpa den.

De sociala skillnaderna i längd var olika stora under olika perioder, men minskade med tiden. Skillnaderna i längd minskade när tillgången till mat förbättrades och det blev lättare att köpa mat istället för att producera den själv. Minskningen av skillnaderna verkar därför ha varit ett resultat både av att levnadsvillkoren förbättrades i allmänhet och att ekonomin och den sociala strukturen ändrades.

Artikel 2 – Antalet syskon och sönernas längd

Ett stort antal studier har visat på olika nackdelar för personer med många syskon jämfört med personer med färre syskon. Personer med fler syskon har till exempel, i genomsnitt, lite kortare utbildning och blir lite kortare än personer med färre syskon. Vi vet fortfarande inte säkert varför det är så. En av de vanligaste förklaringarna är att när ett större antal syskon måste dela på föräldrarnas resurser, blir det mindre till varje barn. Vi förväntar oss att alla föräldrar gör vad de kan för att ge alla sina barn tillräckligt med mat. Om det finns ett samband mellan antalet syskon och barnens längd, är det därför troligt att det var ont om resurser i familjer med många barn. Jag prövar detta genom att undersöka om det finns ett samband mellan antalet syskon och sönernas längd. Vi förväntar oss också att sambandet mellan antalet syskon och barnens längd blev svagare med tiden, allt efter som levnadsvillkoren förbättrades och alla familjer fick tillgång till mer resurser. Jag prövar detta genom att undersöka hur sambandet mellan antalet syskon och sönernas längd förändrades över tid. Detta är den första studie som undersöker sambandet mellan antalet syskon och längd under 1800-talet och kan visa på de långsiktiga förändringarna av detta samband.

Mina resultat bekräftar att det är troligt att det var ont om resurser i familjer med många barn. Män som bodde tillsammans med fyra syskon var två–tre centimeter kortare än män som bara bodde med sina föräldrar. Sambandet mellan antalet syskon och männens längd försvagades över tid. I mitten av 1900-talet var det bara söner i familjer med ovanligt många barn som i genomsnitt var kortare än andra. Resultaten visar också att även om familjens resurser var betydelsefulla, är det viktigt att ta hänsyn till den sociala och historiska kontexten.

Artikel 3 – Sambandet mellan sjukdom och längd

Hur lång en person blir påverkas också av om hen är sjuk under barndomen. Det är troligt att det var så under 1800-talet, precis som idag, men det är svårt att undersöka, eftersom vi vet väldigt lite om *hur* människor var sjuka under denna tid. Vi måste därför använda information om dödlighet för att uppskatta när människor var sjuka. Under 1800-talet dog många av infektionssjukdomar och dödligheten i befolkningen varierade mycket från år till år på grund av epidemier. Under år då många dog är det därför troligt att också många av dem som överlevde var sjuka. Medellängden ökade allt efter som 1800-talet gick, samtidigt som spädbarnsdödligheten sjönk. En del studier har därför föreslagit att sjukdom under spädbarnstiden bidrog till att människor blev korta. Tidigare studier har också visat att personer som föddes under år då spädbarnsdödligheten var hög hade en något kortare livslängd än andra. Det var dock många saker som förändrades i samhället samtidigt som medellängden ökade och dödligheten sjönk. Jag prövar därför om männens längd vid mönstringen påverkades av dödligheten bland spädbarn när de föddes, genom att jämföra bröder. Genom att jämföra bröder med varandra kan jag utesluta de flesta andra faktorer som påverkade hur långa männen blev. Detta är den första studie där en forskare har kunnat undersöka detta på detta sätt och under denna tid.

Dödligheten, och därmed även risken för att männen var sjuka som spädbarn, varierade mycket från år till år, men också under året. Dödligheten var ofta högst i slutet av sommaren och under vintern. Jag räknar därför ut dödligheten bland spädbarn under det första levnadsåret för varje person i undersökningen. Det är också möjligt att männens längd påverkades av om deras mammor var sjuka under graviditeten. Jag räknar därför också ut dödligheten bland vuxna under den tid som männen låg i sin mammas mage.

Jag hittar inga systematiska eller starka samband i denna artikel. Dödligheten bland befolkningen under tiden före eller efter det att männen föddes påverkade inte hur långa de blev som unga vuxna. Undernärda och därför korta barn har en högre risk att dö än andra barn. Det är därför möjligt att medellängden för de personer som överlevde barndomen är högre än den skulle ha varit om alla barn i samma befolkning hade överlevt. Om hög dödlighet bland barn kan leda till högre medellängd bland dem som överlever barndomen vid samma tid, blir det svårare att mäta den negativa påverkan från sjukdom på längd. På grund av detta och andra problem med mitt material så kan jag bara dra försiktiga slutsatser i denna artikel. Mina resultat visar att såväl negativ påverkan på medellängden från sjuklighet under spädbarnstiden som påverkan av att undernärda och korta barn har en högre risk att dö, är svag – om den alls finns.

Jag kan alltså inte visa någon direkt påverkan på männens längd från sjukdom under spädbarnstiden när jag använder dödligheten som mått på risken att männen var sjuka när de var spädbarn. Dödligheten är dock ett väldigt oprecist mått på sjuklighet. Studier på nutida befolkningar har visat att sjukdom påverkar växten och också kan påverka hur lång en person blir som vuxen. Det är därför väldigt troligt att sjukdom var en av orsakerna till att människor blev kortare i Sverige under 1800-talet och i början av 1900-talet än idag. Det som gjorde att de blev kortare var i så fall att de var sjuka ofta och länge, inte minst i olika diarrésjukdomar, i kombination med att de inte hade tillräckligt mycket och tillräckligt bra mat att äta. Det finns antagligen gemensamma orsaker till att medellängden ökade och dödligheten sjönk över tid. Men den sjunkande spädbarnsdödligheten var i sig inte en viktig orsak till att medellängden ökade.

Artikel 4 – Sociala skillnader i vikt i mitten av 1900-talet

Medellängden ökar fortfarande i Sverige, men bara väldigt långsamt. Medelvikten har dock fortsatt att öka i högre grad än medellängden, vilket har lett till ökande problem med övervikt och fetma. Ökande övervikt och fetma är ett globalt problem i både hög- och låginkomstländer. I Sverige började BMI-talen att stiga och andelen överviktiga bland män att öka när män födda på 1950-talet mönstrades för värnplikten. I höginkomstländer, som Sverige, är problemen med övervikt större bland personer med lägre utbildning eller arbetaryrken än bland personer med högre utbildning eller tjänstemannayrken. Dessa skillnader gäller för vuxna, men påverkar också deras barn. Det finns mängder av undersökningar av dessa sociala mönster i vikt på nutida befolkningar men fortfarande väldigt få studier på befolkningar förr i tiden. Orsakerna till att det finns sociala skillnader i vikt är ännu inte vetenskapligt belagda. Historiska studier kan bidra till att ta reda på det genom att visa om mönstren alltid har sett likadana ut eller om de har förändrats med tiden. Jag undersöker i denna artikel hur skillnaderna i BMI såg ut mellan män med olika yrke och familjebakgrund under mitten av 1900-talet, innan trenden med ökande BMI och större andel överviktiga startade.

Mina resultat visar att de sociala skillnaderna i BMI-tal i Sverige under mitten av 1900-talet var ungefär likadana som de är idag. Män som, till exempel, hade ett tjänstemannayrke eller var studenter vid mönstringen hade i genomsnitt lägre BMI-tal än andra. Jag undersöker också hur de sociala skillnaderna i vikt förändrades över tid genom att jämföra män födda 1934–1942 med män födda 1943–1950. De sociala skillnaderna i vikt förändrades under denna tid. Bland män födda 1943–1950 fanns ett samband mellan BMI och skillnaden mellan det yrke männen själva hade vid mönstringen och det deras pappor hade (haft). Män som hade ett yrke med lägre status än sin pappas hade något högre BMI-tal än andra, medan män som hade ett yrke med högre status än sin pappas hade något lägre BMI-tal än andra. Det måste dock ha funnits flera olika orsaker till de sociala skillnaderna i vikt för att förklara de mönster jag hittar.

Slutsatser

Det har hela tiden funnits sociala skillnader i både längd och vikt i de befolkningar jag har studerat. Föräldrarnas yrke och antalet barn i familjen påverkade till exempel hur långa männen blev. Skillnader i tillgång till materiella resurser, som mat, var viktiga för att skapa dels sociala skillnader i längd och vikt och dels den ökande medellängden över tid. Däremot var det aldrig enbart materiella resurser som var viktiga. Resursernas påverkan berodde på samhälleliga strukturer och mänskliga beteenden, som i sin tur påverkade fördelningen av resurserna. Mycket mer forskning behövs innan vi kan veta säkert vad som var de viktigaste orsakerna för de sociala skillnaderna i vikt och längd och den ökade medellängden över tid. För att förstå trenderna och de sociala skillnaderna i längd och vikt räcker det inte med grova mått, som nationalinkomst eller hur mycket mat som var tillgänglig. Det behövs mer detaljerad kunskap om trender över tid och skillnader i, till exempel, matvanor och sjuklighet. Historiska studier med information om individer och familjer, som de jag har gjort, kan bidra till att öka vår förståelse av trender och skillnader i längd och vikt, samtidigt som de tar hänsyn till att dessa bestäms av unika biologiska, och delvis genetiska, processer.

MEDDELANDEN FRÅN EKONOMISK HISTORISKA INSTITUTIONEN VID GÖTEBORGS UNIVERSITET (1-73)

MEDDELANDEN FRÅN EKONOMISK HISTORISKA INSTITUTIONEN, HANDELSHÖGSKOLAN VID GÖTEBORGS UNIVERSITET (74-100)

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